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# El desplazamiento activo al centro escolar: análisis de los patrones y factores de influencia e implementación de intervenciones que fomenten el desplazamiento activo en el alumnado de educación primaria

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Tesis Doctoral

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**UNIVERSIDAD DE ZARAGOZA**
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## Active commuting to school: analysis of patterns and influencing factors and implementation of interventions to promote active commuting in primary school students


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# El desplazamiento activo al centro escolar: análisis de los patrones y factores de influencia e implementación de intervenciones que fomenten el desplazamiento activo en el alumnado de educación primaria

*Active commuting to school: analysis of patterns and influencing factors and implementation of interventions to promote active commuting in primary school students*

**Ana Corral Abós**

*Cuando el ciudadano-ecologista pretende plantearse la cuestión más molesta y se pregunta ¿qué mundo dejaremos a nuestros hijos?, evita plantearse esta otra pregunta, que es realmente inquietante: ¿a qué hijos dejaremos este mundo?*

Jaime Semprum en La Escuela de la Ignorancia de Jean-Claude Michéa

## La tesis se presenta en modalidad de compendio de publicaciones:

### Capítulo I. Patrones y problemática de evaluación

**Corral-Abós, A.,** Aibar, A., Estrada-Tenorio, S., Julián, J. A., Ibor, E., & Zaragoza, J. (2021). Implications of school type for active commuting to school in primary education students. *Travel Behaviour and Society, 24(April)*, 143–151. https://doi.org/10.1016/j.tbs.2021.03.007

Zaragoza, J., **Corral, A.,** Estrada, S., Abós, Á., & Aibar, A. (2019). Active or Passive Commuter? Discrepancies in Cut-off Criteria among Adolescents. *International Journal of Environmental Research and Public Health*, *16*(20), 3796. https://doi.org/10.3390/ijerph16203796

### Capítulo II. Factores de influencia del transporte activo en el contexto de intervención

Zaragoza, J., **Corral, A.,** Ikeda, E., García-Bengoechea, E., & Aibar, A. (2020). Assessment of psychological, social cognitive and perceived environmental influences on children's active transport to school. *Journal of Transport and Health*, *16*(February), 100839. https://doi.org/10.1016/j.jth.2020.100839

**Corral-Abós, A.,** Pizarro, A.N., Santos, M.P., Zaragoza, J., Aibar, A., Mota, J. (202x). Effect of distance and psychosocial variables on active mode of commuting to and from school as independent behaviors in children, *Journal of Transport and Health,* Submitted.

### Capítulo III. Programa de intervención multinivel e interdisciplinar para aumentar los viajes activos al centro escolar

**Corral-Abós, A.,** Zaragoza, J., Aibar, A., Ibor, E., & Julián, J.A. (2022). Applying the Intervention Mapping Protocol to promote Active Transport to School in primary school students: the ProATs intervention. *Retos, 46*, 76-90. Accepted.

En el Anexo 1 pueden consultarse los factores de impacto de las revistas, las áreas temáticas y las contribuciones de la doctoranda a los trabajos presentados en coautoría.

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## Agradecimientos

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## Ítaca

Cuando emprendas tu viaje a Ítaca
pide que el camino sea largo,
lleno de aventuras, lleno de experiencias.
No temas a los lestrigones ni a los cíclopes
ni al colérico Poseidón,
seres tales jamás hallarás en tu camino,
si tu pensar es elevado, si selecta
es la emoción que toca tu espíritu y tu cuerpo.
Ni a los lestrigones ni a los cíclopes
ni al salvaje Poseidón encontrarás,
si no los llevas dentro de tu alma,
si no los yergue tu alma ante ti.

Pide que el camino sea largo.
Que muchas sean las mañanas de verano
en que llegues —¡con qué placer y alegría!—
a puertos nunca vistos antes.
Detente en los emporios de Fenicia
y hazte con hermosas mercancías,
nácar y coral, ámbar y ébano
y toda suerte de perfumes sensuales,
cuantos más abundantes perfumes sensuales puedas.
Ve a muchas ciudades egipcias
a aprender, a aprender de sus sabios.

Ten siempre a Ítaca en tu mente.
Llegar allí es tu destino.
Mas no apresures nunca el viaje.
Mejor que dure muchos años
y atracar, viejo ya, en la isla,
enriquecido de cuanto ganaste en el camino
sin aguantar a que Ítaca te enriquezca.

Ítaca te brindó tan hermoso viaje.
Sin ella no habrías emprendido el camino.
Pero no tiene ya nada que darte.

Aunque la halles pobre, Ítaca no te ha engañado.
Así, sabio como te has vuelto, con tanta experiencia,
entenderás ya qué significaban las Ítacas.

Konstantino Kavafis

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# Resumen/*Abstract*

# Resumen

El transporte activo al centro escolar tiene el potencial de favorecer la salud física y mental de los niños, ayuda a reducir el uso del coche en las ciudades y mejora las relaciones sociales entre los habitantes de los diferentes barrios de una ciudad. Sin embargo, en España, se identifican bajos niveles de desplazamientos activo al colegio, sin haber sufrido cambios significativos durante los últimos diez años.

El contexto escolar puede ser un escenario ideal para realizar intervenciones eficaces para promocionar este comportamiento, aunque tal y como muestra la literatura científica, no siempre estas intervenciones son eficaces ni sostenibles. Esto supone en la actualidad un verdadero reto para la investigación.

Para favorecer tanto la eficacia como la sostenibilidad de este tipo de intervenciones, es imprescindible abordar la promoción de este comportamiento desde una perspectiva socio ecológica, buscando conexiones con el currículo escolar y con las necesidades de los individuos del entorno. Esto nos exigirá conocer las necesidades del contexto de intervención y los factores que influencian este comportamiento en nuestro contexto de referencia. La identificación de estos factores de influencia contextuales, junto con la selección de marcos teóricos de referencia, nos ayudarán a diseñar estrategias eficaces para la intervención.

La tesis doctoral recoge una intervención realizada en un contexto educativo y desde una perspectiva interdisciplinar que intenta dar respuesta a algunos de estos retos. Los participantes de esta investigación son el alumnado de 4º, 5º y 6º de primaria y bachillerato de la ciudad de Huesca (Aragón, España). Además, la intervención piloto a nivel educativo se ha desarrollado en el alumnado de 5º y 6º de primaria de dos centros escolares de la ciudad. El proyecto redactado en la tesis doctoral cuenta con la aprobación del Comité Ético de Investigación Clínica de Aragón (CEICA) (código ético: C1P117/0018)

La tesis doctoral tiene como objetivo general conocer los patrones de transporte activo al centro escolar, e identificar los determinantes contextuales que lo explican para diseñar una intervención que modifique el comportamiento en el contexto específico del alumnado de los cursos 5º y 6º de educación primaria de la ciudad de Huesca (Aragón, España). Para ello se plantean tres objetivos específicos a los que se da respuesta en cada uno de los tres capítulos en los que se agrupan los trabajos publicados, aceptados o en revisión de la tesis doctoral. En primer lugar, se evalúa el contexto de intervención y

se reflexiona sobre la problemática de la medición del transporte activo al centro escolar. En segundo lugar, se analizan los factores de influencia en el contexto de la intervención. Y finalmente, en tercer lugar, se describe la intervención educativa que se ha llevado a cabo y sus resultados preliminares.

En el capítulo I, y en referencia al primer objetivo específico, cabe destacar que el 67,9% de los alumnos de 4º, 5º y 6º de primaria de la ciudad de Huesca utilizan un transporte activo para desplazarse normalmente al centro escolar. Se identificó que los centros concertados de la ciudad de Huesca tenían niveles de transporte activo estadísticamente inferiores (i.e., M=6,38; SD=3,92) a los de los centros públicos (i.e., M=8,50 SD=2,97). La situación geográfica de las escuelas concertadas en la ciudad aumentaba los problemas asociados al tráfico en las horas de entrada y salida de los colegios. Los resultados de este capítulo también constataron que los criterios de evaluación repercuten en los factores de influencia.

Como consecuencia de esta posible variabilidad de los factores, en el capítulo II se estudiaron los patrones desde diferentes perspectivas para comprender mejor las necesidades a las que se enfrentaba la intervención. Entre las diferentes variables identificadas se encontraban la percepción de control del alumnado y la percepción de autonomía como factores de influencia de los diferentes patrones de transporte activo al centro escolar. A nivel familiar, las actitudes de las madres hacia el transporte activo y el nivel socio económico afectaban al comportamiento. La influencia del ambiente físico percibido y sus barreras fue también clave, siendo la distancia a las escuelas un factor determinante en todos los estudios que se realizaron.

En el capítulo III se muestra la intervención que recoge todos los resultados de los capítulos anteriores. La intervención se diseñó siguiendo el *Intervention Mapping Protocol* y dio como resultado un proyecto interdisciplinar con estrategias desde la vía curricular y no curricular. Estas estrategias estaban insertadas en diferentes esferas del modelo socio-ecológico y encaminadas a influenciar en los factores identificados anteriormente. Por ejemplo, al ser la distancia una variable importante previamente detectada, la promoción del uso de la bicicleta fue un aprendizaje clave en la intervención, ya que menos del 1% del alumnado la utilizaba para desplazarse al centro escolar. Los resultados del proyecto piloto muestran un aumento significativo en el número de viajes activos en los centros de intervención. La experiencia de la intervención permite afirmar que el diseño, la implementación y la evaluación de las intervenciones escolares realizadas de forma sistemática permite que aumente su

efectividad y su replicabilidad. A su vez, la formación de la comunidad educativa en agentes de cambio aumenta las posibilidades de sostenibilidad de las intervenciones.

Es por esta razón por lo que esta investigación se ha desarrollado para intentar satisfacer las necesidades del presente, pero sin olvidar durante el proceso la importancia de dotar de capacidad futura a las comunidades educativas. Su relevancia y perspectivas de futuro se ven reflejada en los nuevos horizontes educativos que se están planteando en las nuevas legislaciones, y más concretamente, en las competencias específicas de la Educación Primaria que reivindican enseñar desde el centro escolar la importancia de la movilidad segura, saludable y sostenible.

## Abstract

Active transportation to school has the potential to promote children's physical and mental health, to help reduce car use in cities, and to improve social relations among inhabitants of different neighborhoods in a city. However, in Spain, low levels of active travel to school have been identified, with no significant changes over the last ten years.

The school context can be an ideal setting for effective interventions to promote this behavior, although, as the scientific literature shows, these interventions are not always effective or sustainable. This is currently a real challenge for research.

In order to favor both the effectiveness and sustainability of this type of interventions, it is essential to address the promotion of this behavior from a socio-ecological perspective, seeking connections with the school curriculum and with the individuals' needs in the environment. This will require us to know the needs of the intervention context of and the factors that influence this behavior in our context of reference. Identifying these contextual influencing factors, together with the selection of theoretical frameworks of reference, will help us to design effective intervention strategies.

The doctoral thesis presents an intervention implemented in an educational context and from an interdisciplinary perspective, which attempts to respond to some of these challenges. The participants in this research were in 4th, 5th and 6th grades primary and high school students in the city of Huesca (Aragon, Spain). In addition, the pilot intervention was developed, at an educational level, with 5th and 6th grade students at two schools in the city. The project described in the doctoral thesis has been approved by the Clinical Research Ethics Committee of Aragon (CEICA) (ethical code: C1P117/0018).

The general objective of the doctoral thesis was to know the patterns of active transportation to school, and to identify the contextual determinants that explain it, to then design an intervention that would modify the behavior in the specific context of 5th and 6th grade primary education students in the city of Huesca (Aragon, Spain). For this purpose, three specific objectives were proposed, which are answered in each of the three chapters into which the published works, accepted or under revision of the doctoral thesis, are grouped. Firstly, the intervention context is evaluated and the problems of measuring active transportation to school are reflected upon. Secondly, the

influencing factors in the intervention context are analyzed. And finally, the educational intervention that has been carried out together with its preliminary results are described.

In Chapter I, and in reference to the first specific objective, it should be mentioned that 67.9% of 4th, 5th and 6th grade primary school students in the city of Huesca use active transport to travel to school. It was identified that the private schools in the city of Huesca had statistically lower levels of active transportation (i.e., M=6.38; SD=3.92) than the public schools (i.e., M=8.50 SD=2.97). The geographical location of the private schools in the city increased the problems associated with traffic at school arrival and departure times. The results of this chapter also found that the evaluation criteria have an impact on the influencing factors.

Because of this possible variability of factors, Chapter II studied the patterns from different perspectives to better understand the needs faced by the intervention. Among the different variables identified were the student's perception of control and the perception of autonomy as influencing factors of the different patterns of active transportation to school. At family level, mothers' attitudes toward active transportation and socioeconomic status affected behavior. The influence of the perceived physical environment and its barriers was also key, with distance to schools being a determining factor in all the studies conducted.

Chapter III shows the intervention that compiles all the results of the previous chapters. The intervention was designed following the Intervention Mapping Protocol and resulted in an interdisciplinary project with strategies from the curricular and non-curricular pathways. These strategies were inserted in different spheres of the socio-ecological model and were aimed at influencing the factors identified above. For example, as distance had been previously detected as an important variable, the promotion of bicycle use was a key learning aspect in the intervention, since less than 1% of the students used bicycles to travel to school. The results of the pilot project show a significant increase in the number of active trips to and from the intervention centers. The experience of the intervention allows us to affirm that the design, implementation, and evaluation of school interventions carried out in a systematic manner increase their effectiveness and replicability. In turn, the training of the educational community as agents of change increases the chances of sustainability of the interventions.

It is because of this that this research has been developed to try to meet the needs of the present, but not forgetting, during the process, the importance of providing future capacity to educational communities. Its relevance and future perspectives are reflected

in the new educational horizons that are being proposed in the new legislations, and more specifically, in the specific competences of Primary Education that demand the importance of safe, healthy, and sustainable mobility to be taught by the school.

# Introducción general

# 1. Justificación

LA NECESIDAD DEL TRANSPORTE ACTIVO A LA ESCUELA, UNA APUESTA DE FUTURO QUE VIENE DEL PASADO

> Descubrimos así que nuestra propia especie, el *Homo Sapiens*, es el más consumado caminante que ha producido la evolución.
>
> Arsuaga, J.L, "El primer viaje de nuestra vida"

La Actividad Física (AF) tiene múltiples beneficios sociales, económicos y para la salud, a través de sus diferentes formas (World Health Organization, 2018). Por ejemplo, una de ellas es desplazarse caminando, lo que permite a cualquier persona realizar AF a diario, independientemente de sus recursos. Así pues, caminar es tan accesible para todos, que los seres humanos ya andaban mucho antes de que aparecieran los primeros estudios sobre la importancia del movimiento para la salud y el bienestar. Uno de los rasgos que caracteriza a todas las especies *homo* es que andan erguidos sobre dos piernas (Hart, 2018). *Homo sapiens*, la especie a la que pertenecen todos los humanos actuales, lleva caminado por Europa desde hace unos 47.000 años (Gibbons, 2020). Definitivamente los bajos niveles de AF de la actualidad, unidos a una sobrealimentación y a una falta de necesidad de buscar alimento en la naturaleza, son un problema para un sistema corporal que está preparado y responde a las condiciones en las que vivía nuestra especie hace 50.000 años (Pontzer, 2015). Es por ello que, como especie, a *homo sapiens* le interesa apostar porque el andar sea una de sus huellas evolutivas que deberían perdurar por el resto de su existencia (Villa-González et al., 2017).

Los estilos de vida asociados a altos niveles de gasto energético han cambiado en la mayoría de los países occidentales, lo que se asocia a consecuencias perjudiciales para la salud, como el aumento de las tasas de obesidad y las enfermedades no transmisibles (Katzmarzyk & Mason, 2009). En este contexto, los asentamientos humanos tienen como prioridad reducir su impacto ambiental, garantizar una vida sana y promover el bienestar de la ciudadanía en todas las edades, metas que podrían estar más cerca de ser

conseguidas con la ayuda de la educación para el desarrollo sostenible (Gobierno de España, 2019). Definitivamente educar en salud, en la disminución de la contaminación urbana y en la promoción de la AF es una apuesta para lograrlo (World Health Organization, 2018). Es una necesidad encontrar estrategias que se asuman en el día a día y que puedan promover cambios en las comunidades y en su relación con el entorno más próximo, como puede ser el transporte activo al centro escolar (Benayas et al., 2019).

Durante la realización de la tesis doctoral se vivió una de las crisis sanitarias más graves a nivel global en los tiempos recientes, el COVID-19. Tras meses de confinamiento, en los que cambiaron los hábitos de la población infantil —aumentado todavía más los niveles de sedentarismo y disminuyendo los niveles de AF (Medrano et al., 2021)—, la huella evolutiva emergió, y *homo sapiens* salió a andar por un espacio natural (COVID-19 Community Mobility Report, 2020). En estos momentos ya no debería sorprender que una de las propuestas de la Organización Mundial de la Salud (OMS) de hace más de 10 años fuera el fomento del transporte activo (andando o en bicicleta) para aumentar la AF diaria. Algunos países incluso recogen en sus políticas de medio ambiente que la promoción del transporte activo es una de las formas más prácticas y sostenibles para aumentar los niveles de AF de la población (Costa et al., 2020).

La pandemia mundial del COVID-19 trajo consigo otro recordatorio para nuestra especie, la importancia del cuidado de la infancia como comunidad. Parecía obvio que dentro de las medidas de confinamiento que sufrió España, fueran los niños los primeros en salir a caminar, dando por hecho los beneficios a nivel de salud que esto podría suponerles. El 25 de abril de 2020 se publicaban en el Boletín Oficial del Estado (Disposición 4665 Del BOE Núm. 116 de 2020, 2020) las siguientes justificaciones a tal hecho:

> En este marco, y con el objeto de proteger a la población infantil, se hace preciso dictar una orden para establecer el modo en que los niños y niñas pueden realizar desplazamientos fuera de su domicilio, con el fin de aliviar las medidas a las que han estado sometidos, y las posibles consecuencias negativas que ello conlleva, al tiempo que se respetan las medidas de seguridad necesarias. (Sec. I. Pág. 30361)
>
> Por otra parte, se considera que una salida controlada de la población infantil puede reportar beneficios asociados a un estilo de vida más saludable, prevenir

> algunos problemas asociados al mantenimiento prolongado del estado de alarma, como puede ser la mejora de la calidad del sueño o la síntesis de vitamina D, así como una mejora en el bienestar social o familiar. (Sec. I. Pág. 30362)

En este sentido, los beneficios del transporte activo son tan evidentes, que fue la primera disposición adoptada por el gobierno para atender la salud de los niños y niñas (Disposición 4665 Del BOE Núm. 116 de 2020, 2020). Esta medida, prolongada en el tiempo, ya ha evidenciado los beneficios físicos y sociales que tiene para los niños y sus comunidades (Smith et al., 2020). Por un lado, transportarse de forma activa a la escuela supone un aumento de los niveles de AF moderada-vigorosa (Carlin et al., 2016; Dinu et al., 2019; Larouche et al., 2014; Oliver et al., 2016; Voss et al., 2015) y la mejora de la condición física a largo plazo (Villa-González, Ruiz, & Chillón, 2015). Por otro lado, las personas que se comprometen con el transporte activo tienen una reducción significativa del riesgo de todas las causas de mortalidad, y una disminución significativa en la incidencia de las enfermedades cardiovasculares y la diabetes (Dinu et al., 2019). También puede incrementar la capacidad de concentración de los niños, teniendo efectos en su función cognitiva, y por tanto en su rendimiento académico (World Health Organization, 2018).

Lo mismo sucede con el ambiente cercano al centro escolar, el uso de medios no motorizados para ir a la escuela se traduce en un menor número de vehículos cerca del centro escolar en las horas puntas (Van Ristell et al., 2013), teniendo implicaciones en las emisiones de $CO_2$ (Singleton, 2014), la congestión del tráfico y el ruido (Mandic et al., 2019). Por tanto, el uso de un transporte activo al centro escolar también reduce las emisiones de gases, mejorando la calidad del aire y su correspondiente incidencia en las enfermedades causadas por la contaminación (World Health Organization, 2018). Además, este transporte activo facilita las interacciones sociales entre iguales, ayuda a establecer conexiones con el vecindario y el medio natural, mejora el acceso a la asistencia sanitaria y aumenta la seguridad del barrio (Mandic et al., 2019).

El transporte activo a la escuela puede convertirse en una estrategia educativa para el desarrollo sostenible (Benayas et al., 2019). En primer lugar, la escuela es un promotor esencial para la creación de sociedades más activas, siendo el entorno escolar un escenario clave para impartir conocimientos físicos y de salud para una vida sana (World Health Organization, 2018). Tras la investigación de estos últimos años en algunos países europeos, se pone de manifiesto que el progreso es más probable cuando

el transporte activo al centro escolar se integra y prioriza en las políticas a nivel nacional y local en educación; así como en planificación urbana, transporte y salud (Smith et al., 2020). Ya hace una década que investigadores canadienses reclamaban la importancia de los políticos, los líderes educativos, los trabajadores de la salud pública y los planificadores urbanos y de transporte en la toma de decisiones que buscasen promover un transporte activo (Larouche et al., 2014; Rothman et al., 2018). Resumiendo, una prioridad de la comunidad es apoyar a la escuela en la promoción del transporte activo como una oportunidad de aprendizaje (Smith et al., 2020), para que así la escuela sea un motor para el cambio hacia una comunidad saludable y sostenible.

El transporte activo al centro escolar tiene el potencial de ser una propuesta educativa que (1) desarrolle la salud física y mental de los niños —debido al aumento que supone en los niveles diarios de AF (Costa et al., 2020)—; (2) reduzca el uso del coche en las ciudades —con su consiguiente disminución de ruido, de emisiones de $CO_2$ y de accidentes de tráfico (Singleton, 2014)— y (3) mejore las relaciones sociales de los habitantes de los barrios (Mandic et al., 2019).

A continuación, se plantean diferentes preguntas que guían el apartado de introducción general, y que son una revisión de la literatura destinada a justificar la pertinencia de los capítulos de la tesis doctoral:

En primer lugar, ¿por qué usar un transporte activo para ir a al centro escolar? En este apartado, que justifica la pertinencia del capítulo I, se hace un repaso a los patrones de transporte activo al centro escolar en los últimos años, justificando el por qué puede ser una estrategia para aumentar los niveles de AF del alumnado y disminuir la contaminación de las ciudades, planteando también la problemática de su evaluación.

En segundo lugar, ¿qué determina la utilización de un transporte activo? En este apartado, que justifica la pertinencia del capítulo II, se revisan los diferentes marcos conceptuales planteados en la literatura para explicar este comportamiento, se explican los seleccionados para utilizar en la tesis doctoral y se justifica la necesidad de estudiar cómo se comportan en el contexto en el que se desarrolla la investigación.

En tercer lugar, ¿cómo se promueve el uso de un transporte activo al centro escolar? En este apartado, que justifica la pertinencia del capítulo III, se hace un repaso por las diferentes intervenciones que han intentado promover este comportamiento, buscando cuales han sido las formas de intervenir más eficaces, así como la detección de los retos o necesidades que se les plantean a la hora de llevar a cabo intervenciones futuras.

En cuarto, y último lugar, se propone un apartado de necesidades y retos, en el que se identifican algunas lagunas detectadas en los apartados anteriores. Este apartado tiene como finalidad recopilar aquellas necesidades y retos que se abordarán en la investigación y que dan lugar al planteamiento de los objetivos de la tesis doctoral.

## 2. El transporte activo al centro escolar

### ¿POR QUÉ USAR UN TRANSPORTE ACTIVO PARA IR AL CENTRO ESCOLAR?

Huellas de Laetoli. Tom Moon. The J. Paul Getty Trust.

Huellas de pasos como los nuestros […] datadas en hace unos 3,5 Ma, para que se reconociera, no por interpretación deductiva sino por prueba real grabada sólidamente en esa edad, la antigüedad de la bipedia vertical humana (Aguirre, 2006).

Las políticas de promoción de la AF —entre las que se encuentra la promoción del transporte activo al centro escolar— pueden ser de ayuda para alcanzar los Objetivos de Desarrollo Sostenible (ODS) de 2030 (OMS, 2019). El potencial que tiene la promoción de este comportamiento en el alumnado, tanto para aumentar sus niveles de AF diarios (Costa et al., 2020), como para disminuir la contaminación de la ciudad (Singleton, 2014), hace que sea necesario preguntarse en primera instancia qué se entiende por transporte activo al centro escolar. En este apartado se abordará esta cuestión junto con una revisión de los patrones de este comportamiento en los últimos años, para finalmente plantear la problemática que supone su evaluación. Los temas y problemas planteados en este apartado se abordarán en el capítulo I de la tesis doctoral.

### *2.1.Definición de transporte activo al centro escolar*

La AF es definida por la OMS como cualquier movimiento corporal producido por los músculos esqueléticos, con el consiguiente consumo de energía por encima del metabolismo basal, como puede ser caminar, ir en bicicleta, hacer deporte, formas activas de recreación, trabajo o tareas del hogar (World Health Organization, 2018). Una de las formas de realizar AF de forma regular es el transporte activo (World Health Organization, 2018). La literatura define transporte activo al centro escolar como el comportamiento que realiza el niño en el trayecto de ir y volver a y desde la escuela, utilizando transportes no mecánicos o motorizados (p. ej., andar, bicicleta, patinete, monopatín, patines, etc.) (Herrador-Colmenero et al., 2014).

### *2.2.Patrones y prevalencia del transporte activo al centro escolar*

Parece que la prevalencia de este comportamiento, a pesar de sus múltiples beneficios, ha disminuido en los últimos años en diversos lugares del mundo. En Estados Unidos los niños de 5 a 10 años que se desplazaban activamente al colegio bajaron de un 49% a un 13% entre 1969 y 2009 (McDonald et al., 2011). Aunque la reducción en las tasas de transporte parece haberse reducido, en 2006, en Toronto, una de las ciudades con los rangos de transporte activos más altos (i.e., 40%-50%), el porcentaje de niños de 11-13 años que se desplazaba activamente volvió a disminuir en un 10% de 2006 a 2011. Un estudio longitudinal realizado en 2011 en New Brunswick (Canadá), preguntó a 973 niños de unos 10 años en 18 ocasiones por su modo "usual" de desplazamiento a la escuela en los últimos 7 días. Sus resultados mostraron que, aunque era menor en invierno, las tasas de desplazamientos activos no superaron el 15% en los 7 años que duró el estudio (Larouche et al., 2019). En otros continentes, como Australia, vemos que hay tendencias similares. Un estudio realizado en Sydney, con muestras que van desde los casi 5000 niños en 1971 de 5-9 años, hasta los 816 en 2003, muestra una disminución que va desde el 58% al 25% de los niños que se desplazan de forma activa a la escuela (van der Ploeg et al., 2008).

En lo que hace referencia a Europa, una encuesta nacional de transporte llevada a cabo en Dinamarca, Finlandia, Gran Bretaña y Noruega recoge un aumento del uso del coche del 22% al 48% entre 1985 y 2005 para ir al colegio en los niños de 5-10 años (Fyhri et al., 2011). Una encuesta similar realizada en Suiza entre 1994 y 2005 en 4244 niños de 6-14 años, muestra un ratio de desplazamientos activos mucho mayor (i.e., 71%),

aunque este porcentaje sufrió un descenso del 6%, debido mayoritariamente a la disminución del uso de la bicicleta (Grize et al., 2010). En Alemania, el 40% de 1828 estudiantes de entre 11-17 años se desplazaba de forma activa al centro escolar entre el 2003 y el 2006 (Reimers et al., 2013). En otros países europeos, un estudio de tendencias entre 2011 y 2014 en un total 12.273 niños checos de 11-15 años de edad mostró un descenso del 74% al 53% de niños que se desplazan activamente al centro escolar (Pavelka et al., 2017).

En referencia a los estudios enmarcados en el contexto español, se muestran resultados similares en un estudio transversal llevado a cabo con 6004 jóvenes (7-20 años) de 25 ciudades del sur de España. El estudio muestra que son el 56% de los niños (i.e., aproximadamente 10 años de edad) los que se desplazan de forma activa al centro escolar (Herrador-Colmenero et al., 2019). Esto supone un ligero descenso respecto al 65% de estudiantes que reportaron desplazarse activamente en el estudio AVENA llevado a cabo en 5 ciudades de España (Granada, Madrid, Murcia, Santander y Zaragoza) con 2859 adolescentes de 13-18 años entre el 2000-2002 (Martínez-Gómez et al., 2011). Una recopilación de datos de dos estudios transversales llevados en la ciudad de Madrid analizó la tendencia de los desplazamientos activos en más de 1200 estudiantes de 13-17 años, poniendo de manifiesto que hubo una disminución del 61% al 46% en los desplazamientos andando al centro escolar (Ruiz-Ariza et al., 2015). En la actualidad, aunque los porcentajes en España no son tan bajos como en otros países, un estudio que examinó las tendencias en los ratios de transporte activo en niños y adolescentes españoles desde el 2010 al 2017 concluye que esos ratios no han sufrido cambios significativos durante la última década (Gálvez-Fernández et al., 2021).

### *2.3.Evaluación del transporte activo al centro escolar*

El transporte activo al centro escolar puede medirse en términos de tipo, duración, intensidad y frecuencia (Dinu et al., 2019). La heterogeneidad en los métodos para medir, clasificar o evaluar este comportamiento, ha hecho difícil la comparación de los diferentes resultados (Zaragoza et al., 2019). En la literatura, una de las formas más usuales de medir el desplazamiento es mediante cuestionarios auto reportados (Herrador-Colmenero et al., 2014). En esta revisión de 158 estudios científicos, Herrador-Colmenero et al., (2014) concluyen que las principales diferencias entre las preguntas están en la dirección del desplazamiento (i.e., ir y/o volver de la escuela) y el

periodo de desplazamiento (i.e., normalmente, ayer, la última semana, una semana típica).

Las diferentes investigaciones han estudiado el transporte activo al centro escolar desde múltiples perspectivas: en términos de modo (i.e., activo o pasivo), medio (i.e., andar, bicicleta, coche, autobús), frecuencia (i.e., normalmente, semanalmente, número de viajes, estacional) o intensidad (i.e., tipo de AF, tiempo empleado, distancia recorrida) (Herrador-Colmenero et al., 2014). Algunos estudios miden el tiempo reportado andando o en bicicleta, otros con variables dicotómicas de "sí" y "no" y otros consideran el tiempo y la intensidad de la actividad (p. ej., horas/día, horas/semana, tareas metabólicas equivalentes), lo que dificulta la posibilidad de extraer conclusiones generales (Dinu et al., 2019; Herrador-Colmenero et al., 2014). Es necesario claridad a la hora de explicar cómo se ha realizado la medición del comportamiento, para así después poder establecer cómo han variado estos patrones y los factores que los condicionan a lo largo del tiempo y en los diferentes contextos (Rothman et al., 2015). Puede decirse a este respecto que una de las **mayores limitaciones detectadas en la literatura, es la falta de consistencia en la medición del transporte activo a la escuela** (Lu et al., 2014).

# 3. Marcos conceptuales explicativos del transporte activo al centro escolar

## ¿QUÉ DETERMINA LA UTILIZACIÓN DE UN TRANSPORTE ACTIVO?

Estudiar cómo se desarrollan los diversos fenómenos (i.e., transportarse de forma activa) en los lugares en los que se quiere llevar a cabo un proyecto o intervención, es indispensable debido a las diferencias geográficas, culturales y sociales que surgen en los diferentes contextos (Smith et al., 2020). A su vez, también es imprescindible conocer los determinantes concretos para la edad de los participantes a la hora de desarrollar intervenciones específicas (Rothman et al., 2018). Todo esto conlleva la necesidad de **hacer un análisis específico de los factores que afectan en el contexto dado y una necesidad de adaptación de las estrategias de intervención a estos factores específicos y al propio contexto** (Gálvez-Fernández et al., 2021). Este apartado, en primer lugar, trata de hacer un breve recorrido por los diferentes marcos conceptuales —entendidos como esquemas teóricos explicativos de una realidad compleja— que han intentado identificar los factores que influyen el transporte activo al centro escolar (ver Tabla 1). Seguidamente se exponen los marcos conceptuales utilizados en la tesis doctoral y las relaciones existentes entre sus diferentes determinantes recogidas en la literatura. El funcionamiento de estos determinantes en la población de la investigación será estudiado en el capítulo II de la tesis doctoral.

**Tabla 1**

*Marcos conceptuales usados para el análisis del transporte activo al centro escolar*

| Nombre del marco conceptual | Breve explicación | Autor/es |
|---|---|---|
| Framework for assessment of the environmental determinants of walking and cycling | **Ambiente físico** (i.e., seguridad, funcionalidad, estética y destino) y **factores individuales** (i.e., motivaciones, intereses, soporte familiar/social y estatus de salud). Remarca la importancia de las **características residenciales** del barrio, del destino y de la ruta. | (Pikora et al., 2003) |
| Urban Form and a Child's Trip to School | **Decisión de los padres** y el **ambiente físico** como principales influencias del comportamiento. Identifica variables a nivel **individual** y a nivel **familiar**, así como el ambiente del barrio y de la escuela que influencian esas decisiones. | (McMillan, 2005, 2007) |
| Five explanations of transport choices | La **cultura** predominante del uso del coche, el miedo y la aversión a los entornos locales, las opiniones de los niños, la responsabilidad y **comportamiento de los padres** y las diferencias **sociodemográficas**, son las explicaciones que se dan para la elección de un medio u otro de transporte al centro escolar. | (Brunton et al., 2006) |
| Integrative Conceptual Framework | Integra la Teoría Social Cognitiva (p. ej., conocimiento) y la Teoría de la Conducta Planificada (p. ej., percepción de control). También introduce el ambiente de la ruta. | (Groesz, 2007) |
| Ecological and cognitive active commuting (ECAC) framework | Los **padres** asumen un rol importante en la **decisión** que puede ser modificada por factores **sociodemográficos**, mediadores **psicosociales** (p. ej., percepción del ambiente físico y social). En la decisión final también influyen variables **individuales** (i.e., actitudes, creencias) y la disponibilidad de recursos familiares. | (Sirard & Slater, 2008) |
| A socio-ecological model of children's and young people's active travel | Entorno percibido y objetivo. Los factores **"intra" individuales** se aplican tanto a los jóvenes como a los padres, e incluyen factores sociodemográficos, siendo todos estos mutuamente influyentes. | (Garrard, 2009) |
| Environmental determinants of active travel in youth | Factores del **ambiente físico**. Factores **individuales**. Factores externos (i.e., tiempo atmosférico, coste del viaje, políticas gubernamentales). Moderadores de la decisión y de la actitud de los niños (i.e., edad, género, distancia) | (Panter, 2010; Panter et al., 2008) |
| Behavioral economics applying to Active School Transport | Introduce la **economía del comportamiento**. Diferentes factores influyen en la elección del modo de transporte en diferentes etapas del proceso de toma de decisiones. Existiendo diferentes procesos en los padres dependiendo de la **localización de la escuela**, y el **nivel socioeconómico**. | (Faulkner et al., 2010) |

(Continúa tabla 1…)

(Continúa tabla 1…)

| Nombre del marco conceptual | Breve explicación | Autor/es |
|---|---|---|
| A conceptual framework connecting preference, location choice and behavior | Los factores pueden agruparse en **entorno construido**, **entorno social** y las características de la escuela y del hogar. Así como las **actitudes** e **intenciones** del comportamiento. | (Yizhao Yang et al., 2010) |
| The Model of Children's Active Travel (M-CAT) | Factores que influyen en el proceso de toma de decisiones de los padres y el niño. **Elementos objetivos** del niño, los padres, la familia y el entorno; y **las percepciones** de los padres y los niños en torno a estos elementos. | (Pont et al., 2011) |
| Agent-based model to simulate children's active travel to school | Estudia la **retroalimentación** entre **individuos** y entre los individuos y su **entorno**. También las posibles implicaciones de las **políticas** dirigidas a las barreras de la larga distancia a la escuela y la seguridad del tráfico. | (Yong Yang & Diez-Roux, 2013) |
| Independent Mobility and Mode Choice for School Transportation | Relación multinivel entre el **entorno urbano** del hogar, las características **intrapersonales** del niño y los **contextos naturales y políticos**. Se identifican cinco dominios ambientales que influyen en el tipo de desplazamiento a la escuela y la movilidad independiente. | (Mitra, 2013; Mitra & Buliung, 2014) |
| Attitudes in Hybrid Choice Model | El importante rol que tienen las **actitudes** a la hora de elegir el modo de desplazamiento, así como variables individuales como edad, educación, ocupación, ingresos y el hogar de los niños. | (Ding et al., 2017) |
| Socio-ecological model of the correlates of active transportation | Incluye dentro del **modelo socio-ecológico** diferentes factores que se relacionan con el transporte activo al colegio, así como factores demográficos, familiares, psicosociales, del **desarrollo motor** y la **movilidad independiente**. | (Larouche, 2018) |
| Behavioural Ecological Model | Para cada uno de los niveles: individual, local/comunitario y social y cultural. **Reforzadores** potenciales para **el transporte activo** y **reforzadores** potenciales para el desplazamiento **motorizado**. | (Ginja et al., 2018) |
| Children's School Travel Behavior Model (C-STBM) | La **movilidad independiente** del niño, la **seguridad** del vecindario percibida por el niño y la **percepción** de los padres sobre la interacción y el entorno social del vecindario. A su vez, la **distancia** a la escuela, y las percepciones de los padres sobre la conveniencia y las preocupaciones sobre la seguridad del tráfico también tienen relevancia en el comportamiento. | (Ikeda et al., 2019; Smith et al., 2020) |

En su mayoría, los marcos conceptuales presentados anteriormente incluyen diferentes determinantes que pueden recogerse en un modelo socio-ecológico, ya que los factores que determinan el transporte activo al centro escolar están situados en diferentes esferas o niveles de influencia del comportamiento humano. Este modelo será el marco conceptual de referencia en el que se introducirán las otras teorías seleccionadas en la tesis doctoral. En primer lugar se selecciona el modelo socio-ecológico ya que es el que mejor explica los factores que promueven el transporte activo al centro escolar (Lu et al., 2014; Pang et al., 2017). Este modelo admite a su vez la integración de diferentes teorías psicosociales que permiten proporcionar hipótesis específicas para un nivel dado (Sallis et al., 2006). En el caso de la tesis doctoral se integran teorías que explican el comportamiento a un nivel individual y que se han utilizado para estudiar las variables que afectan a este nivel. La selección de estos marcos conceptuales —tanto el modelo como las teorías— es debido a su amplía utilización en intervenciones que buscan promover la AF, comunidades más activas (Sallis et al., 2006) y, en concreto, el transporte activo al centro escolar (Lu et al., 2014; Pang et al., 2017; Smith et al., 2020).

### *3.1. Teoría Cognitiva Social*

La Teoría Cognitiva Social postula que el conocimiento de que un hábito es bueno para la salud crea la condición previa para llevarlo a cabo, pero se necesitan influencias adicionales para que las personas adopten realmente nuevos hábitos saludables (Bandura, 1998) —como puede ser el transporte activo al centro escolar—. Motivación y comportamiento son elementos que están regulados a su vez por las metas esperadas (p. ej. las intenciones de realizar un comportamiento), las expectativas de resultados —derivados de las actitudes, las normas sociales y personales—, y las barreras percibidas (i.e., personales y socioculturales). Sin embargo, independientemente de lo que motive estos cambios comportamentales, la creencia en la "autoeficacia"[1] (i.e., la creencia de que uno puede producir los efectos deseados mediante sus acciones) es imprescindible a la hora de realizar un buen uso de las habilidades que uno posee, además de que sin esa creencia en el potencial de uno mismo, se tienen pocos incentivos para actuar o perseverar en los contratiempos (Bandura, 1998). Esta creencia se desarrolla a través de

[1] Hace referencia al término en inglés *self-efficacy*, o autoeficacia percibida en momentos estresantes, que opera tanto en el momento de desarrollo y ampliación de las competencias, como en el momento de ejercer un control en el propio comportamiento.

las experiencias de dominio, un modelo social competente, un estado de ánimo positivo y un apoyo social (Bandura, 1998).

La Teoría Cognitiva Social representa una de las teorías más estudiadas en el campo de la psicología, con aplicaciones en contextos tan diversos como la educación, la asistencia sanitaria, la rehabilitación, el sistema jurídico, la empresa y, por supuesto, el deporte y el ejercicio (Beauchamp et al., 2019). También es una de las teorías más utilizadas como marco conceptual en las intervenciones que buscan promover el transporte activo al centro escolar (Pang et al., 2017). En algunos estudios relacionados con este comportamiento, la "autoeficacia" percibida de los niños, variable determinante en esta teoría, se asoció positivamente con la posibilidad de utilizar la bicicleta como medio de transporte (Ghekiere et al., 2016). También se ha utilizado para explicar las asociaciones que existen entre las barreras del ambiente y las actitudes en referencia a la elección del modo de transporte, tanto en niños como en adultos (Lu et al., 2014). Otras investigaciones muestra la implicación de las barreras de niños y familias, tanto ambientales y de seguridad como de planificación y psicosociales, en la decisión de ir de forma activa al centro escolar (Aibar-Solana et al., 2018; Ross et al., 2017).

### *3.2.Teoría de la Conducta Planificada*

En niveles individuales, la Teoría de la Conducta Planificada (Ajzen, 1991) es una de las teorías que utilizan los psicólogos del comportamiento especializados en el transporte activo. La teoría postula que para realizar un comportamiento deben unirse la motivación (i.e., intención) y capacidad de la persona de decir si puede realizar el comportamiento o no (i.e., percepción de control) (Ajzen, 1991). Así mismo se proponen tres determinantes de intención conceptualmente independientes. El primero es la actitud hacia el comportamiento y se refiere al grado en que una persona tiene una evaluación o valoración favorable o desfavorable de dicho comportamiento. El segundo determinante se refiere a la presión social percibida para realizar o no el comportamiento y es un factor social denominado norma subjetiva. El tercer antecedente de intención es la percepción de control, que se refiere a la facilidad o dificultad percibida de realizar el comportamiento, y que, podría reflejar la experiencia pasada, así como anticipar posibles impedimentos y obstáculos (Ajzen, 1991).

Esta teoría ha sido capaz de explicar intenciones y comportamiento en varios dominios (Armitage & Conner, 2001). La Teoría de la Conducta Planificada es una de las cuatro teorías más utilizadas para explicar el comportamiento de transporte en

adultos, siendo las actitudes una de las variables más importantes estudiadas (Panter & Jones, 2010). A su vez, algunas variables de esta teoría han sido utilizadas en estudios realizados en adolescentes, mayormente para el comportamiento de ir en bicicleta (Frater et al., 2017; Molina-García et al., 2018). En su mayoría, las actitudes positivas hacia el transporte activo y su asociación con la intención, juntamente con otras variables que no pertenecen a la teoría, se correlacionaron significativamente con unos mayores niveles de transporte activo (Mandic et al., 2016; Rhodes et al., 2006). La norma social, o el apoyo social, que podrían entenderse como norma subjetiva de los agentes en base a como se definen en los estudios, parecen tener también una relación con el transporte activo al centro escolar (de Geus et al., 2019; Molina-García et al., 2019; Wendel-Vos et al., 2007). Sin embargo el estudio de estas variables en niños es limitada, y aunque existe una relación significativa entre la Teoría de la Conducta Planificada y el transporte activo al colegio en niños, este comportamiento está condicionado no solo a la intención, sino también al hábito de realizarlo (Larouche, 2018). Por eso es importante adquirir este comportamiento saludable en una edad temprana, para que así aumenten las posibilidades de llevarlo a cabo en la edad adulta (Larouche, 2018).

### *3.3.Teoría de la Autodeterminación*

La Teoría de la Autodeterminación sostiene que la motivación humana hacia un comportamiento depende en cierta medida de la satisfacción o frustración de las Necesidades Psicológicas Básicas —percepción de competencia, autonomía y relación social— (Deci & Ryan, 2000). La motivación es un continuum que va desde las motivaciones más autodeterminadas —intrínseca, integrada e introyectada—, a las más externas —introyectada y externa—, hasta llegar a la desmotivación (Gillison et al., 2019). La motivación por un comportamiento se desplaza por este continuum en base a las experiencias de la satisfacción o frustración que experimenten las Necesidades Psicológicas Básicas (Gillison et al., 2019). Aunque la Teoría de la Autodeterminación ha sido utilizada en intervenciones para la promoción de la AF, existen pocos estudios que la haya relacionado con el comportamiento del transporte activo al centro escolar (Zaragoza et al., 2020).

### *3.4.Modelo Socio-ecológico*

Mientras que las teorías presentadas en los puntos anteriores se circunscriben al ámbito intraindividual o psicológico —ponen el acento en aspectos de la dimensión intrapersonal como son los factores biológicos, fisiológicos y psicológicos del propio sujeto—, el modelo socio-ecológico se fundamenta en cuatro principios básicos: (1) la multiplicidad de factores que influyen en los comportamientos, (2) la multidimensionalidad y complejidad de los entornos, (3) las interacciones humano-ambientales que pueden ser descritas a diferentes niveles de organización y (4) el dinamismo de las interrelaciones entre las personas y su entorno.

Este modelo se distingue por la inclusión explícita de variables que se sitúan a diferentes niveles (i.e., individual, social y cultural, ambiente físico, ambiente político) en base al individuo y de las que se espera que influyan en el comportamiento humano (Sallis et al., 2006). En la última década, revisiones sobre el comportamiento de desplazarse activamente al centro escolar han revelado que son varios los factores que pueden influir en los diferentes niveles del modelo socio-ecológico, poniendo de manifiesto las diferencias geográficas, culturales y sociales que pueden afectar al ser humano (Smith et al., 2020).

A nivel individual (p. ej. variables biológicas, psicológicas), el género del alumnado, la edad, las actitudes positivas y la raza tienen asociaciones positivas moderadas con el transporte activo a la escuela (Rothman et al., 2018). En cuanto al género, parece que a las niñas pequeñas las llevan más en coche que a los niños, además de ser los chicos los que utilizan 2-3 veces más la bicicleta que las chicas (Rothman et al., 2018). No obstante, en niños españoles parece no estar asociado el sexo con desplazarse activamente al centro escolar (Villa-González et al., 2012; Villa-González, Ruiz, & Chillón, 2015). En cuanto a la edad, algunos estudios no han encontrado diferencias significativas entre niños de 6-9 años y los de 10-12 (Rodríguez-López et al., 2013), sin embargo, otros sí que han observado una mayor prevalencia del transporte activo en los niños de 10-12 años que en los de 6-9 años (Villa-González et al., 2012). Quizá el aumento de transporte activo al colegio hasta los 10 años pueda suceder por el desarrollo evolutivo de los niños y su mayor nivel educativo (Ferri-García et al., 2019), y el descenso en las tasas que se produce a partir de esa edad pueda deberse al cambio de escuela, que se traduce en mayores distancias (Rothman et al., 2018).

A nivel social y cultural el acceso a coches y bicicletas, la estructura familiar, las percepciones de los padres, el modelo de los padres, los estudios de los padres y la residencia en áreas de bajo nivel socioeconómico se relacionan con el transporte activo a la escuela (Rothman et al., 2018; Smith et al., 2020). El acceso a vehículo motorizado propio y la alta educación de los padres se relacionan negativamente con el transporte activo al colegio (Ikeda, Hinckson, et al., 2018; Rothman et al., 2018). Un estudio con niños españoles mostró que cuando las familias trabajan y tienen mayores ingresos, los niños son menos activos en su desplazamiento al colegio. Sin embargo, si los progenitores se desplazan a sus trabajos de forma activa, los hijos adoptan igualmente un hábito de desplazarse activamente al colegio (Rodríguez-López et al., 2013). En este nivel, las interacciones sociales del barrio (Ikeda, Hinckson, et al., 2018), así como el apoyo social recibido (Aranda-Balboa et al., 2020) también se asocian positivamente con este comportamiento.

A nivel de ambiente físico (p. ej., construido, natural), el transporte activo se asocia positivamente con la seguridad y la "andabilidad"[2] y negativamente con la distancia (Ikeda, Hinckson, et al., 2018). La seguridad de las rutas, particularmente los niveles de tráfico, son un consistente y fuerte predictor del transporte activo a la escuela (D'Haese et al., 2015; Ikeda, Hinckson, et al., 2018). Además, existen asociaciones entre las barreras percibidas por los padres (i.e., distancia, "andabilidad", seguridad del tráfico) y el transporte activo a la escuela (Aranda-Balboa et al., 2020). En niños españoles las distancias cortas desde el hogar a la escuela, un clima suave (i.e., menos horas de radiación alta en verano o menos lluvia y más horas de luz en invierno), y la ubicación urbana, son factores relacionados con niveles más altos de desplazamientos activos a la escuela (Ferri-García et al., 2019).

El nivel político (p. ej. las políticas escolares) juega un papel integral, por ejemplo, a través de políticas de ubicación escolar y asignación de fondos de transporte (Smith et al., 2020). Según el modelo socio-ecológico, las intervenciones realizadas para aumentar los niveles de AF —y por tanto que podría repercutir en el transporte activo como forma de AF— deberían (a) garantizar lugares seguros, atractivos y convenientes para la práctica, (b) implementar programas motivacionales y educativos para alentar el

[2] Del inglés *walkability* se refiere a un entorno ambiental que apoya a caminar. Algunos instrumentos de medición de la *walkability* (Cerin et al., 2006) la han medido en base a la densidad residencial, la combinación de usos del suelo (incluidos los índices de proximidad y accesibilidad), la conectividad de las calles, la infraestructura para caminar o ir en bicicleta, la estética del barrio, la seguridad del tráfico y la delincuencia, y la satisfacción del barrio.

uso de esos lugares, y (c) usar medios de comunicación y organización comunitaria para cambiar las normas sociales y la cultura (Sallis et al., 2006).

## 4. Intervenciones para la promoción del transporte activo al centro escolar

### ¿CÓMO SE PROMUEVE EL USO DE UN TRANSPORTE ACTIVO AL CENTRO ESCOLAR?

> El aprendizaje implica cambios en el conocimiento, creencias, comportamientos o actitudes. Este cambio se desarrolla con el tiempo; no es fugaz, sino que tiene un impacto duradero en la forma en que los estudiantes piensan y actúan. (Ambrose et al., 2010)

La creación de una cultura físicamente activa dentro de las escuelas y la comunidad en general, puede normalizar e incentivar el transporte activo al centro escolar, gracias al desarrollo de una vigilancia pasiva que aumenta la percepción de seguridad durante los trayectos (Smith et al., 2020). La escuela, y en especial sus dinámicas educativas, son un escenario idóneo para desarrollar esta cultura desarrollando propuestas (i.e., promover el transporte activo) que buscan resolver problemas sociales, como son los altos niveles de sedentarismo (Schoeppe et al., 2013; World Health Organization, 2018) y la contaminación de las ciudades (Brand et al., 2014; World Health Organization, 2018). A este efecto, la Ley Orgánica 3/2020, de 29 de diciembre, por la que se modifica la Ley Orgánica 2/2006, de 3 de mayo, de Educación, en vigor en la actualidad, hace eco de esta idea en su preámbulo:

> En relación al bienestar de los niños y niñas, la OMS considera que las escuelas y otros establecimientos educativos son instituciones privilegiadas (…). La promoción de la salud en el ámbito educativo contribuye a que los grupos de población más joven, independientemente de factores como clase social, género, o el nivel educativo alcanzado por sus padres y madres u otras figuras parentales, desarrollen una vida más saludable. (Preámbulo, LO 3/2020, de 29 de diciembre, de Educación)

Además, aquellos comportamientos que se aprenden en la niñez y en la adolescencia (p. ej. alimentación, hábitos de transporte) tienen más posibilidades de seguirse

practicando en la vida adulta (Corder et al., 2019; Larouche, 2018). Es por eso por lo que el currículum de Educación Primaria de la Comunidad Autónoma de Aragón (Orden ECD/850/2016, de 29 de julio que modifica la Orden de 16 de junio de 2014, currículo de Educación Primaria) también refleja esta intención de que el centro escolar sea un promotor de hábitos saludables:

> La Educación Primaria debe facilitar a todos los alumnos los aprendizajes de […] hábitos de actividad física, higiene y salud, con el fin de garantizar una formación integral que contribuya al pleno desarrollo de la personalidad de los alumnos […]. (Principios generales, Orden ECD/850/2016, de 29 de julio, currículo de Educación Primaria).
>
> Se adoptarán medidas para que la actividad física y la dieta equilibrada formen parte del comportamiento infantil. A estos efectos, se promoverá la práctica diaria de deporte y ejercicio físico por parte de los alumnos durante la jornada escolar […]. (Artículo 8. Elementos transversales. Orden ECD/850/2016, de 29 de julio, currículo de Educación Primaria)
>
> Los centros adscritos a la Red Aragonesa de Escuelas Promotoras de Salud, dedicarán una parte de la carga lectiva del Proyecto de Centro al desarrollo de competencias que faciliten la adopción, por toda la comunidad educativa, de modos de vida sanos en un ambiente favorable a la salud. (Artículo 18. Proyecto de centro. Orden ECD/850/2016, de 29 de julio, currículo de Educación Primaria)

La Educación Física, por tanto, podría ser la candidata principal que liderase estos proyectos de centro, siendo ella la que tiene como objetivo educativo promover hábitos saludables a través de las prácticas físicas, buscando desarrollar en el alumnado prácticas que favorezcan un estilo de vida saludable (Orden ECD/850/2016, de 29 de julio que modifica la Orden de 16 de junio de 2014, currículo de Educación Primaria). El enfoque de estos proyectos, que buscan solucionar problemas del mundo real —como pueden ser el sedentarismo, los bajos niveles de AF, y la movilidad de las ciudades (World Health Organization, 2018)— tiende más hacia metodologías no tradicionales. Una metodología posible podría ser el aprendizaje basado en proyectos, ya que busca solucionar problemas del mundo real mediante un proyecto que se lleve a cabo en la escuela, tanto desde la vía curricular como no curricular (Kokotsaki et al., 2016). Este tipo de aprendizaje tiene un efecto positivo en el rendimiento académico de los alumnos en comparación con la enseñanza tradicional (Chen & Yang, 2019).

Una propuesta a valorar en este tipo de proyectos, que además respondería a los problemas del mundo real citados anteriormente, es el transporte activo —que supone un aumento de los niveles de AF (Costa et al., 2020) y una reducción de la contaminación en las ciudades (Singleton, 2014)——. La promoción desde la escuela del transporte activo como un hábito saludable, mediante un proyecto de centro llevado a cabo con una metodología de aprendizaje basado en proyectos, parece una tarea a liderar por el área de Educación Física. A este respecto, el capítulo III de la tesis doctoral recoge una intervención escolar destinada a promover el transporte activo en escolares, teniendo a la Educación Física como principal promotor del proyecto.

*4.1. La promoción del transporte activo desde el contexto escolar*

Las intervenciones llevadas a cabo para promocionar el transporte activo a la escuela en los últimos 20 años, han sido recogidas en diferentes revisiones sistemáticas (Chillón et al., 2011; Jones et al., 2019; Larouche et al., 2018; Pang et al., 2017; Villa-González et al., 2018). En la primera década de los años 2000, la mayoría de las intervenciones que se llevaron a cabo consistían en realizar rutas seguras al colegio, incorporar el tópico del transporte activo en otros programas que trabajasen hábitos saludables, promover eventos escolares relacionados con ir de forma activa al colegio, e incluso en algunas ocasiones, analizar las necesidades del ambiente físico y realizar intervenciones en algunas infraestructuras (Chillón et al., 2011). A partir del año 2010, algunas de estas estrategias fueron combinándose, dando lugar a intervenciones escolares que buscaban incidir en diferentes esferas del modelo socio-ecológico centrándose en determinantes pertenecientes a uno o varios de los diferentes niveles. A continuación, se presenta una tabla (ver Tabla 2) con las diferentes intervenciones efectivas que se han llevado a cabo en los últimos años recogidas en las revisiones sistemáticas citadas anteriormente (2010-2019)[3].

[3] Para consultar la tabla resumen en las que se recogen todas las intervenciones ver Anexo 2

**Tabla 2**

*Resumen de intervenciones efectivas para promover el transporte activo al centro escolar*

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Hinckson et al., 2011; Hinckson & Badland, 2011) | Nueva Zelanda. 56 escuelas de primaria. 57.096 estudiantes de 5-10 años. Duración: 36 meses. | *School Travel Plan* (STP). Los componentes de la intervención son la ingeniería (p. ej., infraestructura para facilitar la bicicleta); la educación en circulación segura (p. ej., actividades curriculares); actividades de refuerzo (p. ej., refuerzo de multas de aparcamiento); educación pública (p. ej., *walking* bus); eventos (p. ej., día de andar); política (p. ej., no hay plazas de aparcamiento destinadas a dejar a los estudiantes). | Individual (conocimientos). Ambiente social y cultural (eventos). Ambiente físico (infraestructuras). Ambiente político (políticas de uso de aparcamiento escolar). | Aumento significativo del porcentaje de niños que se desplazan activamente al colegio. |
| (Mendoza et al., 2011) | Houston, Texas EEUU. 149 estudiantes de 9-10 años. Duración: 5 semanas. | El personal del estudio acompañó a los niños a la escuela hasta 5 días a la semana. Se establecieron en cada escuela de intervención de 1 a 3 rutas al colegio. Los niños y padres decidían que días participar. | Individual (comportamiento). | Aumento significativo de la frecuencia de desplazamiento en las escuelas experimentales respecto a las control. |
| (Henderson et al., 2013) | Atlanta, EEUU. 1 escuela de primaria. 658 estudiantes). Duración 24 meses. | *Safe Routes to School* (SRTS). Está compuesta por una parte educativa curricular (i.e. seguridad vial) y educación a los padres (beneficios del transporte activo, mapas con las rutas seguras); una parte de marketing (i.e., Día del transporte activo con publicidad en marquesinas, camisetas); una parte de apoyo comunitario (i.e., establecer lugares de aparcamiento para los que viven muy lejos del colegio, para que puedan caminar); y una parte de refuerzo. | Individual (conocimientos). Ambiente social y cultural (eventos). Ambiente físico (aparcamientos para coches a cierta distancia). | Aumento significativo de la prevalencia del transporte activo en la mañana. |

(Continúa tabla 2…)

(Continúa tabla 2…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Bungum et al., 2014) | Henderson, Nevada, EEUU.<br>2 escuelas. 1336 estudiantes de 5-11 años.<br>Duración: 4 días. | *Nevada Moves Day* (NMD). Diseño de un día del transporte activo al colegio para animar a los estudiantes y sus familias. Se promocionó durante 3 días en los anuncios matutinos habituales. Se envió un recordatorio a las familias, vía los estudiantes y vía mensaje telefónico del director. Se anunció en el tablón de la escuela durante la semana anterior al evento, y la profesora de educación física promovió repetidamente el evento en sus clases. Los alumnos que utilizaron transporte activo en el NMD también recibieron una pegatina de participación al llegar al campus. | Ambiente social y cultural (apoyo social). | Aumento del número de desplazamientos activos al colegio el día del evento significativamente respecto a la escuela control. |
| (Stewart et al., 2014) | 6 estados de EEUU.<br>53 escuelas de primaria estudiantes 5-18 años.<br>Duración: 5 años | *Safe Routes to School* (SRTS). Programa estatal que destina fondos para campañas de concienciación pública y de divulgación a la comunidad, educación vial, programas de seguridad para niños en bicicleta y peatones, y formación de voluntarios y gestores de SRTS. También inversiones en infraestructuras (p. ej., mejoras de las zonas peatonales, pacificación de vías, instalaciones de bicicletas en la vía pública). También se exigió a cada estado que financiara un coordinador a tiempo completo. | Individual (conocimientos).<br>Ambiente social y cultural (divulgación).<br>Ambiente físico (infraestructuras).<br>Ambiente político (políticas de financiación para el programa). | Aumento de los desplazamientos activos de forma significativa. |
| (Vanwolleghem et al., 2014) | Flanders, Bélgica.<br>2 escuelas de primaria 58 estudiantes de 6-12 años.<br>Duración: 1 semana. | *Drop-off spot*. Un profesor los acompañaba desde los puntos de encuentro al colegio. | Individual (comportamiento).<br>Ambiente social y cultural (modelo). | Aumento significativo del número de viajes semanales activos. |

(Continúa tabla 2…)

(Continúa tabla 2…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Villa-González, Ruiz, Ward, et al., 2015) | Jaén, Granada, España. 206 niños de 8-11 años. Duración: 11 meses. | Tanto los profesores como el equipo de investigación aplicaron el programa de intervención en cada escuela. 6 actividades mensuales dentro del programa de intervención (cada actividad osciló entre 60 y 120 minutos cada mes) durante el horario escolar, además de sus clases regulares de Educación Física. Los padres participaron en una de las actividades. | Individual (actitudes). Ambiente social y cultural (participación de los padres). | Hubo un aumento significativo en la frecuencia de caminar a la escuela en el grupo de la intervención. |
| (F Xu et al., 2015) | China. 8 escuelas de primaria, 1182 estudiantes de 8-9 años. Duración: 12 meses. | Actividades curriculares, apoyo al entorno escolar, participación de la familia y programas/eventos. | Individual (conocimientos). Ambiente social y cultural (eventos) | Los estudiantes de la intervención fueron más propensos de forma significativa a cambiar su desplazamiento pasivo por activo. |
| (Hoelscher et al., 2016) | Houston, EEUU. 78 escuelas estudiantes de 9-10 años. Duración: 12 meses. | *Self Routes to School*. Incluían actividades de educación, fomento, aplicación y evaluación. Incluye escuelas que tiene proyecto con subvención pública (infraestructura de financiación), escuelas con proyectos sin infraestructura y escuelas control. | Individual (comportamiento). Ambiente político (plan estatal). | Los porcentajes de niños que se desplazan a la escuela de forma activa son significativamente mayores en las escuelas con proyectos |

*Nota.* En el apartado de los niveles de aplicación, entre paréntesis se reporta un ejemplo de cada nivel, en algunas intervenciones podría haber varias estrategias por nivel.

De las 29 intervenciones que se analizaron (ver Anexo 2), solo nueve reportan aumentos estadísticamente significativos del transporte activo al centro escolar. Estas intervenciones tienen tres tipos de duración: (1) aquellas que son puntuales (i.e., de uno a cinco días), (2) las intervenciones que se llevan a cabo en un curso escolar, y (3) las intervenciones que duran más de un curso escolar. Las primeras están caracterizadas por ser eventos relacionados con el transporte activo, o habilitaciones de puntos de encuentro donde el profesorado acompaña al alumnado durante el trayecto de casa a la escuela. Las segundas, además de incluir también eventos y puntos de encuentro, introducen actividades curriculares relacionadas con el uso de la bicicleta o la seguridad vial. Dentro de estas, demuestran ser más efectivos aquellos proyectos que tienen financiación desde la administración. Por último, las intervenciones de más duración que un curso escolar se caracterizan por incluir estrategias en al menos los tres primeros niveles del modelo socio-ecológico (i.e., individual, social y cultural, y ambiente físico).

En este sentido, las intervenciones que ponen el foco en el transporte activo a la escuela pueden ser una estrategia útil para promover este comportamiento (Larouche et al., 2018) y aumentar los niveles de AF de los niños (Jones et al., 2019). Sin embargo, atendiendo a las revisiones de la literatura, se identifican determinadas necesidades o retos que exigen **hacer mejoras en su diseño y evaluación** para aumentar la calidad y la efectividad de los programas de intervención (Villa-González et al., 2018). La **utilización y explicitación de un marco conceptual que sirva de guía para el diseño, implementación y evaluación de programas de intervención; y la utilización de instrumentos válidos y fiables a la hora de recoger los datos y evaluar este comportamiento,** son algunas de las propuestas para mejorar la calidad de las intervenciones (Chillón et al., 2011; Larouche et al., 2018; Villa-González et al., 2018). A su vez, llevar a cabo políticas de transporte activo y cambios en el ambiente físico podría aumentar su eficacia y sostenibilidad de estas intervenciones (Jones et al., 2019). Otras revisiones de la literatura sobre intervenciones escolares para aumentar los desplazamientos activos también recomiendan el uso de modelos socio ecológicos (Pang et al., 2017) adaptados al contexto geográfico, económico y cultural donde se va a realizar la intervención (Larouche et al., 2015).

## 5. Identificación de necesidades y/o retos

La investigación que se propone en esta tesis doctoral pretende integrarse dentro de las propuestas políticas del Ayuntamiento de Huesca —ciudad en la que se enmarca la investigación—, con la intención de realizar una intervención escolar que responda a un problema social real —mediante el aprendizaje basado en proyectos— y que esté soportada por una metodología de investigación que se está proponiendo en la literatura científica —recogida en el apartado anterior—. Todo esto quiere abordarse en ProATS (*Promotion Active Transport To School*), el proyecto de investigación que se presenta en la tesis doctoral y que consiste en el diseño, implementación y evaluación de una intervención escolar interdisciplinar y multinivel.

ProATS se lleva a cabo en Huesca (Aragón), ciudad situada en el norte de España. Las propuestas políticas que el Ayuntamiento de Huesca recogía en su plan de movilidad del año 2014 eran la creación de un modelo de ciudad de calidad y saludable, favoreciendo, entre otras cosas, los desplazamientos peatonales y en modos no motorizados (Ayuntamiento de Huesca, 2014). Una de las acciones que se reclamaba desde la ciudadanía era la necesidad de actuar sobre las dificultades de movilidad en el entorno de los colegios. A su vez, la ciudad realizó un proceso de peatonalización para aumentar el espacio público al peatón, conjuntamente con actuaciones como los caminos escolares señalizados, campañas de sensibilización del uso de la bici y un aumento del carril bici de 4 km (Ayuntamiento de Huesca, 2014). En este momento temporal, el Ayuntamiento de Huesca se convierte en socio principal del proyecto europeo CAPAS-Ciudad (Zaragoza-Casterad et al., 2019) (https://capas-c.eu/). Este proyecto, del que también es socio principal la Universidad de Zaragoza, desarrollará una línea de investigación dedicada al transporte activo al centro escolar. Es en este contexto político y comunitario en el que se enmarca el proyecto ProATS.

Es por eso por lo que ProATS pretende dar solución a algunos de los retos y/o necesidades que se han identificado en la literatura científica, enriqueciendo las actuaciones políticas del ayuntamiento y dotando de significatividad al proyecto educativo que forma parte de ella.

A continuación, se presentan los diferentes retos identificados:

RETO GENERAL: Un primer reto general sería realizar intervenciones significativas, tanto para el contexto político como para el contexto escolar, evaluando

si existe un beneficio adicional en su eficacia y sostenibilidad. Este reto busca combinar por un lado las políticas de transporte activo al centro escolar con intervenciones escolares, y por otro, abordar las intervenciones escolares con aprendizajes que estén conectados con el currículum escolar y el propio centro educativo. Para la consecución de este reto, es necesario atender diferentes cuestiones metodológicas de las intervenciones específicas que promueven el transporte activo al centro escolar, siendo algunas de ellas comunes a intervenciones que promueven diferentes comportamientos saludables. A continuación, se seleccionan tres de los retos que se plantean en la literatura, con intención de ser abordados en la investigación de la tesis doctoral:

RETO 1: En primer lugar, el reto 1 es la evaluación del transporte activo. Es necesario identificar los patrones de transporte activo existentes en un contexto para identificar las posibles necesidades de intervención. A su vez, el reto de la evaluación arrastra el problema en los procedimientos de clasificación de los participantes en activos o pasivos, generando una falta de consistencia que complica la comparación de resultados entre diferentes estudios.

RETO 2: En segundo lugar, el reto 2 es la necesidad de realizar un análisis específico y concreto del contexto en el que se quiere realizar la intervención. Se necesita un análisis específico de los factores que influencian el comportamiento en el contexto determinado. Este análisis permitirá adecuar las estrategias de intervención y tener más probabilidades de tener un efecto en el comportamiento.

RETO 3: En tercer lugar, el reto 3 es aumentar la calidad de las intervenciones. El diseño de la intervención debe hacerse sobre un marco conceptual que la sustente. A su vez, es necesaria la utilización de instrumentos válidos y fiables a la hora de plantear su proceso de evaluación.

# 6. Objetivos

La investigación original, que pertenece en parte al proyecto ProATS, recoge 5 artículos científicos publicados, aceptados para su publicación y en revisión en revistas científicas cuyo índice de impacto se encuentra incluido en la relación de revistas del Journal Citation Reports o de calidad equiparable, y que tienen como unidad temática responder al reto general planteado en el apartado de retos. La pregunta de investigación sería la siguiente, ¿cómo realizar una intervención significativa para promover el transporte activo al centro escolar en un contexto determinado? En respuesta se plantea el siguiente objetivo general:

OBJETIVO GENERAL: conocer los patrones de transporte activo al centro escolar, e identificar los determinantes contextuales que explican el transporte activo al centro escolar para diseñar una intervención que modifique el comportamiento en el contexto específico del alumnado de los cursos 5º y 6º de educación primaria de la ciudad de Huesca (Aragón, España).

Para dar respuesta a este objetivo, y en base a los tres retos seleccionados de la literatura revisada en la introducción general, la investigación original incluye tres objetivos específicos que responden a estos retos. Cada uno de estos retos se aborda en un capítulo de la tesis doctoral, que agrupa los estudios en base a las preguntas de investigación que surgen de cada uno de estos retos planteados.

El **Capítulo I**. Patrones y problemática de evaluación, responde al reto 1 —la evaluación del transporte activo—, con el siguiente objetivo específico y los estudios que lo componen:

OBJETIVO ESPECÍFICO 1**.** Describir los patrones de transporte al centro escolar e identificar las problemáticas de medición de este comportamiento.

Estudio 1. *Implications of school type for active commuting to school in primary education students*.

El estudio 1 responde a la siguiente pregunta de investigación: "¿Son el tipo de centro, la distancia, las actitudes de los padres y el nivel socioeconómico familiar determinantes de los patrones de transporte activo al centro escolar?". Con relación a esta pregunta de investigación se formulan los siguientes objetivos:

OBJ. 1.1.1. Estudiar las implicaciones de la elección de escuela (es decir, privada o pública) para el transporte activo al centro escolar.

OBJ. 1.1.2. Analizar si la distancia umbral, las actitudes de los padres y el nivel socioeconómico de la familia se asociaban con la frecuencia de transporte activo según el tipo de escuela.

Estudio 2. *Active or Passive Commuter? Discrepancies in Cut-off Criteria among Adolescents*.

El estudio 2 responde a la siguiente pregunta de investigación: "¿Son los criterios de corte utilizados eficaces para clasificar los escolares en activos y pasivos? ¿Puede ser la distancia una variable relevante a la hora de realizar esta clasificación?" Con relación a esta pregunta de investigación se formulan los siguientes objetivos:

OBJ.1.2.1. Explorar si el porcentaje de viajeros activos identificados en una muestra de adolescentes sería significativamente diferente en función de los criterios de corte utilizados.

OBJ.1.2.2. Analizar si el umbral de distancia puede ser una variable relevante a tener en cuenta a la hora de seleccionar los criterios de corte para categorizar la muestra en viajeros activos y pasivos.

El **Capítulo II**. Factores de influencia del transporte activo en el contexto de intervención, responde al reto 2 —la adecuación al contexto— con el siguiente objetivo específico y los estudios que lo componen:

OBJETIVO ESPECÍFICO 2**.** Identificar los factores que influencian el transporte activo y cómo estos pueden explicar este comportamiento en la población de referencia (niños de 4º, 5º y 6º de educación primaria).

Estudio 3. *Assessment of psychological, social cognitive and perceived environmental influences on children's active transport to school.*

El estudio 3 responde a la siguiente pregunta de investigación: "¿Es el modelo planteado eficaz para conceptualizar las relaciones entre las variables propuestas y evaluar sus efectos en el contexto de la investigación?". Con relación a esta pregunta de investigación se formulan los siguientes objetivos:

OBJ. 2.1.1. Desarrollar y probar un modelo que conceptualice las relaciones entre las necesidades psicológicas de los niños, los factores cognitivos sociales y los entornos percibidos.

OBJ. 2.1.2. Evaluar los efectos de los entornos psicológicos, cognitivos sociales y percibidos en el transporte activo de los niños utilizando un modelo de ecuaciones estructurales.

Estudio 4. *Effect of distance and psychosocial variables on active mode of commuting to and from school as independent behaviors in children.*

El estudio 4 responde a la siguiente pregunta de investigación: "¿Tienen los patrones de ida y vuelta determinantes diferentes entre sí en el alumnado que vive más lejos de la distancia umbral?". Con relación a esta pregunta de investigación se formulan los siguientes objetivos:

OBJ. 2.2.1 Explorar los factores psicológicos y ambientales que influyen en la frecuencia de los desplazamientos activos hacia y desde la escuela, como comportamientos independientes en los niños que viven a más de 725 m de la escuela.

El **Capítulo III**. Programa de intervención multinivel e interdisciplinar para aumentar los viajes activos al centro escolar responde al reto 3 —intervenciones de calidad— con el siguiente objetivo específico y el estudio que lo compone:

OBJETIVO ESPECÍFICO 3. Diseñar, implementar y evaluar un programa de intervención interdisciplinar que favoreciese el transporte activo al centro escolar en aquellos colegios que lo reclamasen (ya fuese por necesidad y/o por sensibilidad con la temática).

Estudio 5. *Applying the Intervention Mapping Protocol to promote Active Transport to School in primary school students: the ProATs intervention.*

El estudio 5 responde a la siguiente pregunta de investigación "¿Cómo se lleva a cabo una intervención para promover el transporte activo al centro escolar con la guía del *Intervention Mapping Protocol*?" Con relación a esta pregunta de investigación se formulan los siguientes objetivos:

OBJ. 3.1.1 Describir detalladamente el desarrollo paso a paso de la intervención ProATs utilizando el *Intervention Mapping Protocol*. ProATS se diseñó para aumentar la frecuencia de los desplazamientos activos al centro escolar entre el alumnado de 10 a 12 años.

# 7. Metodología

ProATS es una investigación educativa que pertenece a la línea de investigación "transporte activo al centro escolar" desarrollada por el proyecto europeo transfronterizo CAPAS-Cité-Ciudad (Centro de Promoción de la AF y la Salud) (I-2016/013) (https://capas-c.eu/). La investigación ProATS está planificada en base a las directrices proporcionadas por el *Intervention Mapping Protocol*, y se compone de dos momentos clave: un primer momento de evaluación diagnóstica del contexto (a partir de ahora diagnóstico ProATS) y un segundo momento de diseño, aplicación y evaluación de una intervención escolar (a partir de ahora programa de intervención ProATS). El programa de intervención ProATS se desarrolla a su vez desde dos perspectivas complementarias entre sí. Por un lado, es un programa de intervención multinivel, ya que las diferentes estrategias de intervención están localizadas en los diferentes niveles del modelo socio-ecológico. Y, por otro lado, es un programa de intervención interdisciplinar, ya que las diferentes situaciones de aprendizaje llevadas a cabo se desarrollan desde la vía curricular entre diferentes asignaturas; aunque el programa también propone actividades desde la vía no curricular.

## *7.1. Intervention Mapping Protocol*

La realización de una intervención significativa es el reto general que se plantea en la tesis doctoral y del que derivan los objetivos que se han presentado en el apartado de objetivos. Este tipo de programas de intervención, como ProATS, buscan ser eficaces a la hora de llevar a cabo un cambio comportamental, y para ello se necesitan herramientas que mejoren la calidad de dichas intervenciones. El *Intervention Mapping Protocol* proporciona a los planificadores de estas intervenciones una mejora en el proceso de toma de decisiones en los momentos de planificación, ejecución y evaluación de la intervención (Bartholomew et al., 2006). Es por esto por lo que ha sido utilizado para llevar a cabo los dos momentos de la investigación ProATS, los cuales han seguido las directrices propuestas por el *Intervention Mapping Protocol* en las seis etapas o fases clave que propone (Bartholomew et al., 2006, 2016):

Una primera fase llamada evaluación de las necesidades se aborda en los estudios de los capítulos I y II y recoge el momento de diagnóstico ProATS. En el capítulo I, y en relación con la revisión de la literatura realizada en el apartado 2 de la introducción

general, se presentan los patrones de transporte activo de todo el alumnado de 4º, 5º y 6º de educación primaria de la ciudad de Huesca (a partir de aquí muestra diagnóstica) y las diferencias que puede haber en ellos según los diferentes centros educativos. En este capítulo también se reflexiona acerca de la problemática de la medición del transporte activo en una muestra de adolescentes, y las implicaciones que puede tener la disparidad en las formas de clasificar al alumnado en activo o pasivo en lo que hace referencia al transporte a la hora de comparar estudios. En el capítulo II, y en relación con la revisión de los marcos conceptuales realizada en el apartado 3, se estudia el funcionamiento de los determinantes del transporte activo al centro escolar en la muestra diagnóstica.

Las otras cinco fases: formulación de los objetivos de cambio de comportamiento; selección de métodos basados en la teoría y estrategias prácticas, desarrollo del programa; adopción, aplicación y sostenibilidad del programa, y diseño de la evaluación se abordan en profundidad en el estudio perteneciente al capítulo III, que recoge el programa de intervención ProATS realizado en dos centros escolares de la ciudad de Huesca en los niños de 5º de primaria (a partir de ahora muestra intervención). Este capítulo III hace referencia a las propuestas y retos detectados en el apartado 4 de la introducción general.

### *7.2. Investigación ProATS*

La investigación ProATS se enmarca en el contexto político y comunitario concreto de la ciudad de Huesca, como se ha explicado previamente en el apartado 5. A su vez, este se lleva a cabo con un equipo interdisciplinar del que también forma parte la Universidad de Zaragoza. La intervención y los productos científicos derivados de este proyecto pertenecen a la línea de investigación "transporte activo al centro escolar" integrada dentro del proyecto europeo transfronterizo CAPAS-Cité-Ciudad (https://capas-c.eu/) del que son socios principales tanto el Ayuntamiento de Huesca, como la propia Universidad de Zaragoza.

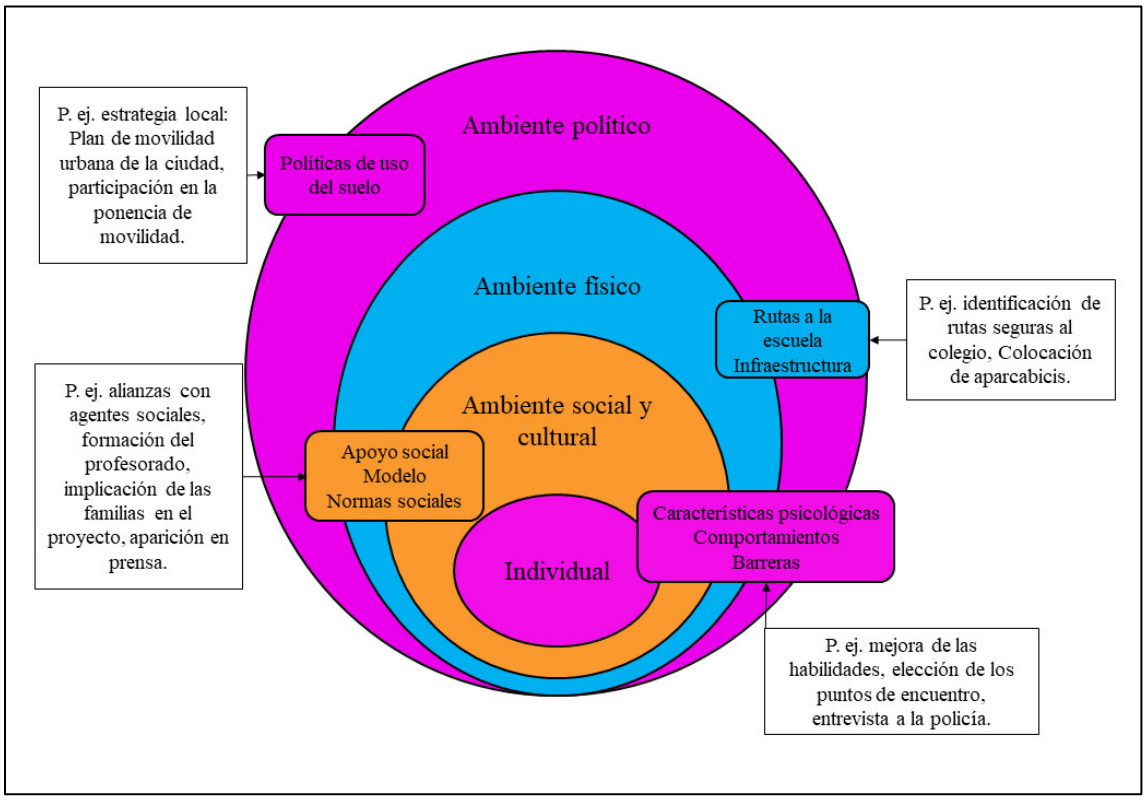
La investigación ProATS sigue el *Interventiong Mapping Protocol* como guía en su planificación, ejecución y evaluación y tiene en cuenta los diferentes niveles del modelo socio-ecológico, tanto en su momento diagnóstico como en la selección e implementación de estrategias del programa de intervención. Este, al ser multinivel, utiliza diferentes marcos conceptuales (i.e., Teoría de la Conducta Planificada, Teoría Cognitiva Social, y Teoría de la Autodeterminación) para implementar las estrategias dependiendo de los niveles en el que estas se insertan. Para seleccionar las estrategias

del programa de intervención ProATS se han utilizado las taxonomías de los Métodos de Cambio de Conducta (Kok et al., 2016) y la de las Técnicas de Cambio del Comportamiento (Abraham & Michie, 2008; Bird et al., 2013).

El programa de intervención ProATS se sitúa en escuelas pertenecientes a la Red de Escuelas Promotoras de Salud y se lleva a cabo por los profesores de la escuela primaria a través de una metodología de aprendizaje basado en proyectos, desde una perspectiva interdisciplinar, buscando convertirse en un proyecto educativo de centro (Zaragoza et al., 2019). Este programa de intervención tiene como finalidad fomentar los desplazamientos activos del alumnado de 5º y 6º de primaria de forma autónoma y con seguridad al y desde el centro educativo. Para ello, se inserta tanto en la vía curricular (p. ej. situaciones de aprendizaje de identificación de rutas seguras) como en la no curricular (p. ej. situaciones de referencias de la ciudad como la Inspección Técnica de Bicicletas —ITB—), teniendo en cuenta en estas situaciones diferentes estrategias en los diferentes niveles del modelo socio-ecológico, planteado por ejemplo ciertas modificaciones ambientales (p. ej. instalación de aparca bicis). Todo ello dentro de un ambiente político sensibilizado (i.e., Plan de Movilidad de la ciudad de Huesca) y un ambiente social y cultural a los que se intenta implicar en el proyecto (p. ej. evento en el que se invita a las familias y al resto del centro a participar en la semana del transporte activo). En la Figura 1 se presentan ejemplos de las diferentes estrategias de la intervención realizadas en cada uno de los niveles del modelo socio-ecológico.

**Figura 1**

*Ejemplos de estrategias de intervención en cada uno de los niveles de la intervención*




*Nota.* Los círculos concéntricos representan los diferentes niveles del modelo socio-ecológico. Los cuadros coloreados hacen referencia a los determinantes contemplados en cada nivel. Los cuadros blancos contienen ejemplos de estrategias desarrolladas en cada nivel.

El programa de intervención se detalla a un nivel más concreto en el capítulo III de la tesis doctoral. En el estudio incluido en este capítulo se explica, siguiendo las fases *Intervention Mapping Protocol*, cómo se ha ido co-diseñando el proyecto educativo con la comunidad educativa de los diferentes centros en las diferentes fases propuestas por el protocolo. En este capítulo también se recogen los diferentes determinantes, estrategias y actividades utilizados en el diseño de la intervención en base a los objetivos de rendimiento planteados para la intervención. La explicación del proyecto educativo a nivel curricular y no curricular, con la planificación y la temporalización de las diferentes actividades y propuestas didácticas puede consultarse en profundidad en la guía educativa Promoción del transporte activo al Centro Escolar[4].

[4] Para acceder a la guía completa ver: https://capas-c.eu/wp-content/uploads/2019/09/Guia-desplazamiento-activo-V5-WEB.pdf

### 7.2.1. Diseño de la investigación ProATS

La investigación ProATS está bajo un paradigma empírico-analista, ya que se asume la existencia de una sola realidad, existente por sí misma sin necesidad del investigador, y que se rige por unas tendencias[5] a conocer por este que le permitan explicar, predecir y controlar los fenómenos estudiados (González, 2003). La investigación que se presenta por tanto utiliza diseños de campo, basados en los datos primarios obtenidos de la realidad (Bernardo & Calderero, 2002).

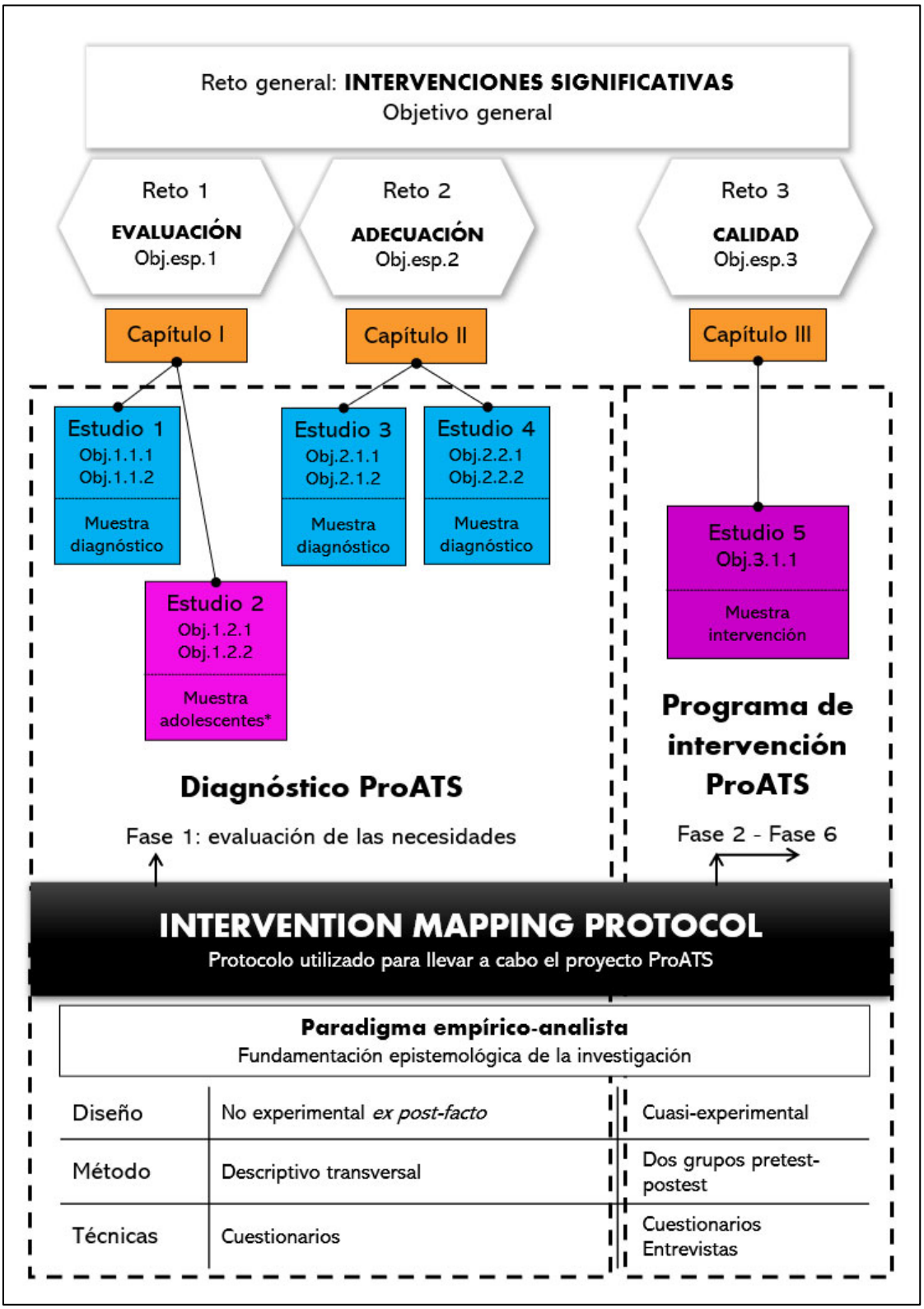
En concreto se han combinado dos diseños siguiendo las propuestas de (Bernardo & Calderero, 2002), uno para el diagnóstico ProATS, que es un estudio no experimental *ex post facto* que utiliza el método descriptivo del estudio transversal; y otro para el programa de intervención ProATS, que es un estudio cuasi-experimental que sigue un diseño de dos grupos con pretest y postest.

En la Figura 2 se presenta el diseño general de la investigación ProATS. En ella se muestra cómo los estudios que se presentan como parte de la tesis doctoral intentan responder a los retos planteados en el apartado 5 y a los objetivos de la tesis que surgen de los mismos. En esta figura también se identifican los dos momentos del proyecto (i.e., diagnóstico ProATS y programa de intervención ProATS) y cómo estos están enmarcados en las fases del *Intervention Mapping Protocol.* Finalmente, también están ilustrados los diferentes diseños de investigación seguidos en cada uno de los momentos. A su vez, dentro de cada estudio queda reflejada la muestra que se utiliza en cada uno de ellos. La selección de estos participantes, al igual que las variables, instrumentos y análisis estadísticos utilizados en la tesis están explicados de forma general en los siguientes apartados.

[5] Se utiliza la palabra tendencias, ya que según González (2003) es más apropiado hablar de tendencias en las realidades sociales, y no tanto de leyes propiamente dichas, que serían más propias de las ciencias naturales.

**Figura 2**

*Diseño de la investigación ProATS*




*Nota.* * La muestra de adolescentes se recogió en uno de los centros de la intervención, pero el tipo de estudio que se desarrolló forma parte de la evaluación diagnóstica de la investigación, tal y como se explica en el apartado de participantes.

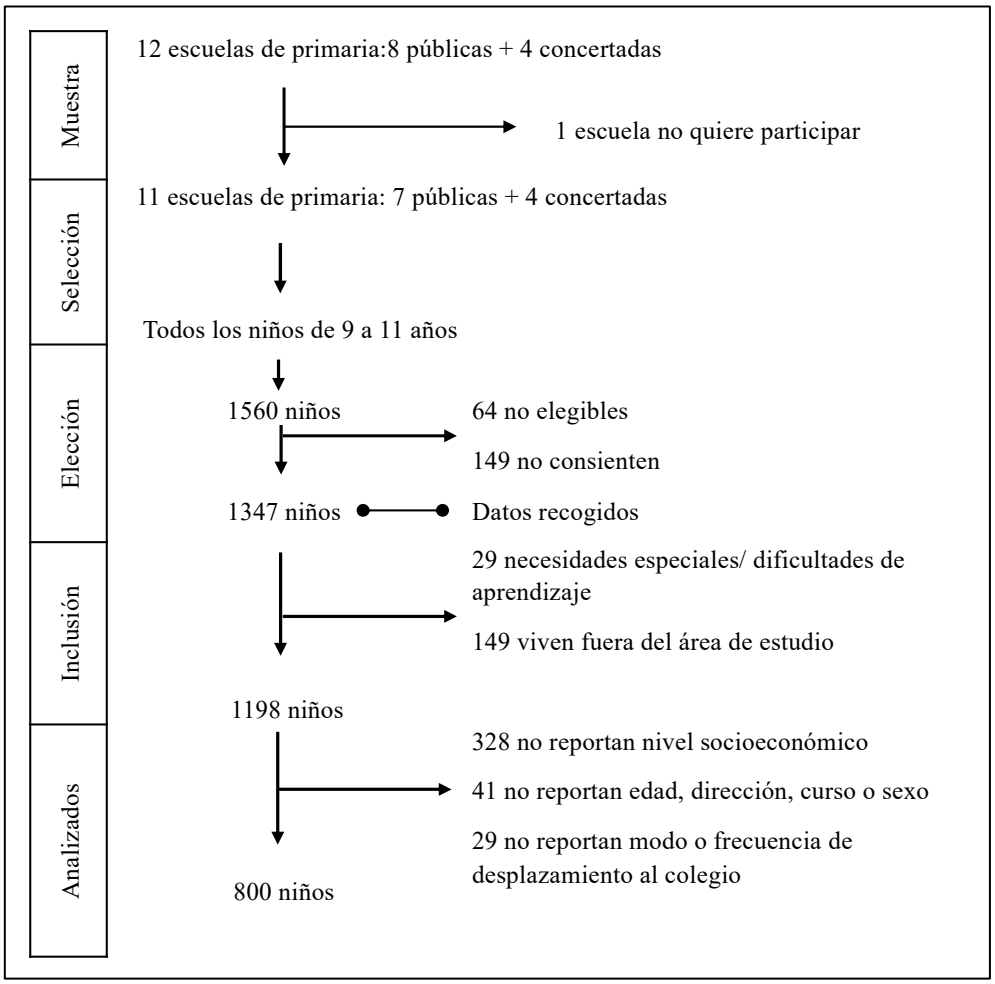
7.2.1.1. Participantes

Los muestreos realizados en ambos momentos (i.e., diagnóstico ProATS y programa de intervención ProATS) fueron muestreos accidentales, y por tanto no probabilísticos, ya que el criterio de selección era la posibilidad de acceder a los participantes (Bernardo & Calderero, 2002).

En la primera fase de la investigación (i.e., diagnóstico ProATS), el equipo de CAPAS-Ciudad se reunió con los equipos directivos de todas las escuelas de educación primaria de la ciudad Huesca para explicar el proyecto. Huesca es una ciudad mediana localizada en el noreste de España que cuenta con una población total de 53.656 habitantes, y que posee un área urbana de 4,21 $km^2$ y una densidad de población de 7.763 habitantes/ $km^2$ (National Institute of Statistics, 2018). Para acceder a todos los centros educativos se contactó con la Dirección Provincial de Educación para convocar a todos los centros de la ciudad de Huesca de educación primaria. Una vez se tenía el consentimiento de los equipos directivos, se envió una carta de invitación al estudio a las familias de todos los centros que quisieron participar. En esta carta se redactaron los objetivos del estudio y el consentimiento informado para ser firmado por las familias (ver Anexo 3). Solo aquellos que accedieron expresamente a participar, fueron seleccionados. Los datos recogidos conforman la muestra diagnóstica que se ilustra más detalladamente en la Figura 3. En algunos estudios de la tesis también se tienen en cuenta variables recogidas en todos aquellos padres y madres de los niños seleccionados que quisieron participar.

**Figura 3**

*Criterios de exclusión de la muestra diagnóstica*




Una vez realizado el diagnóstico ProATS, cada uno de los centros recibió un informe personalizado de sus resultados (ver ejemplo del informe en Anexo 4). En este momento fueron las escuelas interesadas las que solicitaron participar en una siguiente fase de intervención (i.e., programa de intervención ProATS). De aquellos centros que lo solicitaron (i.e., cuatro centros), dos de ellos fueron asignados como grupo experimental y dos como grupo control para un primer proyecto piloto. Es aquí donde comienzan el resto de las fases de la investigación establecidas en el *Intervention Mapping Protocol*.

Los datos recogidos en estos centros conformaran la muestra de adolescentes —que responde a una solicitud de uno de los centros solicitantes de la intervención— y la muestra intervención. Ambas se detallan en la Figura 4 y Figura 5 respectivamente.

**Figura 4**

*Criterios de exclusión de la muestra de adolescentes*

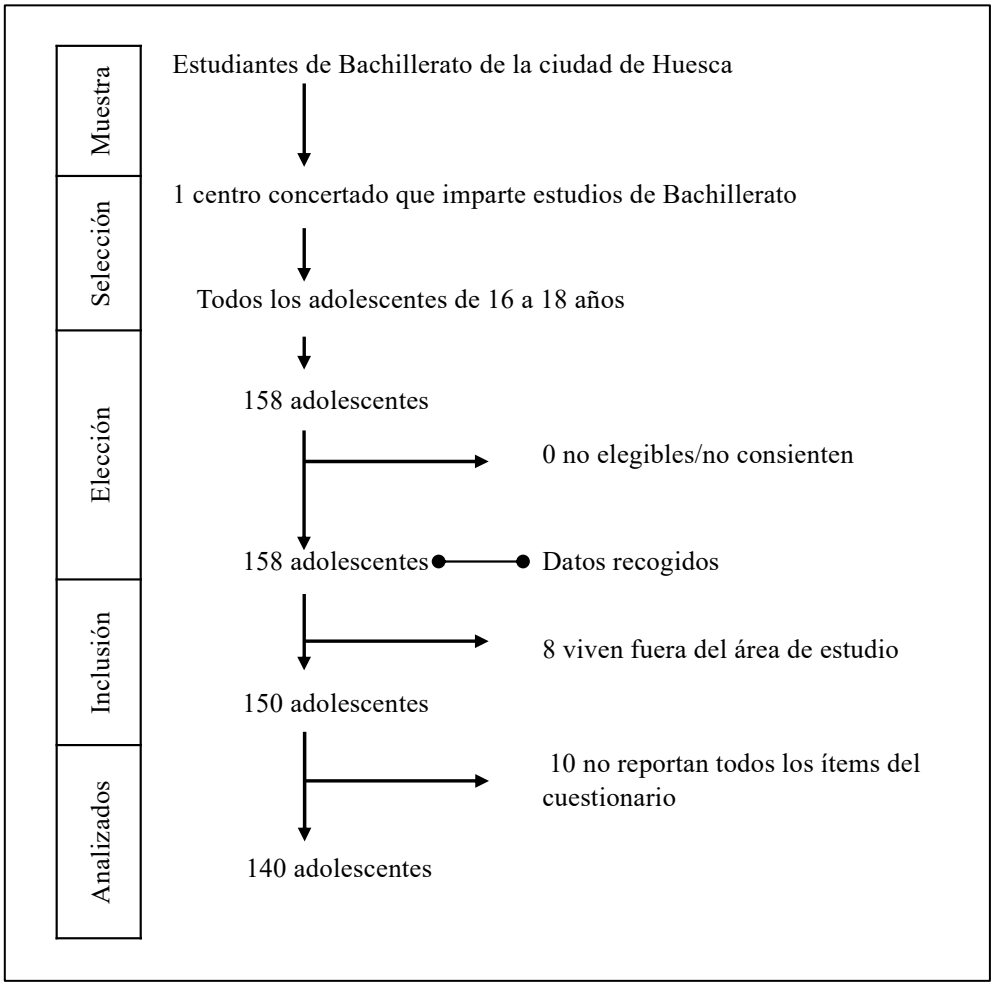
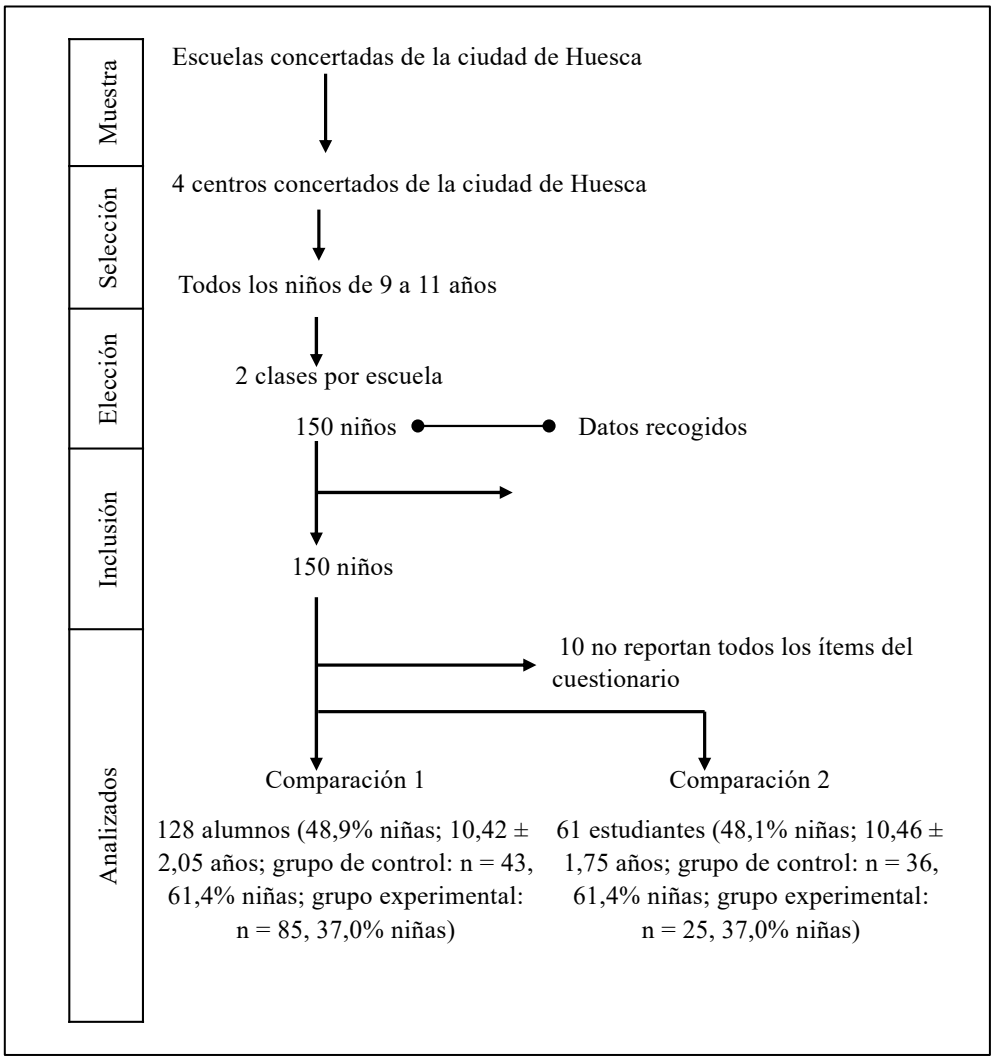


**Figura 5**

*Criterios de exclusión de la muestra de intervención*




7.2.1.2. Variables e instrumentos

Las técnicas utilizadas para la recogida de datos fueron los cuestionarios en ambos diseños —en su modalidad de encuestas— y en el programa de intervención ProATS se añadieron las entrevistas como técnica cualitativa para enriquecer los resultados (González, 2003). Los instrumentos utilizados y las variables que los componían en los diferentes estudios están plasmado en la Tabla 3.

**Tabla 3**

*Variables e instrumentos utilizados en la tesis doctoral*

| **Variables e instrumentos en niños y adolescentes** | | **Estudio 1** | **Estudio 2** | **Estudio 3** | **Estudio 4** | **Estudio 5** |
|---|---|---|---|---|---|---|
| Variables | Instrumento utilizado | | | | | |
| Sociodemográficas<br>Sexo y edad. | Preguntas auto reportadas (Chico/ chica /prefiero no contestar.<br>Fecha de nacimiento). | ✓ | ✓ | ✓ | ✓ | ✓ |
| Patrones de desplazamiento<br>Modo y frecuencia. | *New Version of Mode and Frequency of Commuting To and From School* (Segura-Díaz et al., 2020) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Necesidades psicológicas básicas<br>Autonomía, competencia y relación social. | *Basic Psychological Need Satisfaction in Active Commuting to and from School (BPNS-ACS) Scale* (Burgueño et al., 2020) | ✓ | ✗ | ✓ | ✓ | ✗ |
| Teoría de la conducta planificada<br>Actitudes, norma subjetiva, percepción de control, intención. | Adaptado* del cuestionario utilizado en el estudio de (Mandic et al., 2016) | ✓ | ✗ | ✓ | ✓ | ✗ |
| Distancia<br>Distancia caminando y distancia en coche. | Cálculo con Google Maps de la distancia más corta desde la vivienda (dirección completa) a la escuela. Caminando y en coche de forma separada. | ✓ | ✓ | ✓ | ✓ | ✗ |
| Percepción de barreras<br>Ambientales, seguridad, planificación y psicosociales. | Escala de percepción de BArreras en el Transporte Activo al Centro Educativo (BATACE) (Molina-García et al., 2016) | ✓ | ✓ | ✓ | ✓ | ✗ |
| Percepción del ambiente construido | Adaptado* de: *ALPHA enviromental questionnaire* (Spittaels et al., 2010) y la versión adaptada de *ALPHA enviromental questionnaire en jóvenes* españoles (García-Cervantes et al., 2014) | ✗ | ✗ | ✓ | ✗ | ✗ |

(Continúa tabla 3 …)

(Continúa tabla 3 …)

| **Variables e instrumentos de medida en padres y madres** | | **Estudio 1** | **Estudio 2** | **Estudio 3** | **Estudio 4** | **Estudio 5** |
|---|---|---|---|---|---|---|
| Variables | Instrumento utilizado | | | | | |
| Nivel socioeconómico<br>Nivel socioeconómico y número de coches. | *The Family Affluence Scale II* (Boyce et al., 2006) | ✓ | ✗ | ✗ | ✓ | ✗ |
| Actitudes | Adaptado* de los cuestionario utilizados por (Mandic et al., 2016) y (Panter et al., 2010) | ✓ | ✗ | ✗ | ✓ | ✗ |
| **Variables calculadas** | | **Estudio 1** | **Estudio 2** | **Estudio 3** | **Estudio 4** | **Estudio 5** |
| Variables | Procedimiento | | | | | |
| Distancia umbral | Análisis de la curva ROC (*Receiver Operating Characteristic*), basado en el modo de desplazamiento a la escuela (activo vs. pasivo), y la distancia desde casa al colegio (Chillón et al., 2015). El Índice de Younden (Schisterman et al., 2005) se calculó para identificar la distancia umbral que mejor distingue a los viajeros activos de los pasivos. Los valores del área bajo la curva de 0,90 se consideraron excelentes, de 0,80 a 0,89 buenos, de 0,70 a 0,79 regulares, y<0,70 pobres (Metz, 1978). | ✓ | ✓ | ✓ | ✓ | ✗ |
| Emisiones de $CO_2$ | Las emisiones de $CO_2$ (kg/km) se estimaron multiplicando la distancia y la frecuencia de los viajes pasivos al colegio (Singleton, 2014). Estos kilómetros totales recorridos en coche se multiplicaron por el promedio de $CO_2$ (Kg de $CO_2$/Km) atribuido al modo de transporte coche, según *The Guide To Low Carbon Lifestyles* (Mitchell, 2007). | ✓ | ✗ | ✗ | ✗ | ✗ |

*Nota.* *Los cuestionarios adaptados pueden consultarse en el Anexo 5.

Durante en programa de intervención ProATS se llevaron a cabo 11 grupos de discusión con los diferentes agentes que participaban en el proyecto (i.e., director de la escuela, profesorado, familias y alumnado). Estos grupos de discusión tenían como objetivos (1) comprender mejor el funcionamiento de los factores que afectan al transporte activo en los centros en los que se llevó a cabo la intervención; (2) Detectar las formas de intervención más adecuadas al contexto; (3) evaluar la eficacia, la fiabilidad y la sostenibilidad de la intervención. Los datos cualitativos se recogieron durante el periodo de la investigación, pero serán analizados posteriormente y no forman parte de los estudios que se presentan en esta tesis doctoral. Sin embargo, estos datos se utilizaron para conducir y reconducir el programa, sobre todo dando respuesta al objetivo (2) de detección de las formas más adecuadas de intervención en el contexto.

#### 7.2.1.3. Análisis estadísticos

A continuación, se presenta una tabla resumen (ver Tabla 4) de los diferentes análisis estadísticos que se han llevado a cabo en la tesis doctoral y en qué estudios en concreto se desarrollan en una mayor profundidad. En ella aparecen tanto los análisis descriptivos como los análisis utilizados para contrastas las hipótesis que se aceptan o rechazan en cada uno de los estudios.

**Tabla 4**

*Análisis cuantitativos realizados en los diferentes estudios de la tesis doctoral*

| Análisis de datos | Estudio 1 | Estudio 2 | Estudio 3 | Estudio 4 | Estudio 5 |
|---|---|---|---|---|---|
| Descriptivos | | | | | |
| Porcentajes y/o frecuencias | ✓ | ✓ | ✗ | ✓ | ✗ |
| Medias y dispersiones | ✗ | ✗ | ✓ | ✓ | ✗ |
| Comparaciones entre grupos | | | | | |
| Q de Cochran | ✗ | ✓ | ✗ | ✗ | ✗ |
| Chi-Cuadrado | ✓ | ✗ | ✓ | ✗ | ✗ |
| T-Student | ✓ | ✗ | ✗ | ✗ | ✗ |
| Análisis univariante-ANOVA | ✓ | ✗ | ✗ | ✗ | ✗ |
| ANOVA de medidas repetidas | ✗ | ✗ | ✗ | ✗ | ✓ |
| Modelo predictivo | | | | | |
| Modelo de regresión lineal por pasos | ✓ | ✗ | ✗ | ✓ | ✗ |
| Regresión logística binaria multivariante | ✗ | ✓ | ✗ | ✗ | ✗ |
| Modelo de ecuaciones estructurales | ✗ | ✗ | ✓ | ✗ | ✗ |

Para todos ellos se utilizó $p<.05$ para rechazar la $H_0$. El estadístico Alpha de Cronbach se utilizó para comprobar la fiabilidad de los instrumentos.

Para todos los análisis se utilizó el programa estadístico SPSS, versión 21.0 y versión 26.0, excepto para el modelo de ecuaciones estructurales, que se realizó con MPlus versión 6.1. También se realizó un análisis descriptivo de los porcentajes con el programa ArcGISpro versión 2.4.

### 7.2.2. Aspectos éticos de la investigación ProATS

El proyecto redactado en la tesis doctoral cuenta con la aprobación del Comité Ético de Investigación Clínica de Aragón (CEICA) (código ético: C1P117/0018) (ver Anexo 6).

La selección de la muestra de estudio se realizó a través del Departamento de Educación, para acceder de esta forma a todos los centros escolares, con los que se adquirió diversos compromisos:

En primer lugar, se les facilitó un informe completo a los centros con los resultados de la evaluación diagnóstica (ver Anexo 4), teniendo en cuenta solo los datos del centro

al que iba dirigido el informe. Para la entrega de estos informes, el equipo de investigación llevó a cabo un total de 13 reuniones individualizadas con los centros educativos (una en cada centro), para explicar los resultados del informe y hacer entrega de este.

En segundo lugar, se redactaron dos informes generales[6] distribuidos a toda la ciudad de Huesca, tanto en la ponencia de movilidad del ayuntamiento, como en la prensa (ver Anexo 7).

En tercer lugar, y como se ha explicado en el procedimiento, se llevaron a cabo diversos compromisos con los grupos control. Se realizaron reuniones con las familias para explicar resultados de la investigación, tanto en reuniones grupales, como en tutorías individuales si se querían conocer los resultados de un alumno en particular, para lo que se diseñaron informes individualizados (ver un ejemplo en el Anexo 8).

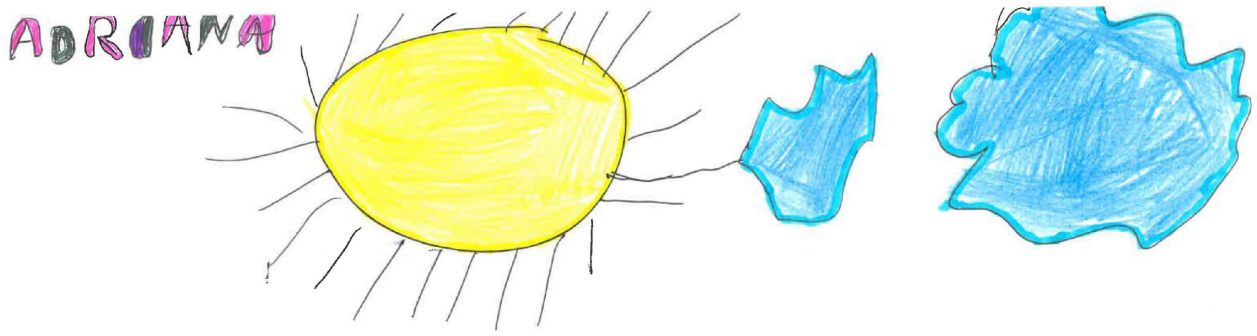
En cuarto lugar, todos los centros escolares fueron invitados a participar en la ITB[7], facilitando así esta actividad a todos los centros educativos, participaran o no en la intervención posterior.

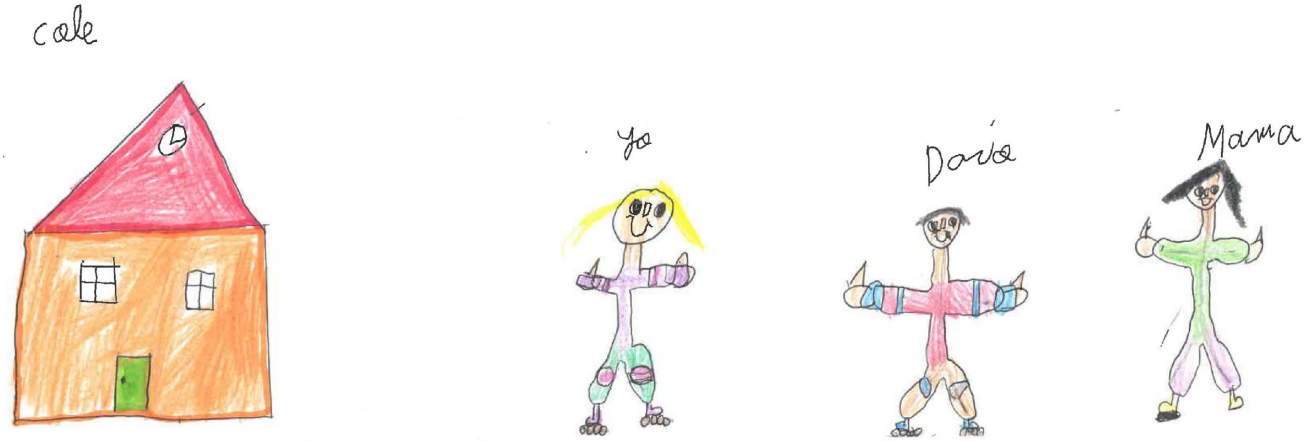
[6] Informe 1: https://capas-c.eu/wp-content/uploads/2018/11/Informe-Global-8-FINAL.pdf
Informe 2: https://capas-c.eu/wp-content/uploads/2018/11/Informe-BARRERAS_3.pdf
[7] Para consultar el material educativo en referencia a la ITB ver Ibor Bernalte et al. (2018)

# Trabajos publicados

# CAPÍTULO I. Patrones y problemática de evaluación

## Reto 1: La evaluación del transporte activo




"Andando voy al cole". Dibujo realizado por Adriana Montes Corral. 7 años.

# Estudio 1. *Implications of school type for active commuting to school in primary education students*

**Corral-Abós, A.,** Aibar, A., Estrada-Tenorio, S., Julián, J. A., Ibor, E., & Zaragoza, J. (2021). Implications of school type for active commuting to school in primary education students. *Travel Behaviour and Society, 24(April)*, 143–151. https://doi.org/10.1016/j.tbs.2021.03.007

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# Implications of school type for active commuting to school in primary education students

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ABSTRACT

School choice has implications for school travel as it allows students to attend schools that are further away from their residence than their neighborhood schools. The aim was to study the implications of school choice (i.e., private or public) for active commuting to school (ACS). Differences on ACS, parental attitudes, socio-economic status (SES) and CO2 emissions with respect to the type of school and the threshold distance to ACS were analyzed. The influence of distance, parents' attitudes, and family socioeconomic status, in the frequency of ACS by type of school were also analyzed. All students aged 9 to 11 years old, from eleven public or private primary education schools in Huesca (Spain), and their parents (i.e., mother and father, separately), participated in this study. The results show differences among students, who live above the threshold distance and attend public and private schools, in terms of frequency of ACS, mothers' attitudes, and SES. CO2 emissions were higher in the area around private schools than public schools, regardless of the threshold distance. Effects of school choice on weekly frequency of ACS behavior appear to be mostly explained by its connection with travel distance, SES and by mothers' attitudes, in students attending public schools. While, for private schools, the final model showed an influence of distance, mother's attitudes, and gender, on weekly frequency of ACS. This paper highlights how school choice can influence the mode of commuting to school, and some other related variables such as distance, mothers' attitudes, and CO2 emissions.

## 1. Introduction

More than 80% of the European population are expected to live in urban areas by 2030 (European Union, 2016). The growth model of European cities has been characterized by an expansion into peripheral areas (Jaraiz-Cabanillas et al., 2018), creating a decentralization of services (e.g., schools), changing mobility patterns (Dombriz, 2009; Pozueta and Gurovich, 2007), increasing the use of private vehicles for school travel (Ortúzar and Willumsen, 2008) and, consequently, reducing active transportation, such as walking or cycling (European Union, 2019; Gálvez-Fernández et al., 2020). This car reliance has led to negative impacts on the environment in several ways. For example, cars emit greenhouse gasses, such as carbon dioxide, which contribute to global warming (Van Ristell et al., 2013). A reduction in active commuting to school (ACS) patterns, has led to concerns over such environmental consequences as greenhouse gas emission, air and water pollution, and traffic congestion (Ewing, 2003; Ewing et al, 2004). Moreover, car reliance causes traffic congestion around schools and adverse health impacts related to less physical activity (PA) levels (Faulkner et al., 2009). The World Health Organization (WHO, 2016), recommends urban planners to encourage PA through the design of urban spaces, and to promote active transportation as a serious alternative to motorized options.

Several factors have been described as determinants of the decision to carry out ACS (Souza, et al., 2019). For instance, intra-individual factors including demographic and psycho-social factors (e.g., income, age, perception of competence, etc.), built and social/cultural environment (e.g., distance, neighborhood walkability, perceived safety, parents' attitudes, etc.), and the policy/regulatory environment (e.g., school planning or location, and zoning policies), are variables related to ACS. Some of these relevant variables (e.g., distance, traffic volume) should be considered in ACS promotion interventions (Chillón, et al., 2011). The probability of using motorized transport increases when travelling distance increases (Beck and Nguyen, 2017). However, an

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ecological perspective would suggest this relationship to be moderated by intra-individual, interpersonal or environmental factors (Garnham-Lee, et al., 2017), because several other factors, besides distance, have also been described as influential determinants regarding the decision to actively commute (Villa-Gonzalez et al., 2012). Further, some of these factors could be the result of decisions, such as, for instance, school location and school choice.

Habitually, children used to attend the school nearest to their homes (i.e., "neighborhood school"), but in different countries across the world, parents are allowed to choose any school for their children. (O"Shaughnessy, 2007). In Spain, the Ministry of Education and Vocational Training (*Ministerio de Educación y Formación Profesional* or MEFP) has overall responsibility for the country's education. However, seventeen autonomous regions have control over some decisions of their own education systems. National educational authorities have modified school choice policies over the last three decades, implementing two forms of school choice: a) an inter-district school choice or a unique educational zone (i.e., inter-district choice allows families to send their children to any public school in the district where they reside); and b) intra-district school or a zoning model (i.e., in intra-district open enrollment, families may choose to send their children to any type of school located within their resident school district). The Government of the region where this study was conducted (i.e., Community of Aragon) introduced the intra-district school choice policy (i.e., zoning model), where two models of school management (public and private) coexist. One of the defining characteristics of the schooling system in the Community of Aragon is its dual nature, consisting of a predominantly public sector provision, but with a substantial private sector. Public schools in Spain are open and lay centers, directly funded and managed by the central government and local administrations. However, private schools, within the limits established by law, have complete freedom of management. Enrollment limits and access are established by the private company that manages the center. Their funds depend exclusively on the contributions of the students' families.

The zoning model establishes a zonal structure in each municipality, and consequently, each of these zones or districts is assigned one public school and a private school if it exists in that area. Public schools are almost always within that zone, but it doesn't have to be that way for private schools (Decree-Law, 2016). This model allows families to freely choose a school (i.e., private or public). But, these school policies could influence children's transportation. School choice should be considered as a possible cause of longer journeys, and greater variation in transportation modes to and from school (Wilson et al., 2010; Yang et al., 2012).

Even so, within the Spanish state education system, children usually attend the school nearest to home (i.e., usually a public school) at both primary and secondary level. At primary level, the school is often within walking distance of home, while at secondary level, the nearest school may be some distance away, so pupils often travel to school on the school bus (Mayor, 2017).

Taken together, school choice has two different implications: a) education, and b) public health, transport and sustainability. Education is a key factor in enhancing equal opportunities, social mobility, and social cohesion. School choice will reduce the opportunities for students from different racial and socioeconomic backgrounds to interact and learn from each other. School choice is associated with higher levels of segregation of pupils from different socioeconomic and ethnic backgrounds between schools (Dronkers et al., 2010). From a public health, transport and sustainability perspective, can contribute to meeting physical activity guidelines, less congestion, and lower greenhouse gas emissions (Barnett, et al., 2019; Ewing, et al., 2004; McDonald, 2007; OECD, 2012).

The influence of school choice (public vs, private school) on ACS behavior occurs through two paths. First, it affects ACS via its connection with environmental factors, such as home-school distance (i.e., free school choice normally implies longer school commute distances because children attend schools anywhere in the district rather than in their neighborhood). Distance plays an important role in mode and frequency of ACS (i.e., long distances to school imply a low likelihood of adopting active transport practices) (Lee et al., 2008). Further, identifying the threshold distance below which young people are more likely to walk to school seems to be an important issue, because the walkable distance from home to school could be a context-specific variable to be considered (Chillón, et al., 2015). In other Spain context, the threshold distance to walk to school was 0.88 km for elementary school children (7–12 years old) (Rodríguez-Rodríguez et al., 2019). However, it is important identify the walkable distance from home to school in our specific context (e.g., our city, our neighborhood…) due to it could be also influenced by the urban planning and the cultural perception (Larouche et al., 2015). Second, school choice could affect parents' school travel decision-making process and may even influence their attitudes towards ACS (Yang et al., 2012). There is a growing body of evidence that parental attitudes are also critical determinants of children's school travel mode (Seraj, et al., 2012). Parents' negative perceptions of active travel, and neighborhood safety, strongly reduce the likelihood of their children participating in ACS (Mitra & Buliung, 2014). Specifically, when parents have more positive attitudes toward ACS, and negative attitudes toward car-use, they should be more likely to allow their children to walk or bike to school.

The available and limited empirical research suggests that school choice allows students to attend schools that are further away from their residences, resulting in longer travel distances, and a greater demand for motorized travel. (Yang, et al., 2012). But, this relationship between school choice and school travel cannot be completely explained only by the long travel distance, usually associated with free school choice (Wilson et al, 2010). Therefore, school choice policy is a possible cause of longer journeys and greater variation in transportation modes for journeys to school (Yang et al., 2012). Thus, there is a need to study how school choice could be affecting children's ACS in different contexts, as well as how it could be influenced by other closely-related variables. To our knowledge, this is the first study conducted in Spain on ACS in the light of school choice. This research adds a different perspective to current literature in terms of understanding the decline of active commuting, the increase in length of journeys, and some consequences (i.e., CO2 emissions) by linking travel distance and other related variables to school choice in Spanish primary education.

The aim was to study the implications of school choice (i.e., private or public) for ACS. More specifically, we examined if there were differences in ACS, parental attitudes towards ACS, family socioeconomic status (SES) and CO2 emissions by school type (i.e., public or private primary education schools) and threshold distance to school. Furthermore, we analyzed if the threshold distance, parental attitudes and family SES were associated with the frequency of ACS by the type of school.

## 2. Material and methods

### 2.1. Setting, participants and procedures

This study was conducted in the city of Huesca, a mid-sized city located in the north-east of Spain. It has 53,132 inhabitants and an urban area of 6.75 km2 (4.21 km2 without the industrial area), with a population density of 7,762.8 inhabitants/km2.

Prior to the start of the study, a meeting was held with all the principals of each of the city's schools, to explain and officially invite their schools to participate and collaborate in the study. From the twelve public and private primary schools in the city of Huesca (8 public and 4 private), eleven primary schools accepted to participate in this study (7 public and 4 private). After obtaining consent from the schools, all students aged 9 to 11 years old from all primary education schools and their parents (i.e., mother and father, separately), were invited to participate in this study. All parents (mothers and fathers) and children

were informed about the aims of the study, and about the anonymity conditions of the data compilation process, by invitational letter and initial meeting, respectively. Invitational letters, including an in-depth explanation of the study, were sent to parents, who gave their informed consent following opt-out or opt-in procedures based on the school's preference.

Data were collected from students and parents through self-reporting questionnaires. Students completed a questionnaire during class-time under the supervision of the research staff. It took 15–30 min to complete the questionnaire, depending on the children's age, and their reading and comprehension skills. Parents (i.e., mother and father, separately) completed the questionnaire at home, and then their children returned it to the respective schools. The study was approved by the Ethics Committee for Clinical Research of Aragon (CEICA) (Ethic code: C1P117/0018).

### 2.2. School zoning model

Educational authorities of Huesca have implemented an intra-district school zoning model comprising eight different zones (see Fig. 1). Every zone has been assigned to one public school (usually inside the geographical zone) and to one private school (sometimes outside the geographical zone), by default. Nevertheless, families who live in each zone do not have to compulsorily choose the assigned public or private school; they may freely choose any other school in the city. But, there are some priority criteria to allocate a school, including (from the highest to lowest score): a) attendance of siblings at the same school; b) proximity to family home (i.e., living within the school zone assigned); c) parents or guardians working in the school or proximity of the job place (i.e., within the school zone assigned); d) low socioeconomic status with special attention to large families; e) existence of students', parents' or siblings' disability. All public and private schools follow the same criteria. Each criterion has a score and each family should choose 4 schools in preference. Finally, a ranking is established where the total score obtained by each family is included. If the families' demand is greater than the supply of places, the families that are not allocated places are distributed among other schools in the order that they established in their application, also respecting the order provided by the assigned score (Decree-Law, 2016).

### 2.3. Variables

#### 2.3.1. Sociodemographic variables.

Sociodemographic variables (i.e., gender, age, school zip code, and home address), were self-reported. School type was used to classify students according to the type of school (i.e., public or private school).

The objective measure of the distance to school was estimated using Google Maps, selecting the shortest route on foot option and car option (i.e., only used for CO2 analysis) between the home address and the school's main entrance.

To calculate the specific coordinates of the family home and school addresses, the National Cartographic System webpage was used (see at http://www.cartociudad.es/portal/web/guest/calculos).

#### 2.3.2. Usual mode of commuting and ACS Frequency.

Similar to previous studies (Villa-González et al., 2016) the usual mode of commuting to/from school was assessed by asking the following questions: 'How do you usually commute from home to school?' and 'How do you usually commute from school to home?' The answer options were walking, cycling, by car, motorcycle, or bus. Walking and cycling were categorized as usual active transport modes whereas travelling by car, motorcycle or bus were categorized as usual passive transport modes. Accordingly, participants were categorized as: (1) usual active commuters (i.e., having usual active transport mode to and from school, or (2) usual passive commuters (i.e., less than two usual active transport modes).

Usual weekly frequency of ACS to and from school of the weekday period (Monday to Friday) was expressed as the number of active trips per week to and from school. Children self-reported all their weekly trips to and from school using a single item from a validated school travel questionnaire (Chillón, et al., 2017) for each travel day: "How do you commute to school on 'Mondays'?" and "How do you commute from school on 'Mondays'?", repeating this question for every weekday. The answer options were walking, cycling, by car, motorcycle, or bus. Walking and cycling were categorized as active trips. All weekly active trips were summed into a single variable ranging from 0 to 10.

#### 2.3.3. Socioeconomic status

Socioeconomic status (SES) was reported by parents using the Family Affluence Scale (FAS II) questionnaire for children (Currie, et al., 1997). FAS II included four items and they were answered by parents from their children's perspective: (1) Car: does your family own a car, van, or truck? (Codes: No = 0; One = 1; Two or more = 3); (2) Own bedroom: do you have your own bedroom for yourself? (Codes: No = 0; Yes = 1); (3) Vacation: during the past 12 months, how many times have you gone on vacation with your family? (Codes: Never = 0; Once = 1; Twice = 2; Three or more times = 3); and (4) Computers: how many computers does your family own? (Codes: None = 0; One = 1; Two = 2; Three or more = 3). Family affluence was calculated by the summation of answers into a scale from 0 to 9.

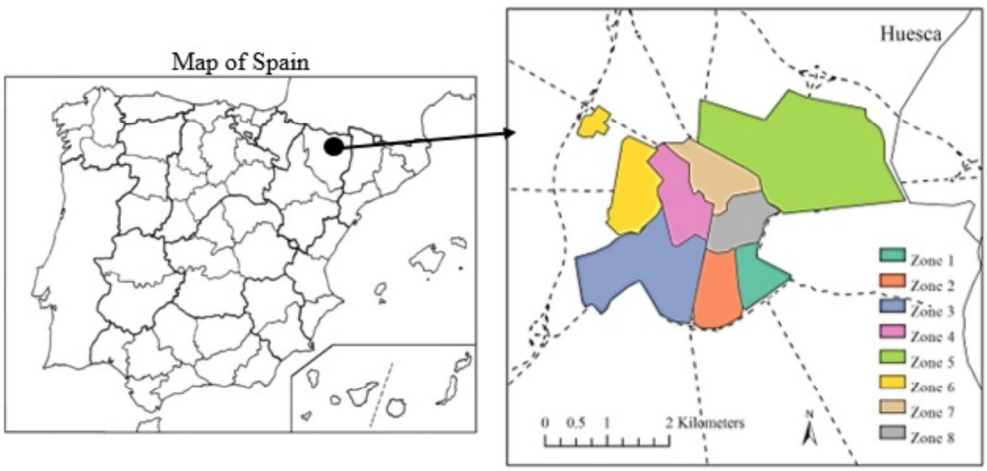


**Fig. 1.** Location of Huesca in Spain and distribution of school zones.

#### 2.3.4. Mother's and Father's attitudes

Based on previous studies investigating attitudinal factors in travel behavior (Mandic et al., 2016; Panter et al., 2010), we developed ten questions (see in Appendix 1) to assess parents' attitudes toward ACS (i.e., responsibility, convenience, and children skills). A five-point Likert-scale was used, ranking from 1 (strongly disagree) to 5 (strongly agree). There were 6 items that were reverse-coded (see in Appendix 1). The average score of the 10 items (ranging from 0 to 5) was calculated for mothers and fathers.

#### 2.3.5. Estimated CO2 emissions

Similar to previous studies (Singleton, 2014), CO2 emissions (kg/km) were estimated by multiplying the distance (i.e., shortest distance driving a car –kilometers– between home address and the school's main entrance) and frequency of passive trips (i.e., number of car trips) between locations. These total kilometers traveled by car were multiplied by the average CO2 (Kg of CO2/Km) attributed to specific modes of transport (i.e., car) according to The Guide To Low Carbon Lifestyles (Mitchell, 2007).

### 2.4. Statistical analysis

Percentages of usual active commuters and differences by gender, type of school and age in the usual mode of commuting for the total sample were tested using Chi-square test (i.e., gender and type of school) and t-student analysis (i.e., age).

Threshold distance for active commuting was calculated using the Receiver Operating Characteristic (ROC) curve analysis, based on the mode of commuting to school (active vs. passive), and the distance from home to school, similar to a previous study (Zaragoza et al., 2019). The Younden Index (Schisterman, 2005) was calculated to identify the threshold distance that best distinguishes active from passive commuters. The area under the curve values of 0.90 is considered excellent, 0.80 to 0.89 good, 0.70 to 0.79 fair, and<0.70 poor (Metz, 1978).

Percentages of usual active commuters for each school were calculated. Every active (i.e., represented as a point in Fig. 2) and passive commuter (i.e., represented as a triangle in Fig. 2) child for each school were then represented on maps (see Fig. 2). Differences by schools in usual mode of commuting were tested using Chi-square test, and distance and socioeconomic status were examined with t-student analysis.

Differences in weekly frequency of ACS, mother's attitudes, father's attitudes, distance, socioeconomic status, and estimated CO2 emission by type of school were analyzed using one-way analysis of variance. All these differences were explored in the total sample and in three different subsamples (i.e., students living above the threshold distance, below the threshold distance, and for the total sample).

First of all, we initially considered the nested nature of data at the very beginning of the study. However, after conducting two initial null models (i.e., one for public schools and another for private schools), ICC values (0.079; p = .112 for public schools; 0.0004; p = .921 for private schools) showed that a two-level multilevel structure (i.e., student and school) was not required. Then, two different stepwise linear regression models (i.e., one for public schools and another for private schools) were used to test the influence of parent's attitudes to ACS (i.e., mothers and fathers), distance and socioeconomic status on weekly frequency of ACS. Moreover, age and gender were also included as control variables in both models. The Nagelkerke R Square values were provided as a goodness-of-fit measure.

A low percentage of missing values were found in fathers' and mothers' attitudes (i.e., 0.45% fathers and 12.45% mothers). Those individuals (fathers = 3; mothers = 139) with missing values in the other parent' attitude were omitted for the regression analysis. Finally, $n$ = 655 fathers and mothers had both attitude values and were included in the analysis.

All significant levels were established at $p < .05$. All analyses were conducted using SPSS V.26 and ArcGISpro v. 2.4.

## 3. Results

A total sample of 800 children (i.e., *Mean* age = 10.60 *Standard Deviation*=0.92; 52.0% girls), and the majority of their parents (i.e., n = 795 mothers, n = 658 fathers) were recruited. From the total sample of children (n = 800), the percentage of usual active commuters to school was 67.9% (i.e., n = 543). We found significant differences ($p < .05$) in the percentage of active commuters in public (i.e., 79.2%) versus private schools (i.e., 53.25%). No significant differences in usual active commuters were found in the total sample, according to age (p = .661) or gender (p = .393).

The ROC curve analysis showed a threshold distance of 725 m (area under the curve: 0.834; $p < .000$), below which 59.3% (i.e., n = 474) of the total sample lived. Of the children who lived above the threshold distance, 41.7% (i.e., n = 136) were classified as usual active commuters, whilst 85.9% (i.e., n = 407) of the children, who lived below the threshold distance, were classified as usual active commuters.

Fig. 2 shows the distribution of usual active commuters according to schools. In most cases, we found significant differences ($p < .05$) between all public and private schools, except in the percentage of usual active commuters between Public Schools F/D and all private schools ($p > .05$).

Mothers of Public School F significantly reported ($p < .05$) higher socioeconomic status (i.e., M = 10.80, DT = 1.29) than mothers of Public School C (i.e., $M = 9.39$, $SD = 1.56$). Children who belonged to Public School D showed a significantly ($p < .05$) higher distance (i.e., $M = 751$, $SD = 493$) from home to school than children who belonged to Public School G (i.e., $M = 384$, $SD = 344$).

As shown in Table 1 there were statistically significant differences between public and private school for students who lived above the threshold distance in frequency of ACS (p = .010), and mother's attitudes (p = .034). Furthermore, there are statistically significant differences in the CO2 emissions between public and private school students in total sample (p = .000).

Table 2 shows the results of the two linear regression models (i.e., one for each type of school). For public schools, the final model showed statistically significant influence from distance and socioeconomic status (negative influence), and from mother's attitudes (positive influence) on weekly frequency of ACS. For private schools, the final model showed statistically significant influence from distance (negative influence), from mother's attitudes (positive influence) and gender (i.e., higher odds of ACS in girls) on weekly frequency of ACS.

The fathers' attitudes became statistically non-significant in both public and private school samples. For the public school model, the Nagelkerke $R^2$ increased from 0.37 in model 1, to 0.41 in model 2, and to 0.42 in model 3, including mother's attitudes and socioeconomic status, respectively. Meanwhile, for the private school model, the Nagelkerke $R^2$ increased from 0.49 in model 1 to 0.54 in model 2, and to 0.55 in model 3 after including the mothers' attitude variable and gender variable (i.e., girl).

## 4. Discussion

This study was designed to produce novel insights into the implication of school choice in primary education for ACS, CO2 emission as a consequence of car use, and some closely-related variables with ACS, in a small city in the north of Spain. Our objective was mainly to study the implications of school choice (i.e., private or public) for ACS. More specifically, we have analyzed, a) if there were differences on ACS, parental attitudes to actively commute, SES and CO2 emissions by type of school and the threshold distance to active commute and b) if distance, parents' attitudes, and family socioeconomic status, influence the frequency of ACS by type of school (i.e., public and private primary education schools). Overall, findings showed differences in frequency of ACS, mothers' attitudes, and SES, between students from public and private schools, who lived below the threshold distance of 725 m.

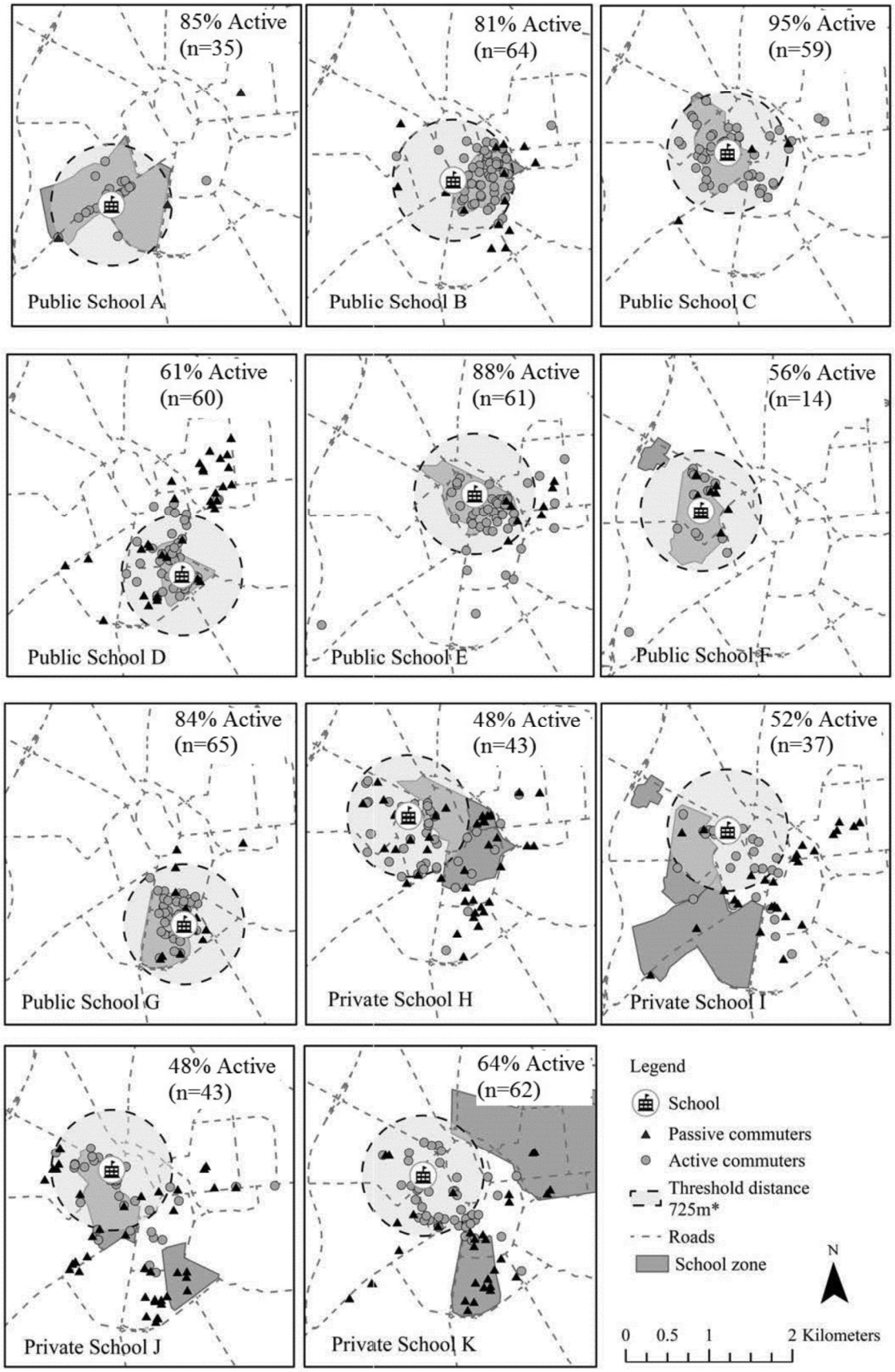


**Fig. 2.** Distribution and percentages of active and passive commuters for the eleven schools of the study.

**Table 1**
Differences in study variables for total sample, and students who lived above and below the threshold distance by type of school.

| Variables | Type of school | N | Mean | SD | F | p |
|---|---|---|---|---|---|---|
| Weekly frequency of active trips | Total | 800 | 7.57 | 3.57 | | |
| Below the threshold | Public | 344 | 9.24 | 1.86 | 1.68 | 0.094 |
| | Private | 130 | 8.84 | 2.44 | | |
| Above the threshold | Public | 108 | 6.14 | 4.32 | 6.67 | **0.010** |
| | Private | 218 | 4.90 | 3.91 | | |
| Total sample | Public | 452 | 8.50 | 2.97 | 75.68 | **0.000** |
| | Private | 348 | 6.38 | 3.92 | | |
| Distance from school (m) | Total | 800 | 752 | 534 | | |
| Below the threshold | Public | 344 | 387 | 167 | 3.82 | 0.051 |
| | Private | 130 | 422 | 184 | | |
| Above the threshold | Public | 108 | 1183 | 489 | 5.91 | **0.016** |
| | Private | 218 | 1312 | 430 | | |
| Total sample | Public | 452 | 577 | 439 | 129.21 | **0.000** |
| | Private | 348 | 979 | 560 | | |
| Socioeconomic status | Total | 800 | 10.19 | 1.62 | | |
| Below the threshold | Public | 344 | 10.08 | 1.54 | 2.68 | 0.102 |
| | Private | 130 | 10.35 | 1.58 | | |
| Above the threshold | Public | 108 | 9.58 | 1.60 | 24.63 | **0.000** |
| | Private | 218 | 10.55 | 1.67 | | |
| Total sample | Public | 452 | 9.96 | 452 | 19.72 | **0.000** |
| | Private | 348 | 10.47 | 348 | | |
| Mothers' attitudes | Total | 795 | 4.04 | 0.67 | | |
| Below the threshold | Public | 341 | 4.17 | 0.58 | 0.893 | 0.345 |
| | Private | 129 | 4.23 | 0.58 | | |
| Above the threshold | Public | 107 | 3.94 | 0.75 | 4.526 | **0.034** |
| | Private | 218 | 3.76 | 0.69 | | |
| Total sample | Public | 448 | 4.12 | 0.64 | 14.81 | **0.000** |
| | Private | 347 | 3.93 | 0.69 | | |
| Fathers' attitudes | Total | 658 | 3.97 | 0.73 | | |
| Below the threshold | Public | 284 | 4.14 | 0.64 | 0.348 | 0.556 |
| | Private | 106 | 4.19 | 0.63 | | |
| Above the threshold | Public | 83 | 3.70 | 0.88 | 0.020 | 0.887 |
| | Private | 185 | 3.69 | 0.72 | | |
| Total sample | Public | 367 | 4.04 | 0.72 | 9.241 | **0.002** |
| | Private | 291 | 3.87 | 0.73 | | |
| CO2 emission (kg/km) | Total | 800 | 0.872 | 2.27 | | |
| Below the threshold | Public | 344 | 0.119 | 0.359 | 3.62 | 0.058 |
| | Private | 130 | 0.275 | 1.40 | | |
| Above the threshold | Public | 108 | 1.97 | 4.78 | 0.08 | 0.778 |
| | Private | 218 | 1.87 | 1.91 | | |
| Total sample | Public | 452 | 0.562 | 2.48 | 19.71 | **0.000** |
| | Private | 348 | 1.27 | 1.90 | | |

Note. SES range 0 (low)-13 (high) score. Mothers' and fathers' attitude range 1 (bad attitudes towards ACS of their children) −5 (great attitudes towards ACS of their children) score.

Among students living below the threshold distance, those from public schools, had higher rates of frequency of ACS, and higher values of mothers' attitudes towards ACS, than those from private schools. In contrast, students who lived below the threshold distance and attended private schools, were associated with having higher family SES than students attending public schools. Further, effects of school choice on weekly frequency of ACS behavior appear to be mostly explained by their connection with travel distance, SES and mothers' attitudes towards ACS, in the case of students attending public schools. Meanwhile, for students attending private schools, the final model only showed a significant influence of distance, mothers' attitudes, and gender (i.e., be a girl) on weekly frequency of ACS.

Similarly to previous studies (Merom, et al., 2006), our results suggest that students who attend public schools, are more likely to actively commute to school than those who attend private schools. Investigation of the relationship between school type and ACS has focused on the analysis that school choice (private vs. public) allows parents and students to attend schools farther from their home than neighborhood schools, resulting in longer travel distances and greater demand for car travel (Yang, et al., 2012; Steiner et al, 2006). Specifically, the differences are more evident in the case of private schools in some countries, with almost four times the average home-school distance in comparison to public schools (Torres, et al., 2010). In the city of Huesca, private schools are not distributed around the city in a homogenous way, in fact, they are placed together in the same peripheric area. The distance that children are currently willing to walk to school (i.e., threshold distance) differs between contexts (D'Haese et al., 2011; Merom, et al., 2006; Rodríguez-López, et al., 2017). For example, 875 m has been evidenced as a walkable distance to commute to school in Spanish children (Rodríguez-López, et al., 2017) and specifically, 725 m in our city research context. According to Rodríguez-Rodríguez, et al. (2019), the use of private transportation (i.e., own car) to and from school, seems to be higher in big urban areas than in small cities like Huesca, because the conditions for ACS in small cities are more favorable (e.g., shorter distance from home to school), increasing the possibilities of using active transport modes (Ikeda et al., 2019; Mota et al., 2007). This may suggest that effects of school choice on ACS, could be not completely explained by travel distance, typically associated with private school (Wilson et al, 2010). In this sense, private schools could solve distance problem, implementing promotion ACS programs that incorporate strategies oriented towards different variables (i.e., personal and environmental). Promoting cycling use through these programs could help dismissing distance problem, due to cycling' threshold distance could be higher than walk threshold distance, as it happens with Spanish university students (Chillón et al., 2016). In this sense, Yang et al. (2012), indicated that school type affects ACS via environmental factors as home-school distance, but also, could affect parents' attitudes to use ACS. The transport mode adopted by students for their daily commuting to school, has implications for CO2 emissions (Singleton, 2014). Therefore, rates of ACS and as a consequence, traffic volumes during school commuting times, could be influenced by school choice (Keall et al., 2020). Our study shows that pupils attending private schools travel, on average, further to school, with lower rates of active transport and, consequently, higher average CO2 in kg/km travelled. As Bearman and Singleton (2014) proposed, our results showed that CO2 emissions seem to be higher in the area around private schools than public schools, regardless of the threshold distance. These data support some previous studies in

**Table 2**
Regression models on weekly frequency of ACS for each type of school.

| | | MODEL 1 | | | MODEL 2 | | | MODEL 3 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | B | $\beta$ | $p$ | B | $\beta$ | $p$ | B | $\beta$ | $p$ |
| Public | Constant | 10.76 | | <0.001 | 6.71 | | <0.001 | 8.53 | | <0.001 |
| | Distance | -0.004 | -0.607 | <0.001 | -0.004 | -0.565 | <0.001 | -0.004 | -0.566 | <0.001 |
| | Mothers' attitudes | | | | 0.941 | 0.197 | <0.001 | 0.993 | 0.208 | <0.001 |
| | SES | | | | | | | -0.203 | -0.105 | 0.010 |
| Private | Constant | 11.20 | | <0.001 | 4.69 | | <0.001 | 4.49 | | <0.001 |
| | Distance | -0.005 | -0.701 | <0.001 | -0.004 | -0.586 | <0.001 | -0.004 | -0.583 | <0.001 |
| | Mothers' attitudes | | | | 1.45 | -0.254 | <0.001 | 1.41 | 0.246 | <0.001 |
| | Gender | | | | | | | 0.635 | 0.081 | 0.04 |

Note. Males are the reference group. B: non-standardized coefficient. $\beta$: standardized coefficient.

this field (Van Ristell et al. 2013), that defend more sustainable 'neighborhood schools', where pupils are assigned to the nearest school, thus minimizing travel distance and increasing the prevalence for active transport.

The predictors of ACS are complex and conditioned not only by environmental factors, but also by school-level factors, as well as individual or household characteristics (Easton and Ferrari, 2015). Our findings support the hypothesis that the effects of school choice on ACS are further explained by family factors like SES (i.e., in this study, only in the case of public schools), demographical factors like gender (i.e., in this study, only in the case of private school), attitudinal variables (i.e., mothers' attitudes), and not only by environmental variables, such as distance (Mah et al., 2017).

The type of school could reflect specific characteristics of the families (e.g., parents' professional or educational level). Our data showed that attending private schools was associated with having higher family SES. However, our study also showed that higher SES predicted lower frequency of ACS in public school students. This variable seems to be inversely related to ACS in Spanish youth (Chillon et al., 2009). Similar findings have also been reported in European children (Cooper et al., 2005, 2003). For example, Mehdizadeh et al. (2018) reported that children from households with a higher income, are more likely to travel to school by car. It seems that the influence mechanisms of SES on ACS need to be further investigated, considering the potential mediator effects of inter- and intra-personal factors (e.g., socio-demographic characteristics, social support), and environmental factors (e.g., distance, traffic safety, etc.) (Cerin et al., 2009).

Gender plays a role in commuting behavior and varies across geographic contexts. Studies carried out in Spain have shown inconclusive results. While some studies reported that gender is not associated with the frequency of active trips to school (Villa-Gonzalez et al., 2012; Zaragoza et al., 2020), others (Chillón et al., 2009), showed that ACS levels were higher among the Spanish females compared with their male peers. Similar to previous studies, our results suggest that girls are more active commuters than boys but only, in the case of private schools. Similar findings have also been reported in European (Cooper et al., 2003, 2005) and in American children (Sirard et al., 2005). However, the opposite pattern has been shown in Australian children (Timperio et al., 2006) where a greater proportion of boys commuted actively to school compared with girls. Commuting to/from school is a daily activity highly influenced by environmental and cultural factors, that are specific for each country and geographical area (Faulkner et al., 2009). Some study has proposed security as a possible cause of gender differences in ACS (Chillón et al., 2013). Further research should be conducted to explore in depth this issue.

According to McMillan (2007), attitudes influence the travel mode choice more than the attributes of the built environment. Parental attitudes have been identified as a key factor that influences active transport, especially in terms of travel to school (Kerr, et al., 2006; Pont et al., 2011). Further, school type appears to be related to parents' consideration about the choice of an active school travel mode. We found that, in contrast to parents who sent their children to public schools, parents of private school students tended to give less consideration (i.e., attitudes) towards ACS. According to literature, several factors can influence parental attitudes towards children's ACS (e.g., children's age and gender, school type, household attributes, built environment attributes) (Merom et al., 2006; Sirard and Slater, 2008). Our results suggest that school choice (i.e., public or private schools) could be related to parents' attitude toward ACS, specifically to mothers' attitude, but it is necessary further investigation to clarify it.

Moreover, the effects of school choice policy on weekly frequency of ACS behavior appear to be mostly explained by its connection with mothers' attitudes towards ACS, both in students who attend public and private schools. This could suggest that, in the context of school choice, the mothers' positive attitude toward ACS has a major impact on ACS behavior. Accordingly, there is growing evidence indicating that the mother's traits have a higher influence than father's on several behaviors (Schoeppe et al.,2017). One possible explanation is that mothers spend more time at home with their offspring (Aranceta, et al., 2003), and therefore, their role in the family structure is still as the primary caregiver (Schoeppe et al., 2017), which could have a greater influence on their children's attitudes and behaviors. Some studies reveal that escorting is shared unequally between mothers and fathers, even when both parents are earners, women do more of the chauffeuring, because they are considered to be the primary caregivers for the children (Schwanen, 2007). Also, in Spain and more specifically in the city of Huesca, women in dual-earner households tend to have jobs with shorter and more flexible working hours, jobs that are closer to home and that allow them to do most of the caregiving and escorting for the children (Schuh et al., 2019).

The findings of this study should be interpreted in light of the following limitations. Our study context may not fully represent other contexts, and the generalization of our research results may be limited. The unique setting of Huesca may limit generalizability of findings to other Spanish cities and other countries with different characteristics and school enrollment policies. Another limitation includes the use of self-reported measures of ACS, which are frequently under/overestimated (McCormack et al., 2008). Despite this limitation, we have used the children's ACS questionnaire that has proven acceptable validity (Herrador-Colmenero et al., 2014). Despite these limitations, this study has an important strength, such as including a large representative sample of students aged 9 to 11 years old, and their parents (i.e., mother and father, separately) from almost all primary education schools from one city in Spain (91.6% participation rate between the schools).

## 5. Conclusions

The effects of school choice on weekly frequency of ACS behavior appear to be partially explained by environmental conditions (i.e., distance), mothers' attitudes and SES (only in public schools). In addition, school choice may have substantial implications for ACS (e.g., such as adverse health impacts on children due to a reduction in physical activities, increased reliance on motorized transport, and greenhouse gas emissions. Promoting ACS should require a coordination of efforts among institutions (e.g., schools, university, police, healthcare…) and extensive collaboration among educational policy-makers and urban designers, to increase rates of ACS.

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## CRediT authorship contribution statement

**Ana Corral-Abós:** Formal analysis, Resources, Writing - original draft, Writing - review & editing. **Alberto Aibar:** Methodology, Writing - review & editing. **Sergio Estrada-Tenorio:** Writing - review & editing. **Jose Antonio Julián:** Conceptualization, Investigation. **Eduardo Ibor:** Conceptualization, Investigation. **Javier Zaragoza:** Conceptualization, Methodology, Resources, Writing - review & editing, Supervision.

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## Appendix 1. . Questionnaire on parents' attitudes

1-Strongly disagree 2-Somewhat disagree 3-I am not clear 4-Somewhat agree 5-Strongly agree

| Indicate whether or not you agree with these phrases. | | | | | |
|---|---|---|---|---|---|
| - *It is very convenient to take my child to school by car. | 1 | 2 | 3 | 4 | 5 |
| - I am usually willing to walk with my child to school | 1 | 2 | 3 | 4 | 5 |
| - It is interesting for my child to walk to school alone or with friends | 1 | 2 | 3 | 4 | 5 |
| -*It is dangerous for my child to walk to school alone or with friends | 1 | 2 | 3 | 4 | 5 |
| -*I think it is useless (it is useless) for my child to walk to school alone or with friends | 1 | 2 | 3 | 4 | 5 |
| -*It is irresponsible for parents to allow their children to walk to school alone, without being accompanied by adults | 1 | 2 | 3 | 4 | 5 |
| -*I think the most responsible thing is for parents to take their children to school by car | 1 | 2 | 3 | 4 | 5 |
| -*I think that the most responsible thing is for parents or an adult to walk with their children to school | 1 | 2 | 3 | 4 | 5 |
| - I think it is important for my son to develop skills to walk to school alone | 1 | 2 | 3 | 4 | 5 |
| - I am sure that my son has the ability to walk to school alone, without an adult | 1 | 2 | 3 | 4 | 5 |

Note: * Items with reverse coded.

## References


Aranceta, J., Perez-Rodrigo, C., Ribas, L., Serra-Majem, L.L., 2003. Sociodemographic and lifestyle determinants of food patterns in Spanish children and adolescents: the enKid study. Eur. J. Clin. Nutr. 57 (1), S40–S44. https://doi.org/10.1038/sj.ejcn.1601813.

Barnett, A., Akram, M., Sit, C.H.P., Mellecker, R., Carver, A., Cerin, E., 2019. Predictors of healthier and more sustainable school travel mode profiles among Hong Kong adolescents. Int. J. Behav. Nutr. Phys. Act. 16 (1), 48–64. https://doi.org/10.1186/s12966-019-0807-4.

Bearman, N., Singleton, A.D., 2014. Modelling the potential impact on CO2 emissions of an increased uptake of active travel for the home to school commute using individual level data. J. Transp. Health 1 (4), 295–304. https://doi.org/10.1016/j.jth.2014.09.009.

Beck, L.F., Nguyen, D.D., 2017. School transportation mode, by distance between home and school, United States, *ConsumerStyles* 2012. J. Saf. Res. 62, 245–251. https://doi.org/10.1016/j.jsr.2017.04.001.

Cerin, E., Leslie, E., Owen, N., 2009. Explaining socioeconomic status differences in walking for transport: an ecological analysis of individual, social and environmental factors. Soc. Sci. Med. 68 (6), 1013–1020. https://doi.org/10.1016/j.socscimed.2009.01.008.

Chillón, P., Evenson, K.R., Vaughn, A., Ward, D.S., 2011. A systematic review of interventions for promoting active transportation to school. Int. J. Behav. Nutr. Phys. Act. 8 (1), 10–27. https://doi.org/10.1186/1479-5868-8-10.

Chillón, P., Herrador-Colmenero, M., Migueles, J.H., Cabanas-Sánchez, V., Fernández-Santos, J.R., Veiga, Ó.L., Castro-Piñero, J., Marcos, A., Marcos, A., Veiga, O.L., Castro-Piñero, J., Bandrés, F., Martínez-Gómez, D., Ruiz, J.R., Carbonell-Baeza, A., Gomez-Martinez, S., Santiago, C., Marcos, A., Gómez-Martínez, S., Nova, E., Díaz, E. L., Zapatera, B., Veses, A.M., Mujico, J.R., Gheorghe, A., Veiga, O.L., Villagra, H.A., del-Campo, J., Cordente, C., Díaz, M., Tejero, C.M., Acha, A., Moya, J.M., Sanz, A., Martínez-Gómez, D., Cabanas-Sánchez, V., Rodríguez-Romo, G., Izquierdo-Gómez, R., Garcia-Cervantes, L., Esteban-Cornejo., I., Castro-Piñero, J., Mora-Vicente, J., Montesinos, J.L.G., Conde-Caveda, J., Ortega, F.B., Ruiz, J.R., Padilla Moledo, C., Carbonell Baeza, A., Chillón, P., del Rosario Fernández, J., González Galo, A., Bellvís Guerra, G., Alfonso, Á.D., Parrilla, F., Gómez, R., Gavala, J., Bandrés, F., Lucia, A., Santiago, C., Gómez-Gallego, F., 2017. Convergent validation of a questionnaire to assess the mode and frequency of commuting to and from school. Scand. J. Public Health 45 (6), 612–620. https://doi.org/10.1177/1403494817718905.

Chillón, P., Martínez-Gómez, D., Ortega, F.B., Pérez-López, I.J., Díaz, L.E., Veses, A.M., Veiga, O.L., Marcos, A., Delgado-Fernández, M., 2013. Six-year trend in active commuting to school in Spanish adolescents. Int. J. Behav. Med. 20 (4), 529–537. https://doi.org/10.1007/s12529-012-9267-9.

Chillón, P., Molina-García, J., Castillo, I., Queralt, A., 2016. What distance do university students walk and bike daily to class in Spain. J. Transp. Health 3 (3), 315–320. https://doi.org/10.1016/j.jth.2016.06.001.

Chillon, P., Ortega, F.B., Ruiz, J.R., Perez, I.J., Martin-Matillas, M., Valtuena, J., Gomez-Martinez, S., Redondo, C., Rey-Lopez, J.P., Castillo, M.J., Tercedor, P., Delgado, M., 2009. Socioeconomic factors and active commuting to school in urban Spanish adolescents: the AVENA study. Eur. J. Public Health 19 (5), 470–476. https://doi.org/10.1093/eurpub/ckp048.

Chillón, P., Panter, J., Corder, K., Jones, A.P., Van Sluijs, E.M.F., 2015. A longitudinal study of the distance that young people walk to school. Health & Place 31, 133–137. https://doi.org/10.1016/j.healthplace.2014.10.013.

Cooper, A.R., Andersen, L.B., Wedderkopp, N., Page, A.S., Froberg, K., 2005. Physical activity levels of children who walk, cycle, or are driven to school. Am. J. Prev. Med. 29 (3), 179–184. https://doi.org/10.1016/j.amepre.2005.05.009.

Cooper, A.R., Page, A.S., Foster, L.J., Qahwaji, D., 2003. Commuting to school: are children who walk more physically active? Am. J. Prev. Med. 25 (4), 273–276. https://doi.org/10.1016/S0749-3797(03)00205-8.

Currie, C.E., Elton, R.A., Todd, J., Platt, S., 1997. Indicators of socioeconomic status for adolescents: the WHO Health Behaviour in School-aged Children Survey. Health Educ. Res. 12 (3), 385–397. https://doi.org/10.1093/her/12.3.385.

D'Haese, S., De Meester, F., De Bourdeaudhuij, I., Deforche, B., Cardon, G., 2011. Criterion distances and environmental correlates of active commuting to school in children. Int. J. Behav. Nutr. Phys. Act. 8 (1), 88. https://doi.org/10.1186/1479-5868-8-88.

Dombriz, M.A., 2009. Urbanismo y movilidad: dos caras de la misma moneda. [Urban planning and mobility: two sides of the same coin]. Ingeniería y Territorio 86, 4–9. http://dialnet.unirioja.es/servlet/articulo?codigo=2994250.

Dronkers, J., Felouzis, G., van Zanten, A., 2010. Education markets and school choice. Educ. Res. Eval. 16 (2), 99–105. https://doi.org/10.1080/13803611.2010.484969.

Easton, S., Ferrari, E., 2015. Children's travel to school—the interaction of individual, neighbourhood and school factors. Transp. Policy 44, 9–18. https://doi.org/10.1016/j.tranpol.2015.05.023.

European Union (2016). Urban Europe statistics on cities, towns and suburbs (2016). Eurostat. Luxembourg: Publications office of the European Union. https://ec.europa.eu/eurostat/documents/3217494/7596823/KS-01-16-691-EN-N.pdf/0abf140c-ccc7-4a7f-b236-682effcde10f.

Union, E., 2019. Promoting Active Modes of Transport. A Policy Brief from the Policy Learning Platform on Low-carbon economy, European Regional Fund (Interreg Europe) https://www.interregeurope.eu/fileadmin/user_upload/plp_uploads/policy_briefs/TO4_PolicyBrief_Active_Modes.pdf.

Ewing, R., 2003. Travel and environmental implications of school siting. US Environmental Protection Agency, Washington, DC https://doi.org/10.13016/M2901ZK8W.

Ewing, R., Schroeer, W., Greene, W., 2004. School location and student travel analysis of factors affecting mode choice. Transp. Res. Rec. 1895 (1), 55–63. https://doi.org/10.3141/1895-08.

Faulkner, G.E., Buliung, R.N., Flora, P.K., Fusco, C., 2009. Active school transport, physical activity levels and body weight of children and youth: a systematic review. Prev. Med. 48 (1), 3–8. https://doi.org/10.1016/j.ypmed.2008.10.017.

Gálvez-Fernández, P., Herrador-Colmenero, M., Esteban-Cornejo, I., Castro-Piñero, J., Molina-García, J., Queralt, A., Fernández-Muñoz, S., 2020. Active Commuting to School Among 36,781 Spanish Children and Adolescents: A Temporal Trend Study. Research Square 1–20. https://doi.org/10.21203/rs.3.rs-46091/v1.

Garnham-Lee, K.P., Falconer, C.L., Sherar, L.B., Taylor, I.M., 2017. Evidence of moderation effects in predicting active transport to school. Journal of Public Health 39 (1), 153–162. https://doi.org/10.1093/pubmed/fdw016.

Herrador-Colmenero, M., Pérez-García, M., Ruiz, J.R., Chillón, P., 2014. Assessing modes and frequency of commuting to school in youngsters: a systematic review. Pediatric exercise science 26 (3), 291–341. https://doi.org/10.1123/pes.2013-0120.

Ikeda, E., Hinckson, E., Witten, K., Smith, M., 2019. Assessment of direct and indirect associations between children active school travel and environmental, household and child factors using structural equation modelling. Int. J. Behav. Nutr. Phys. Act. 16 (1), 32. https://doi.org/10.1186/s12966-019-0794-5.

Jaraiz-Cabanillas, F.J., Hernandez-Carretero, A.M., Ruiz-Labrador, E.E., Gutierrez-Gallego, J.A., 2018. Propuesta metodológica para la generación de zonas de asignación escolar: fomento de una movilidad sostenible y activa [Methodological proposal for the generation of school assignment areas: promotion of sustainable and active mobility]. Documents d'Analisi Geografica 64 (1), 73–98. https://doi.org/10.5565/rev/dag.359.

Keall, M., Hopkins, D., Coppell, K., Sandretto, S., Bengoechea, E.G., Spence, J., Wilson, G., Mandic, S., 2020. Implications of attending the closest school on adolescents' physical activity and car travel in Dunedin, New Zealand. J. Transp. Health 18, 100900. https://doi.org/10.1016/j.jth.2020.100900.

Kerr, J., Rosenberg, D., Sallis, J.F., Saelens, B.E., Frank, L.D., Conway, T.L., 2006. Active commuting to school: associations with environment and parental concerns. Med. Sci. Sports Exerc. 38 (4), 787–793. https://doi.org/10.1249/01.mss.0000210208.63565.73.

Larouche, R., Sarmiento, O.L., Broyles, S.T., Denstel, K.D., Church, T.S., Barreira, T.V., Chaput, J.-P., Fogelholm, M., Hu, G., Kuriyan, R., Kurpad, A., Lambert, E.V., Maher, C., Maia, J., Matsudo, V., Olds, T., Onywera, V., Standage, M., Tremblay, M. S., Tudor-Locke, C., Zhao, P., Katzmarzyk, P.T., 2015. Are the correlates of active school transport context-specific? International journal of obesity supplements 5 (S2), S89–S99. https://doi.org/10.1038/ijosup.2015.25.

Lee, M.C., Orenstein, M.R., Richardson, M.J., 2008. Systematic review of active commuting to school and children's physical activity and weight. Journal of Physical Activity and Health 5 (6), 930–949. https://doi.org/10.1123/jpah.5.6.930.

Mah, S.K., Nettlefold, L., Macdonald, H.M., Winters, M., Race, D., Voss, C., McKay, H.A., 2017. Does parental support influence children's active school travel? Preventive medicine reports 6, 346–351. https://doi.org/10.1016/j.pmedr.2017.04.008.

Mandic, S., Flaherty, C., Pocock, T., Mintoft-Jones, A., Frater, J., Chillón, P., Bengoechea, E.G., 2016. Attitudes towards cycle skills training in New Zealand adolescents. Transportation research part F: traffic psychology and behaviour 42, 217–226. https://doi.org/10.1016/j.trf.2016.08.002.

Mayor, D. (2017). Effects of School Choice on Students' Mobility: Evidence from Madrid [Master's thesis, Centro de Estudios Monetarios y Financieros (CEMFI) del Banco de España]. https://www.comunidad.madrid/sites/default/files/doc/educacion/sgea_estudio_efecto_incremento_libertad_eleccion_centro_en_movilidad_estud.pdf.

McCormack, G.R., Cerin, E., Leslie, E., Du Toit, L., Owen, N., 2008. Objective versus perceived walking distances to destinations: correspondence and predictive validity. Environment and behavior 40 (3), 401–425. https://doi.org/10.1177/0013916507300560.

McDonald, N.C., 2007. Active transportation to school: trends among US schoolchildren, 1969–2001. Am. J. Prev. Med. 32 (6), 509–516. https://doi.org/10.1016/j.amepre.2007.02.022.

McMillan, T.E., 2007. The relative influence of urban form on a child's travel mode to school. Transportation Research Part A: Policy and Practice 41 (1), 69–79. https://doi.org/10.1016/j.tra.2006.05.011.

Mehdizadeh, M., Nordfjaern, T., Mamdoohi, A., 2018. The role of socioeconomic, built environment and psychological factors in parental mode choice for their children in an Iranian setting. Transportation 45 (2), 523–543. https://doi.org/10.1007/s11116-016-9737-z.

Merom, D., Tudor-Locke, C., Bauman, A., Rissel, C., 2006. Active commuting to school among NSW primary school children: implications for public health. Health & place 12 (4), 678–687. https://doi.org/10.1016/j.healthplace.2005.09.003.

Metz, C. E. (1978, October). Basic principles of ROC analysis. In Seminars in nuclear medicine (Vol. 8, No. 4, pp. 283-298). WB Saunders. https://doi.org/10.1016/S0001-2998(78)80014-2.

Mitchell, M., 2007. The guide to low carbon lifestyles. Devon, The Low Carbon Lifestyle Tour http://www.lowcarbonlifestyle.org.uk/downloadables/TheGuideToLowCarbonLifestyles.pdf.

Mitra, R., Buliung, R.N., 2014. The influence of neighborhood environment and household travel interactions on school travel behavior: an exploration using geographically-weighted models. J. Transp. Geogr. 36, 69–78. https://doi.org/10.1016/j.jtrangeo.2014.03.002.

Mota, J., Gomes, H., Almeida, M., Ribeiro, J.C., Santos, M.P., 2007. Leisure time physical activity, screen time, social background, and environmental variables in adolescents. Pediatric exercise science 19 (3), 279–290. https://doi.org/10.1123/pes.19.3.279.

O'Shaughnessy, T., 2007. Parental choice and school quality when peer and scale effects matter. Economics of Education Review 26 (4), 501–515. https://doi.org/10.1016/j.econedurev.2005.05.009.

OECD, 2012. Equity and Quality in Education: Supporting Disadvantaged Students and Schools. OECD Publishing. https://doi.org/10.1787/9789264130852-en.

Ortúzar, J.D., Willumsen, L., 2008. Modelos de transporte [Transport models]. PubliCan. Universidad de Cantabria, Santander https://leerlaciudadblog.files.wordpress.com/2016/05/ortc3bazar-y-willumsen-modelos-de-transporte.pdf.

Panter, J.R., Jones, A.P., Van Sluijs, E.M., Griffin, S.J., 2010. Attitudes, social support, and environmental perceptions as predictors of active commuting behaviour in school children. J. Epidemiol. Community Health 64 (01), 41–48. https://doi.org/10.1136/jech.2009.086918.

Pont, K., Ziviani, J., Wadley, D., Abbott, R., 2011. The Model of Children's Active Travel (M-CAT): A conceptual framework for examining factors influencing children's active travel. Aust. Occup. Ther. J. 58 (3), 138–144. https://doi.org/10.1111/j.1440-1630.2010.00865.x.

Pozueta, J. & Gurovich, A. (2007). Alternativas al modelo dominante de ciudad dispersa, zonificada y de baja densidad: el caso de los corredores fluviales y la interfaz urbana rural de Madrid y Santiago de Chile [Alternatives to the dominant model of dispersed, zoned and low-density city: the case of river corridors and the rural urban interface of Madrid and Santiago de Chile]. [Investigation report, Project A/4930/06] http://repositorio.uchile.cl/bitstream/handle/2250/118079/AECI-A4930-06.pdf?sequence=1.

Rodríguez-López, C., Salas-Fariña, Z.M., Villa-González, E., Borges-Cosic, M., Herrador-Colmenero, M., Medina-Casaubón, J., Ortega, F.B., Chillón, P., 2017. The threshold distance associated with walking from home to school. Health Education & Behavior 44 (6), 857–866. https://doi.org/10.1177/1090198116688429.

Rodríguez-Rodríguez, F., Pakomio Jara, O., Kuthe, N.M., Herrador-Colmenero, M., Ramírez-Vélez, R., Chillón, P., Zou, Y., 2019. Influence of distance, area, and cultural context in active commuting: Continental and insular children. PLoS ONE 14 (3), e0213159. https://doi.org/10.1371/journal.pone.021315910.1371/journal.pone.0213159.g00110.1371/journal.pone.0213159.g00210.1371/journal.pone.0213159.g00310.1371/journal.pone.0213159.t00110.1371/journal.pone.0213159.t00210.1371/journal.pone.0213159.s001.

Royal Decree-Law 30/2016, 22 March, Government of Aragon, regulating the schooling of students in public and private educational centers arranged in the second cycle of infant education, primary education, special education, compulsory secondary education, high school and vocational training in the Autonomous Community of Aragon. Boletín Oficial de Aragón, 62, de 1 de abril de 2016, 6892-6915. http://www.boa.aragon.es/cgi-bin/EBOA/BRSCGI?CMD=VEROBJ&MLKOB=900407843737&type=pdf.

Schisterman, E.F., Perkins, N.J., Liu, A., Bondell, H., 2005. Optimal cut-point and its corresponding Youden Index to discriminate individuals using pooled blood samples. Epidemiology 16 (1), 73–81. https://doi.org/10.1097/01.ede.0000147512.81966.ba.

Schoeppe, S., Vandelanotte, C., Bere, E., Lien, N., Verloigne, M., Kovács, É., ... & Van Lippevelde, W. (2017). The influence of parental modelling on children's physical activity and screen time: Does it differ by gender? The European Journal of Public Health, 27(1), 152-157. https://doi.org/10.1093/eurpub/ckw182.

Schuh, B., et al., 2019. Research for AGRI Committee – The EU farming employment: current challenges and future prospects, European Parliament, Policy Department for Structural and Cohesion Policies, Brussels. Available. In:http://bit.ly/2qPyjAV.

Schwanen, T., 2007. Gender differences in chauffeuring children among dual-earner families. The Professional Geographer 59 (4), 447–462. https://doi.org/10.1111/j.1467-9272.2007.00634.x.

Seraj, S., Sidharthan, R., Bhat, C.R., Pendyala, R.M., Goulias, K.G., 2012. Parental attitudes toward children walking and bicycling to school: multivariate ordered response analysis. Transp. Res. Rec. 2323 (1), 46–55. https://doi.org/10.3141/2323-06.

Singleton, A., 2014. A GIS approach to modelling CO2 emissions associated with the pupil-school commute. International Journal of Geographical Information Science 28 (2), 256–273. https://doi.org/10.1080/13658816.2013.832765.

Sirard, J.R., Riner, W.F., McIver, K.L., Pate, R.R., 2005. Physical activity and active commuting to elementary school. Med. Sci. Sports Exerc. 37 (12), 2062–2069.

Sirard, J.R., Slater, M.E., 2008. Walking and bicycling to school: a review. American Journal of Lifestyle Medicine 2 (5), 372–396. https://doi.org/10.1177/1559827608320127.

Souza, S., Carvalho, W., Matos, A.P., Silva, A., Oliveira, E., Soares, I., Bezerra, S., Pereira, B., 2019. Modes of commuting to school among 5th and 6th grade schoolchildren. Revista Brasileira de Cineantropometria & Desempenho Humano 21 (e55564), 1–10. https://doi.org/10.5007/1980-0037.2019v21e55564.

Steiner, R.L., Crider, L.B., Betancourt, M., Hall, A.K., Perrotta, T., 2006. Safe ways to school: The role in multimodal planning. The Department of Transportation Systems Planning Office, Florida.

Timperio, A., Ball, K., Salmon, J.o., Roberts, R., Giles-Corti, B., Simmons, D., Baur, L.A., Crawford, D., 2006. Personal, family, social, and environmental correlates of active commuting to school. Am. J. Prev. Med. 30 (1), 45–51. https://doi.org/10.1016/j.amepre.2005.08.047.

Torres, J., Bussière, Y., Lewis, P., 2010. Primary schools' territorial policy and active commuting: Institutional influences in Montreal and Trois-Rivières. J. Urban Plann. Dev. 136 (4), 287–293. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000021.

Van Ristell, J., Quddus, M., Enoch, M., Wang, C., Hardy, P., 2013. Quantifying the transport-related impacts of parental school choice in England. Transportation 40 (1), 69–90. https://doi.org/10.1007/s11116-012-9410-0.

Villa-Gonzalez, E., Rodriguez-Lopez, C., Huertas-Delgado, F.J., Tercedor, P., Ruiz, J.R., Chillon, P., 2012. Personal and environmental factors are associated with active commuting to school in spanish children. Revista De Psicologia Del Deporte 21 (2), 343–349. https://www.redalyc.org/pdf/2351/235126897014.pdf.

Villa-González, E., Ruiz, J.R., Ward, D.S., Chillón, P., 2016. Effectiveness of an active commuting school-based intervention at 6-month follow-up. Eur. J. Public Health 26 (2), 272–276. https://doi.org/10.1093/eurpub/ckv208.

WHO (World Health Organization Regional Office for Europe), 2016. Physical Activity Strategy for WHO European Region 2016–2025. World Health Organization, Copenhagen http://www.euro.who.int/__data/assets/pdf_file/0014/311360/Physical-activity-strategy-2016-2025.pdf?ua=1.

Wilson, E.J., Marshall, J., Wilson, R., Krizek, K.J., 2010. By foot, bus or car: children's school travel and school choice policy. Environ. Plann. A 42 (9), 2168–2185. https://doi.org/10.1068/a435.

Yang, Y., Abbott, S., Schlossberg, M., 2012. The influence of school choice policy on active school commuting: a case study of a middle-sized school district in Oregon. Environ. Plann. A 44 (8), 1856–1874. https://doi.org/10.1068/a44549.

Zaragoza, J., Corral, A., Estrada, S., Abós, Á., Aibar, A., 2019. Active or passive commuter? Discrepancies in cut-off criteria among adolescents. Int. J. Environ. Res. Public Health 16 (20), 3796–3808. https://doi.org/10.3390/ijerph16203796.

Zaragoza, J., Corral, A., Ikeda, E., García-Bengoechea, E., Aibar, A., 2020. Assessment of psychological, social cognitive and perceived environmental influences on children's active transport to school. J. Transp. Health 16, 100839. https://doi.org/10.1016/j.jth.2020.100839.

# Estudio 2. *Active or Passive Commuter? Discrepancies in Cut-off Criteria among Adolescents*

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# Active or Passive Commuter? Discrepancies in Cut-off Criteria among Adolescents

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**Abstract:** Active commuting to school has health implications for young people. Previous research has shown the need to consistently define the concept of "active commuter", given that assessment as well as comparison between studies may be hindered by current discrepancies in frequency criteria. Using a sample of 158 Spanish students (12th–13th grade, 60.8% girls), the current study aimed to compare several cut-off criteria to rigorously identify the frequency of weekly active trips to school in order to categorize adolescents as active or passive commuters, and to analyze whether the threshold living distance to school is associated with the different trip cut-off criteria. Percentages of active commuters ranged from 75% to 88.6%, varying significantly depending on the cut-off criteria (5–10 active trips/week) used. The results also support the need to be stricter in the selection of a cut-off criterion when the distance to the school becomes shorter. Our findings highlight the importance of following a standard criterion to classify individuals as active or passive commuters, considering the characteristics of the context in which each study is conducted.

**Keywords:** active commuting; adolescents; cut-off criteria; distance

## 1. Introduction

Physical inactivity is the fourth leading risk factor of mortality worldwide [1]. The benefits of physical activity (PA) in adolescents are significant and widely accepted [2,3]. However, a vast body of international [4] and Spanish studies [5] showed that most adolescents do not meet international PA recommendations (i.e., 60 min of daily moderate-to-vigorous PA). Therefore, promoting PA in adolescents seems of paramount importance, not only to enhance current health benefits, but also to transfer them into adulthood [6,7].

Active commuting can be a promising strategy to promote PA among adolescents [8], providing an alternative to more traditional PA domains such as sport and exercise [9]. A large body of research has indicated that active commuting plays an important role in increasing the overall PA level in children and youth [10]. Promoting PA through walking and cycling is a priority of the World Health Organization, as reflected in the Global Action Plan on Physical Activity 2018–2030 [11].

Active commuting (i.e., walking or cycling) is an accessible and inexpensive kind of PA which can be easily integrated into adolescents' daily routines. Although independent mobility increases in adolescence [12], the prevalence of active commuting to school (ACS) has markedly decreased in recent decades in many developed countries [13–15], and in the last decade in Spain [16]. However, comparisons are often complicated due to measurement differences. The literature has also shown some inconsistencies in the categorization of active and passive commuters. The heterogeneity of

research questions and methods makes it difficult to compare the results and percentages of ACS between studies.

The most commonly asked question refers to a period called 'usually', more specifically, 'How do you usually go to school?' [17–19]. Most studies have reported the mode of travel (i.e., by car, on foot, by bicycle) in both trip directions (routes to and from school), without reporting the frequency. This dichotomous variable frequently occurs in the scientific literature, although no absolute consensus has yet been reached on dichotomizing active versus passive [20]. The number of active or passive journeys per week (i.e., 0 to 10 trips) seems important, not only to categorize adolescents in terms of active or passive commuting, but also to know how active or passive they are [21]. However, the continuous variable may be categorized as a dichotomous variable, although there is still no agreement on the cut-off criteria for dichotomizing active versus passive commuters.

Taking into account the number of active trips to define and differentiate active from passive commuters, there is a wide range of cut-off criteria across literature [17]. For example, while Bere and Bjørkelund [22] classified adolescents as active commuters when they actively commuted more than 50% of the times, Carver, Timperio and Crawford [23] considered adolescents who reported more than seven out of 10 trips (i.e., 70%) as active commuters. Ruiz-Ariza and colleagues [24] recently classified adolescents as inactive when they made less than five out of 10 active journeys per week, or at least five weekly active trips lasting for more than 15 min. However, other studies have suggested a four-out-of-five (i.e., 80%) active trip criterion to categorize adolescents as active commuters [25,26]. A recent study [27] has identified individuals who used active transport means (i.e., walking, cycling, scooters, or skateboards) on three or more school days per week (i.e., 60%) as active commuters. These findings are similar to those reported by Ross and colleague [28] and Veitch and colleague [29]. Finally, considering the potentially different number of trips to school that a student may make (e.g., different schedules), Mah and colleagues [30] classified students who actively commuted more than 90% of the time as active commuters.

This variability in criteria makes it complicated to make comparisons between studies. For instance, the 0% of passive commuters found by Bere and Bjørkelund [22] using a 50% active trip cut-off criterion cannot be fully compared to the 29.7% of passive commuters found by Te-Velde and colleagues [26] using an 80% active trip cut-off criterion. Therefore, it seems important to shed more light on the most accurate cut-off to correctly evaluate the prevalence of active and passive commuting modes among adolescents [19,31]. This may help not only to identify changes in the proportion of ACS, but also to clarify some current issues, such as the effectiveness of interventions focused on active commuting, considering potentially relevant factors (e.g., the distance from home to school) [20]. In this vein, previous studies have identified a threshold distance below which adolescents are more likely to commute actively to school. The threshold distance to ACS depends on sociodemographic and contextual variables [32].

To the best of our knowledge, no studies to date have focused on identifying active trip cut-off criteria to categorize individuals as active or passive commuters based on an exact number of weekly active trips. To bridge this gap, the first objective of this study was to explore whether the percentage of active commuters identified in a sample of adolescents would be significantly different depending on the cut-off criteria used. The second objective was to analyze whether the threshold distance may be a relevant variable to be considered when selecting cut-off criteria to categorize the sample into active and passive commuters.

It should be pointed out that this study was based on the most common international range of active trips per week for high school students, from zero to ten possible active trips (i.e., five weekdays and two trips [there and back] per week).

## 2. Materials and Methods

### 2.1. Participants and Procedure

An initial sample of 158 healthy students with no disability (12th–13th grade and 60.8% girls) from a high school in the city of Huesca (Spain) took part in this study. Huesca is a mid-sized city located in the north-east of Spain. It has 52,399 inhabitants and an urban area of 6.75 $km^2$ (4.21 $km^2$ not counting the industrial area), with a population density of 7762.8 inhabitants/$km^2$. Written informed consent was required from both parents and adolescents, and their participation was entirely voluntary and confidential. A paper-and-pencil survey was administered by the research team to students in their classrooms, which lasted for approximately 30 min, without the presence of teachers. The survey was administered in a normal week of April 2017. After applying the two inclusion criteria (i.e., living at a distance of less than 4500 m from the school [considering the specific urban area], and completing all the items on the questionnaire), 140 of the eligible 158 students ($M$ = 17.15 ± 0.63 years old; 60.7% girls) were included in the final study (i.e., 88.6% valid rate). Approval from the Ethics Committee for Clinical Research of Aragon (CEICA) was obtained (Ethic code: C1P117/0018). All procedures were performed in accordance with the relevant guidelines and regulations of the Ethics committee.

### 2.2. Assessment of Sociodemographic Characteristics

Participants self-reported their age, gender and home address.

### 2.3. Assessment of Mode and Frequency of Commuting to/from School

Participants completed a self-report questionnaire on their usual as well as on their latest weekly commuting patterns to and from school (Monday to Friday), respectively. Similarly to previous studies [33], the usual commuting mode to/from school was assessed by asking the following questions: 'How do you usually commute from home to school?' and 'How do you usually commute from school to home?'. The answer options were walking, cycling, by car, motorcycle, or bus. Walking and cycling were categorized as usual active transport modes, whereas travelling by car, motorcycle or bus were categorized as usual passive transport modes. Accordingly, participants were considered to be categorized as (1) usual active commuters (i.e., having a usual active transport mode to and from school, or (2) usual passive commuters (i.e., less than two usual active transport modes). These questions had been validated in the Spanish population [34] and were the result of a systematic review of 158 studies from the scientific literature on the assessment of the usual mode of commuting, using questionnaires [17].

With respect to the weekly commuting patterns, the frequency of ACS was expressed as the number of active trips per week to and from school (range: 0–10). Adolescents self-reported all their weekly trips to and from school using a single item from a validated school travel questionnaire for each travel day[34]:"How do you commute to school on 'Mondays'?" and "How do you commute from school on 'Mondays'?", repeating this question for every weekday. Each question for every day of the week about commuting to/from school was categorized as 'active commuting' (i.e., walking or cycling) or 'passive commuting' (i.e., by car, motorbike or bus). All weekly active trips (i.e., 'active commuting') were summed into a single variable ranging from 0 to 10. Based on this variable, subjects were classified as 'active commuters' according to six increasing weekly cut-off criteria: ≥five active trips, ≥six active trips, ≥seven active trips, ≥eight active trips, ≥nine active trips, and 10 active trips.

### 2.4. Assessment of Distance from Home to School

The objective measure of the distance to school was estimated using Google Maps, selecting the shortest route on foot option between the home address and the school's main entrance. Adolescents' home addresses and their respective school addresses were entered into Google Maps using the 'get directions' function and the walking distance between the two points was recorded in meters. Using

Google Maps as a GPS mapping resource has been recommended in research studies [35–37] as a method to measure walking and cycling routes to school.

### 2.5. Assessment of Perceived Barriers to ACS

Adolescents completed the BATACE scale (Spanish acronym for *Barreras en el Transporte Activo al Centro Educativo* and translated as Barriers to Active Commuting to School [38]). This scale includes 18 items and measures two factors: environmental and safety barriers (e.g., 'It is too far'), and planning and psychosocial barriers (e.g., 'It is easier to go by car'). The scale was completed for walking and cycling barriers, separately. All items were assessed using a four-point Likert scale ranging from (1) strongly disagree to (4) strongly agree. This scale has shown adequate reliability and validity in past research studies with Spanish populations [37].

### 2.6. Statistical Analysis

All statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS, version 21.0, IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) and the level of significance was set at $p < 0.05$. Percentages of active commuters were calculated both for usual commuting mode and for the weekly frequency of commuting to school for every cut-off criterion. Cochran's Q analyses were conducted to analyze differences in percentages of active commuters between different weekly cut-off criteria.

Participants' perceived barriers to ACS were analyzed for each weekly cut-off criterion through a binary logistic regression analysis. First, univariate regression analyses were run to examine the independent association between the commuting modes according to the six different weekly cut-off criteria (as dependent variables) and perceived barriers for walking and cycling to school (as independent variables). Then, considering only significant univariate barriers (i.e., those that significantly predicted dependent variables), a series of multivariate binary logistic regression analyses were conducted.

Finally, the threshold distance for ACS was calculated using the receiver operating characteristic (ROC) curve analysis based on the usual commuting mode (i.e., usual active or passive commuter), and distance from home to school. The Younden Index was calculated [39] to identify the threshold distance that best distinguishes active from passive commuters. The area under the curve values of 0.90 is considered excellent, 0.80 to 0.89 good, 0.70 to 0.79 fair, and less than 0.70 poor [40]. The sample was split according to the threshold distance. Using the two resulting samples (i.e., who lived above and below the threshold distance), a series of Cochran's Q tests were conducted again to analyze differences in percentages of active commuters between different weekly cut-off criteria.

## 3. Results

From the final sample of 140 adolescents ($M = 17.15 \pm 0.63$ years old; 60.7% girls), 80% of the participants were 'usual active commuters'. No differences were found by gender in either of the two usual commuting modes [to school: $\chi^2(3, 140) = 4.04$, $p = 0.26$; from school: $\chi^2(3, 140) = 5.57$, $p = 0.14$; usual active commuters: $\chi^2(1, 140) = 0.749$, $p = 0.39$].

As observed in Table 1 and based on the six different weekly cut-off criteria, percentages of active commuters ranged from 75% to 88.6% of the participants, showing a decrease in the percentage of active commuters as the number of active trips increased. Cochran's Q analysis showed significant differences between percentages of the different cut-off criteria [$Q(5) = 63.468$, $p < 0.00$]. Pair-comparison of Cochran's Q analysis revealed that no significant differences were found between the percentages from the ≥six, ≥seven, and ≥eight active trip cut-off criteria. Similarly, no significant differences were found between the percentages of active commuters from the ≥nine and ten active trip cut-off criteria either.

**Table 1.** Cochran's Q test values for the percentage of active commuters depending on the number of weekly active trips to and from school.

| ***n* = 140** | **1** | **2** | **3** | **4** | **5** | **6** | **%** |
|---|---|---|---|---|---|---|---|
| 1. ≥five active trips | - | 13.00 ** | 14.00 ** | 15.00 ** | 18.00 ** | 19.00 ** | 88.6 |
| 2. ≥six active trips | | - | 1.00 | 2.00 | 5.00 * | 6.00 * | 79.3 |
| 3. ≥seven active trips | | | - | 1.00 | 4.00 * | 5.00 * | 78.6 |
| 4. ≥eight active trips | | | | - | 3.00 | 4.00 * | 77.9 |
| 5. ≥nine active trips | | | | | - | 1.00 | 75.7 |
| 6. =10 active trips | | | | | | - | 75.0 |

Note: * $p < 0.05$, ** $p < 0.01$. % = percentage of active commuters.

Table 2 shows the association between significant univariate barriers to ACS and the commuting mode for each weekly cut-off criterion. It should be noted that the planning and psychological walking barrier, 'It is easier to go by car', was significantly and negatively associated with ACS for the seven ($\beta = -0.85$; SE = 0.41, $p < 0.05$) and the eight ($\beta = -0.86$; SE = 0.38, $p < 0.05$) active trip cut-off criteria. The environmental and safety walking barrier, 'It is too far', was significantly and negatively associated with ACS for the eight ($\beta = -0.72$; SE = 0.36, $p < 0.05$), nine ($\beta = -0.96$; SE = 0.35, $p < 0.05$) and ten ($\beta = -0.1.03$; SE = 0.35, $p < 0.01$) active trip cut-off criteria. The dependent variable eight active trip weekly cut-off criterion had the greatest number of significant barriers.

The ROC curve analysis showed a threshold distance of 1350 m (area under the curve: 0.809; $p < 0.001$). In total, 60.7% (i.e., $n = 85$) of the total sample lived below the threshold distance (see Figure 1). The percentages of active commuters for each weekly cut-off criterion ranged from 90.6% to 97.6% for participants who lived below the threshold distance and from 50.9% to 74.5% for those who lived above the threshold (see Table 3). With respect to the participants who lived below the threshold distance, Cochran's Q analysis showed significant differences between percentages of the different cut-off criteria [Q(5) = 23.182, $p < 0.00$]. Pair-comparison of Cochran's Q analysis revealed that no significant differences were found between the six, seven, eight, nine, and ten active trip cut-off criteria. With regard to adolescents who lived above the threshold, Cochran's Q analysis reported significant differences between percentages of different cut-off criteria [Q(5) = 41.282, $p < 0.00$]. A pair-comparison of Cochran's Q analysis revealed that no significant differences were found between the percentage of active commuters between the eight, nine, and ten active trips cut-off criteria.

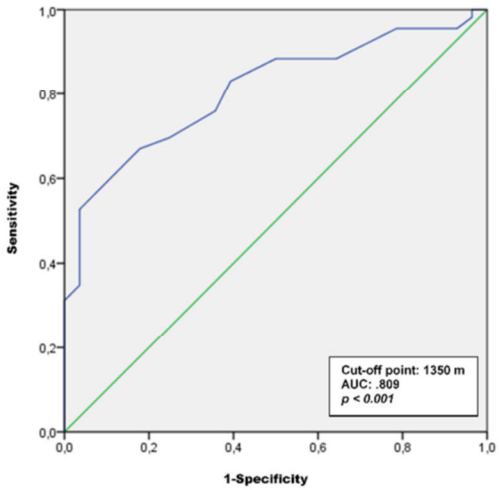


**Figure 1.** Receiver operating characteristic (ROC) curve analysis for active versus passive commuters by distance.

**Table 2.** Multivariate binary logistic regression analysis of different active trip cut-off criteria based on children's active commuting to school (ACS) barriers.

| Variables | ≥Five Active Trips | | | ≥Six Active Trips | | | ≥Seven Active Trips | | | ≥Eight Active Trips | | | ≥Nine Active Trips | | | =10 Active Trips | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | β | SE | *p* | β | SE | *p* | β | SE | *p* | β | SE | *p* | β | SE | *p* | β | SE | *p* |
| **Walking barriers (*n* = 108)** | | | | | | | | | | | | | | | | | | |
| Planning and psychosocial barriers | | | | | | | | | | | | | | | | | | |
| I get hot and sweat, or it is always raining | | | | | | | | | | | | | −0.28 | 0.36 | 0.43 | | | |
| It is easier to go by car | −0.81 | 0.52 | 12 | −0.67 | 0.37 | 0.07 | **−0.85** | **0.41** | **0.04** | **−0.86** | **0.38** | **0.02** | −0.55 | 0.32 | 0.09 | −0.62 | 0.33 | 0.06 |
| It involves too much planning | −0.38 | 0.43 | 0.37 | −0.28 | 0.36 | 0.43 | −0.20 | 0.36 | 0.60 | −0.40 | 0.36 | 0.28 | −0.07 | 0.34 | 0.83 | −0.31 | 0.35 | 0.36 |
| I do not enjoy myself | | | | | | | −0.77 | 0.47 | 0.11 | | | | | | | | | |
| Environmental and safety barriers | | | | | | | | | | | | | | | | | | |
| It is too far | −0.75 | 0.50 | 0.13 | −0.67 | 0.36 | 0.06 | −0.65 | 0.38 | 0.09 | **−0.72** | **0.36** | **0.04** | **−0.96** | **0.35** | **0.01** | **−10.03** | **0.35** | **0.00** |

Note: Only significant univariate barriers were included in the analysis of each dependent variable. SE = Standard Error. Bold fond = $p < 0.05$.

**Table 3.** Cochran's Q test values for the percentage of active commuters depending on the number of weekly active trips to and from school for participants below and above the threshold distance.

| Cut-off Criteria | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. ≥five active trips | - | 8.00 ** | 9.00 ** | 10.00 ** | 12.00 ** | 13.00 ** |
| 2. ≥six active trips | 5.00 * | - | 1.00 | 2.00 | 4.00 * | 5.00 * |
| 3. ≥seven active trips | 5.00 * | 0.00 | - | 1.00 | 3.00 | 4.00 * |
| 4. ≥eight active trips | 5.00 * | 0.00 | 0.00 | - | 2.00 | 3.00 |
| 5. ≥nine active trips | 6.00 * | 1.00 | 1.00 | 1.00 | - | 1.00 |
| 6. =10 active trips | 6.00 * | 1.00 | 1.00 | 1.00 | 0.00 | - |
| % of active commuters above the threshold | 74.5 | 60.0 | 58.2 | 56.4 | 52.7 | 50.9 |
| % of active commuters below the threshold | 97.6 | 91.8 | 91.8 | 91.8 | 90.6 | 90.6 |

Note: * $p < 0.05$, ** $p < 0.01$; Q-Cochran test values from students who lived below the threshold distance ($n = 85$) are displayed below the diagonal, and signification levels from students who lived above the threshold distance ($n = 55$) are displayed above the diagonal.

## 4. Discussion

The present study aimed to propose the most valid and reliable criteria to correctly classify adolescents as active or passive commuters, in agreement with the frequency of active trips to school.

As previous research has shown [22,30,41], the current study provides different percentages of active commuters depending on the various cut-off criteria used. Percentages ranged from 75% (i.e., the strictest cut-off criterion) to 88.6% (i.e., the least strict cut-off criterion). The present study reported significant differences between the percentage of active commuters for the total sample when ≥five, ≥eight and 10 active trip cut-off criteria were applied. Based on these results, it seems that the most recommendable cut-off criteria for adolescents fluctuated between the ≥eight and ≥nine active trip cut-off criteria.

Considering the ≥eight active trip cut-off criterion as a reference, the percentage of active commuters in this research study (i.e., 77.9%) is more similar to other studies that used the same active trip cut-off criterion (i.e., 76.2% of active commuters [26]), although in those studies, data were collected from 11–12-year-old children. On the other hand, when the ≥eight active trip cut-off criterion is chosen, the percentage of adolescents classified as active commuters is much higher (i.e., 18.7%) in the current study, in contrast to previous research [30]. This controversy in the results may be explained by other variables that influence ACS, such as age [42], socio-cultural context [43], climate [44], socio-economic status [45], and city size [46].

A multivariate binary logistic regression analysis was conducted to corroborate which would be the most accurate criterion, including perceived barriers to ACS. A positive association between the number of perceived barriers and active commuting has been observed in previous studies [47]. Our results suggest that the ≥eight active trip cut-off criterion could be considered as the most accurate, because it proved to be associated with a greater number of planning and environmental barriers. In addition, these results are similar to those reported by Becker and collegues[47]. These authors found similar barriers in adolescents (e.g., 'It is easier to go by car/bus'), which have been highlighted in the present research when applying the ≥eight active trip cut-off criterion. Moreover, an average of 7.7 active trips/week has recently been reported in a large sample of Spanish children and adolescents [48], which reinforces the choice of the ≥eight active trip cut-off criterion as the most suitable in this context. Nevertheless, the ≥nine active trip cut-off criterion should not be forgotten in future methodological studies.

A vast body of studies has suggested that there is a clear association between distance from home to school and the use of an active commuting mode, highlighting that participants living closer to school are more likely to actively commute than those who live further away [32,49–51]. Consequently, the most accurate cut-off criteria may hypothetically oscillate when the distance from home to school variable is considered in the analysis. Regarding adolescents who lived below the threshold distance (i.e., <1350 m from home to school), our results did not show any variation between the ≥six active trip cut-off criterion and the 10 active trip cut-off criterion in terms of the percentage of subjects classified

as active commuters (i.e., 91.8%–90.6% of active commuters). Therefore, a significant oscillation of the percentage of active commuters was only found between the ≥five active trip cut-off criterion (i.e., 97.6% active commuters) and all the other cut-off criteria. Considering these results, the present study also provides evidence about the need for greater strictness in the selection of a cut-off criterion when the distance to school becomes shorter. Assuming that distance might not constitute a major barrier to ACS (i.e., living below the threshold distance), and given that ACS seems to be a stable behavior, some stricter cut-off criteria could be adopted to correctly differentiate active commuters from passive commuters in adolescence.

Turning our attention to adolescents who lived above the threshold distance (i.e., ≥1350 m from home to school), different percentages of active commuters were displayed, depending on the cut-off criterion chosen. This decision resulted in lower rates of active commuters as the criteria became stricter. Cochran's Q analysis findings suggest that the most accurate cut-off criterion should be either the ≥seven or the ≥eight active trip cut-off criteria. Although the size of the city could be an influential variable in these results, distance from home to school should be considered an important variable (i.e., living above the threshold distance) when methodological recommendations are stated. Further research should focus on the influence of distance on ACS behavior.

In sum, this study suggests that the ≥eight active trip cut-off criterion could be considered as optimal for the current sample. It also indicates the need to consider other variables (e.g., distance) to apply this criterion in different contexts. The results of the research on ACS may be influenced by the correct choice of cut-off criteria. This has already occurred on previous occasions with the methodological decisions adopted to measure PA (e.g., epoch length in accelerometers; for further information [52]). Consequently, similar considerations should be taken into account when using frequency of active trips to school to categorize people as active or passive commuters. This fact will allow researchers to conduct rigorous, standardized and comparable ACS studies. This is promising, but more research is needed, however, to confirm our findings.

This work has several limitations. Firstly, our findings may not be generalizable to other contexts. This study was developed in a specific socio-cultural context using a convenience sample of a specific age. Therefore, further research should address different cultural contexts. Secondly, another limitation of this study is related to the self-report questionnaire used for data collection. Even though a children's self-report questionnaire seems to be the most common way of assessing ACS [17], this method should be used with caution because it has been proven to agree poorly with objective estimates [31].

Despite these limitations, this study has notable strengths. To our knowledge, this is the first research that raises the issue of cut-off criteria to classify active commuters in adolescence according to the number of weekly active trips to school. Although it is only an approximation and more research is required, the current study begins to draw conclusions about the need to establish common criteria to compare international results. Nevertheless, the need to consider the characteristics of each context and other potential moderator variables in the analysis is also stated. These issues should be addressed in future research.

## 5. Conclusions

The literature has also shown some inconsistencies in the categorization of active and passive commuters. The heterogeneity of research questions and methods makes it difficult to compare prevalence between studies and to investigate the influence of ACS on health-related outcomes[17]. According to the objectives of this research, significant differences were found in the percentage of active commuters, depending on the cut-off criteria used. In addition, the results show the relevance of the threshold distance when selecting the most accurate cut-off criterion. Nonetheless, the intention of our study was not to conclude with any final and decisive recommendations about the ideal cut-off criteria to differentiate active from passive commuters. Our sole aim was to pose a cutting-edge question on this methodological topic that should be addressed by the scientific community in coming years. Although there is still no consensus regarding the optimal cut-off criteria for dichotomizing

active versus passive commuters [17], we tried, to some extent, to provide some evidence to clarify this issue in the adolescent population.

Prior to designing any intervention to promote ACS, this methodological issue should be considered for any population, paying special attention, in particular, to the characteristics of the intervention context. We also truly encourage researchers to compare our recommendations with other proposals in order to find the best criteria.

**Author Contributions:** J.Z., A.C. and A.A. conceived, designed and contributed to the data collection. J.Z. and A.A. designed the present study. A.A. conducted the statistical analyses. A.C. and S.E. drafted the manuscript and J.Z., A.A., and Á.A. critically revised and edited the manuscript. All authors have read and approved the final manuscript.

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## References

1. World Health Organization (WHO). Global Health Estimates. 2014. Available online: http://www.who.int/healthinfo/global_burden_disease/en/ (accessed on 20 May 2018).
2. Chaput, J.-P.; Dinh, T.; Duggan, M.; Gray, C.E.; Gruber, R.; Janson, K.; Janssen, I.; Katzmarzyk, P.T.; Kho, M.E.; Latimer-Cheung, A.E.; et al. Canadian 24-hour movement guidelines for children and youth: An integration of physical activity, sedentary behaviour, and sleep. *Appl. Physiol. Nutr. Metab.* **2016**, *41*, S311–S327. [CrossRef]
3. World Health Organization (WHO). *Global Recommendations on PA for Health*; World Health Organization: Geneva, Switzerland, 2010.
4. Cooper, A.R.; Goodman, A.; Page, A.S.; Sherar, L.B.; Esliger, D.W.; Van Sluijs, E.M.F.; Andersen, L.B.; Anderssen, S.; Cardon, G.; Davey, R.; et al. Objectively measured physical activity and sedentary time in youth: The International children's accelerometry database (ICAD). *Int. J. Behav. Nutr. Phys. Act.* **2015**, *12*, 113–123. [CrossRef] [PubMed]
5. Roman-Viñas, B.; Chaput, J.-P.; Katzmarzyk, P.T.; Fogelholm, M.; Lambert, E.V.; Maher, C.; Maia, J.; Olds, T.; Onywera, V.; Sarmiento, O.L.; et al. Proportion of children meeting recommendations for 24-hour movement guidelines and associations with adiposity in a 12-country study. *Int. J. Behav. Nutr. Phys. Act.* **2016**, *13*, 123–133. [CrossRef] [PubMed]
6. Telama, R.; Yang, X.; Viikari, J.; Välimäki, I.; Wanne, O.; Raitakari, O. Physical activity from childhood to adulthood. *Am. J. Prev. Med.* **2005**, *28*, 267–273. [CrossRef] [PubMed]
7. Tucker, P.; Irwin, J.D.; Gilliland, J.; He, M.; Larsen, K.; Hess, P. Environmental influences on PA levels in youth. *Health Place* **2009**, *15*, 357–363. [CrossRef] [PubMed]
8. Voss, C. Public health benefits of active transportation. In *Children's Active Transportation*; Larouche, R., Ed.; Elsevier: Amsterdam, The Netherlands, 2018; pp. 1–20.
9. Reynolds, R.; McKenzie, S.; Allender, S.; Brown, K.; Foulkes, C. Systematic review of incidental physical activity community interventions. *Prev. Med.* **2014**, *67*, 46–64. [CrossRef] [PubMed]
10. Ostergaard, L.; Kolle, E.; Steene-Johannessen, J.; Anderssen, S.A.; Andersen, L.B. Cross sectional analysis of the association between mode of school transportation and physical fitness in children and adolescents. *Int. J. Behav. Nutr. Phys. Act.* **2013**, *10*, 91–98. [CrossRef] [PubMed]
11. World Health Organization (WHO). Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World. 2018. Available online: http://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf (accessed on 20 May 2018).

12. Shaw, B.; Bicket, M.; Elliott, B.; Fagan-Watson, B.; Mocca, E.; Hillman, M. Children's Independent Mobility: An International Comparison and Recommendations for Action. Policy Studies Institute: London, UK, 2015. Available online: http://www.psi.org.uk/docs/7350_PSI_Report_CIM_final.pdf (accessed on 20 May 2018).
13. Dygrýn, J.; Mitáš, J.; Gába, A.; Rubín, L.; Frömel, K. Changes in active commuting to school in Czech adolescents in different types of built environment across a 10-year period. *Int. J. Environ. Res. Public Health* **2015**, *12*, 12988–12998. [CrossRef] [PubMed]
14. Fyhri, A.; Hjorthol, R.; Mackett, R.L.; Fotel, T.N.; Kytta, M. Children's active travel and independent mobility in four countries: Development, social contributing trends and measures. *Transp. Policy* **2011**, *18*, 703–710. [CrossRef]
15. McDonald, N.C.; Brown, A.L.; Marchetti, L.M.; Pedroso, M.S. US school travel, 2009: An assessment of trends. *Am. J. Prev. Med.* **2011**, *41*, 146–151. [CrossRef]
16. Chillón, P.; Martínez-Gómez, D.; Ortega, F.B.; Pérez-López, I.J.; Díaz, L.E.; Veses, A.M. Six-year trend in active commuting to school in Spanish adolescents. *Int. J. Behav. Med.* **2013**, *20*, 529–537. [CrossRef]
17. Herrador-Colmenero, M.; Pérez-García, M.; Ruiz, J.R.; Chillón, P. Assessing modes and frequency of commuting to school in youngsters: A systematic review. *Pediatr. Exerc. Sci.* **2014**, *26*, 291–341. [CrossRef]
18. Pizarro, A.N.; Ribeiro, J.C.; Marques, E.A.; Mota, J.; Santos, M.P. Is walking to school associated with improved metabolic health? *Int. J. Behav. Nutr. Phys. Act.* **2013**, *10*, 12–19. [CrossRef]
19. Reimers, A.K.; Jekauc, D.; Peterhans, E.; Wagner, M.O.; Woll, A. Prevalence and socio-demographic correlates of active commuting to school in a nationwide representative sample of German adolescents. *Prev. Med.* **2013**, *56*, 64–69. [CrossRef]
20. Chillón, P.; Evenson, K.R.; Vaughn, A.; Ward, D.S. A systematic review of interventions for promoting active transportation to school. *Int. J. Behav. Nutr. Phys. Act.* **2011**, *8*, 1–17. [CrossRef] [PubMed]
21. Evenson, K.R.; Neelon, B.; Ball, S.C.; Vaughn, A.; Ward, D.S. Validity and Reliability of a School Travel Survey. *J. Phys. Act. Health* **2008**, *5*, S1–S15. [CrossRef]
22. Bere, E.; Bjorkelund, L.A. Test-retest reliability of a new self reported comprehensive questionnaire measuring frequencies of different modes of adolescents commuting to school and their parents commuting to work-the ATN questionnaire. *Int. J. Behav. Nutr. Phys. Act.* **2009**, *6*, 68–73. [CrossRef]
23. Carver, A.; Timperio, A.F.; Crawford, D.A.J. Neighborhood Road Environments and Physical Activity Among Youth: The CLAN Study. *J. Urban. Health* **2008**, *85*, 532–544. [CrossRef] [PubMed]
24. Ruiz-Ariza, A.; De la Torre-Cruz, M.J.; Suárez-Manzano, S.; Martínez-López, E.J. El desplazamiento activo al Centro educativo influye en el rendimiento académico de las adolescentes españolas. *Retos Nuevas Tend. Educ. Fís. Deporte Recreac.* **2017**, *32*, 39–43.
25. Chillón, P.; Hales, D.; Vaughn, A.; Gizlice, Z.; Ni, A.; Ward, D.S. A cross-sectional study of demographic, environmental and parental barriers to active school travel among children in the United States. *Int. J. Behav. Nutr. Phys. Act.* **2014**, *9*, 61–71. [CrossRef]
26. Velde, S.J.T.; Haraldsen, E.; Vik, F.N.; De Bourdeaudhuij, I.; Jan, N.; Kovacs, E.; Moreno, L.A.; Dössegger, A.; Manios, Y.; Brug, J.; et al. Associations of commuting to school and work with demographic variables and with weight status in eight European countries: The ENERGY-cross sectional study. *Prev. Med.* **2017**, *99*, 305–312. [CrossRef]
27. Ikeda, E.; Stewart, T.; Garrett, N.; Egli, V.; Mandic, S.; Hosking, J.; Witten, K.; Hawley, G.; Tautolo, E.S.; Rodda, J.; et al. Built environment associates of active school travel in New Zealand children and youth: A systematic meta-analysis using individual participant data. *J. Transp. Health* **2018**, *9*, 117–131. [CrossRef]
28. Ross, A.; Rodríguez, A.; Searle, M. Associations between the physical, sociocultural, and safety environments and active transportation to school. *J. Health Educ.* **2017**, *48*, 198–209. [CrossRef]
29. Veitch, J.; Carver, A.; Salmon, J.; Abbott, G.; Ball, K.; Crawford, D.; Cleland, V.; Timperio, A. What predicts children's active transport and independent mobility in disadvantaged neighborhoods? *Health Place* **2017**, *44*, 103–109. [CrossRef] [PubMed]
30. Mah, S.K.; Nettlefold, L.; Macdonald, H.M.; Winters, M.; Race, D.; Voss, C.; McKay, H.A. Does parental support influence children's active school travel? *Prev. Med. Rep.* **2017**, *6*, 346–351. [CrossRef] [PubMed]

31. Panter, J.; Costa, S.; Dalton, A.; Jones, A.; Ogilvie, D. Development of methods to objectively identify time spent using active and motorized modes of travel to work: How do self-reported measures compare? *Int. J. Behav. Nutr. Phys. Act.* **2014**, *11*, 116–131. [CrossRef] [PubMed]
32. Rodríguez-López, C.; Salas-Fariña, Z.M.; Villa-González, E.; Borges-Cosic, M.; Herrador-Colmenero, M.; Medina-Casaubón, J.; Ortega, F.B.; Chillón, P. The threshold distance associated with walking from home to school. *Health Educ. Behav.* **2017**, *44*, 857–866. [CrossRef]
33. Villa-González, E.; Ruiz, J.R.; Ward, D.S.; Chillón, P. Effectiveness of an active commuting school-based intervention at 6-month follow-up. *Eur. J. Public Health* **2016**, *26*, 272–276. [CrossRef]
34. Chillón, P.; Herrador-Colmenero, M.; Migueles, J.H.; Cabanas-Sánchez, V.; Fernández-Santos, J.R.; Veiga, Ó.L.; Castro-Piñero, J. Convergent validation of a questionnaire to assess the mode and frequency of commuting to and from school. *Scand. J. Public Health* **2017**, *45*, 612–620. [CrossRef]
35. Aibar, A.; Mandic, S.; Generelo, E.; Gallardo, L.; Zaragoza, J. Parental Barriers to Active Commuting to School in Children: Does Parental Gender Matter? *J. Transp. Health* **2018**, *9*, 141–149. [CrossRef]
36. Badland, H.M.; Opit, S.; Witten, K.; Kearns, R.A.; Mavoa, S. Can virtual streetscape audits reliably replace physical streetscape audits? *J. Urban. Health* **2010**, *87*, 1007–1016. [CrossRef] [PubMed]
37. Terrón-Pérez, M.; Molina-García, J.; Martínez-Bello, V.E.; Queralt, A. Active commuting to school among preschool-aged children and its barriers: An exploratory study in collaboration with parents. *J. Transp. Health* **2018**, *8*, 244–250. [CrossRef]
38. Molina-García, J.; Queral, A.; Estevan, I.; Álvarez, O.; Castillo, I. Barreras percibidas en el desplazamiento activo al centro educativo: Fiabilidad y validez de una escala. *Gac. Sanit.* **2016**, *6*, 426–431. [CrossRef] [PubMed]
39. Schisterman, E.F.; Perkins, N.J.; Liu, A.; Bondell, H. Optimal cut-point and its corresponding Youden Index to discriminate individuals using pooled blood samples. *Epidemiology* **2005**, *16*, 73–81. [CrossRef] [PubMed]
40. Metz, C.E. Basic principles of ROC analysis. *Semin. Nucl. Med.* **1978**, *8*, 283–298. [CrossRef]
41. Lu, W.; McKyer, E.L.J.; Lee, C.; Goodson, P.; Ory, M.G.; Wang, S. Perceived barriers to children's active commuting to school: A systematic review of empirical, methodological and theoretical evidence. *Int. J. Behav. Nutr. Phys. Act.* **2014**, *11*, 140–160. [CrossRef] [PubMed]
42. Mitra, R.; Buliung, R.N. The influence of neighborhood environment and household travel interactions on school travel behavior: An exploration using geographically-weighted models. *J. Transp. Geogr.* **2014**, *36*, 69–78. [CrossRef]
43. Rothman, L.; To, T.; Buliung, R.; Macarthur, C.; Howard, A. Influence of social and built environment features on children walking to school: An observational study. *Prev. Med.* **2014**, *60*, 10–15. [CrossRef] [PubMed]
44. Børrestad, L.A.B.; Andersen, L.B.; Bere, E. Seasonal and socio-demographic determinants of school commuting. *Prev. Med.* **2011**, *52*, 133–135. [CrossRef]
45. Shokoohi, R.; Hanif, N.R.; Dali, M. Influence of the socio-economic factors on children's school travel. *Procedia Soc. Behav. Sci.* **2012**, *50*, 135–147. [CrossRef]
46. Panter, J.; Jones, A. Attitudes and the environment as determinants of active travel in adults: What do and don't we know? *J. Phys. Act. Health* **2010**, *7*, 551–561. [CrossRef] [PubMed]
47. Becker, L.; Fermino, R.; Lima, A.; Rech, C.; Añez, C.; Reis, R. Perceived barriers for active commuting to school among adolescents from Curitiba, Brazil. *Rev. Bras. Ativ. Fís. Saúde* **2017**, *22*, 24–34. [CrossRef]
48. Herrador-Colmenero, M.; Escabias, M.; Ortega, F.B.; McDonald, N.C.; Chillón, P. Mode of commuting TO and FROM school: A similar or different pattern? *Sustainability (Switz.)* **2019**, *11*, 1–9. [CrossRef]
49. Chillón, P.; Panter, J.; Corder, K.; Jones, A.P.; Van Sluijs, E.M.F. A longitudinal study of the distance that young people walk to school. *Health Place* **2015**, *31*, 133–137. [CrossRef] [PubMed]
50. Harten, N.; Olds, T. Physical Activity: Patterns of active transport in 11–12 year old Australian children. *Aust. N. Z. J. Public Health* **2004**, *28*, 167–172.

51. Timperio, A.; Ball, K.; Salmon, J.; Roberts, R.; Giles-Corti, B.; Simmons, D.; Baur, L.A.; Crawford, D. Personal, family, social, and environmental correlates of active commuting to school. *Am. J. Prev. Med.* **2006**, *30*, 45–51. [CrossRef]
52. Aibar, A.; Chanal, J. Physical education: The effect of epoch lengths on children's physical activity in a structured context. *PLoS ONE* **2015**, *10*, e0121238. [CrossRef]

# CAPÍTULO II. Factores de influencia del transporte activo en el contexto de intervención

## Reto 2: Análisis específico del contexto de intervención

"Al cole con mamá y papá". Dibujo realizado por Darío Montes Corral. 4 años.

# Estudio 3. *Assessment of psychological, social cognitive and perceived environmental influences on children's active transport to school*

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# Assessment of psychological, social cognitive and perceived environmental influences on children's active transport to school☆

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ABSTRACT

*Introduction:* In recent years, there has been growing interest in studies integrating social cognitive and environmental variables as predictors of active transport to school (ATS). However, a theoretical model of associations between children's ATS and these variables has not been well established. The aims of this study were (1) to develop and test a model which conceptualized relationships between children's ATS and psychological, social cognitive and perceived environments; and (2) to assess direct effects among these variables.

*Methods:* Data were drawn from the ProATs, a cross-sectional study conducted with 1189 children aged 9–12 years from 11 primary schools in Huesca, Spain between January and June 2018. A child self-reported questionnaire was used to measure sociodemographic characteristics (age, sex), school travel mode (ATS: walking, cycling; non-ATS: by car, by motorcycle, by bus), and social cognitive and perceived environments. The social cognitive environment was measured based on four constructs of the theory of planned behavior (intention, attitude, social norm, perceived behavioural control), and three constructs of the basic psychological needs (autonomy, competence, relatedness) in the self-determination theory. The perceived environment was assessed through the security and accessibility of neighborhood environmental barriers to ATS. A structural equation modelling technique was utilised to examine direct effects of social cognitive and perceived environments on ATS.

*Results:* The model achieved acceptable fit, explaining 48% of the variance of children's ATS. Perceived behavioural control was the strongest predictor of intention, and influenced by autonomy, competence and the perceived environment.

*Conclusions:* Social cognitive and perceived environments played important roles in predicting children's ATS. Future interventions might consider strategies to increase perceptions of autonomy, competence and behavioural control along with strategies aimed to foster more positive perceptions of the built environment.

☆ All authors provided critical edits and revisions to the paper and have reviewed and approved the final version of the paper.

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## 1. Introduction

Health benefits of physical activity (PA) (e.g. favourable associations with cardiometabolic health, cardiorespiratory and muscular tionable (Department of Health and Human Services, 2018; Warburton and Bredin, 2017). Despite these benefits, more than 60% of children have not achieved physical activity (PA) recommendations globally (Aubert et al., 2018). According to Spain's 2018 PA Report Card for Children and Youth, the percentage of children aged 3–14 years who met the recommendation of at least 60 min of daily moderate-to-vigorous PA was fairly low (34.2% for boys and 26.9% for girls) (Román-Viñas et al., 2018).

Walking and cycling, the most common forms of active transport to school (ATS), can contribute to daily PA as part of a regular routine as well as other physical, mental and social benefits (Ikeda et al., 2018a; Sun et al., 2015; Larouche et al., 2014). Most recently, the World Health Organization has promoted walking and cycling as one of the priorities in their action plan (World Health Organization (WHO), 2018). Nevertheless, rates of these behaviors have declined or been low in many countries including Spain over the last decade (Rothman et al., 2018; Chillón et al., 2013). Given that ATS is influenced by complex interactions of multiple factors at individual, social and environmental levels (e.g., socio-ecological models) (Ikeda et al., 2019; Mandic et al., 2017), it is critical to obtain insights about these influences to develop effective interventions for children.

Different theoretical models have been developed to understand correlates of ATS including socio-ecological models and social cognitive theories (Lu et al., 2014; Sniehotta, 2009). The Theory of Planned Behavior (TPB), which is a widespread socio-psychological model for the prediction of planned behavior, and is a well-supported theoretical framework applied to analyze attitudes and behavior of children and youth, and has been widely used to explain the mechanism of ATS (e.g. Stark et al., 2018; Abrahamse et al., 2009). The TPB posits that an individual's intention is the most proximal predictor of a health-related behavior (e.g., ATS) and mediates the effect of three belief-based perceptions on the behavior: attitudes, subjective norm, and perceived behavioral control (PBC) (Ajzen, 1991). Intention, attitude and PBC were the most important factors influencing the decision-making of active transport in developing countries (Ding et al., 2017). Subjective norm, despite its positive effect, has a weaker predictive effect on walking and cycling than the other TPB constructs (Darker et al., 2010). It is arguable that the TPB is exclusively based on three predictors (i.e., attitude, subjective norm, PBC), which may not sufficiently explain the variance of behaviour (Hagger, 2010; Sniehotta et al., 2014). Therefore, some researchers have integrated other psychological variables (e.g., psychological needs) into TPB to develop a more comprehensive theoretical model (Hagger and Chatzisarantis, 2016).

The integration of an 'organismic' perspective (i.e., self-determination theory (SDT) can explain why individuals form attitudes, subjective norms, PBC and intentions over the behavior (Ajzen and Madden, 1986). The SDT postulates (Ryan and Deci, 2000) that the satisfaction of basic psychological needs autonomy (the need to feel ownership of one's behavior), competence (the need to produce desired outcomes and to experience mastery), and relatedness (the need to feel connected to others), directly leads to improving psychological wellbeing, and indirectly increasing positive behavioral consequences such as interest, attitude or intention (Vallerand and Losier, 1999). The SDT has been commonly used for PA interventions, but there is little research examining basic psychological

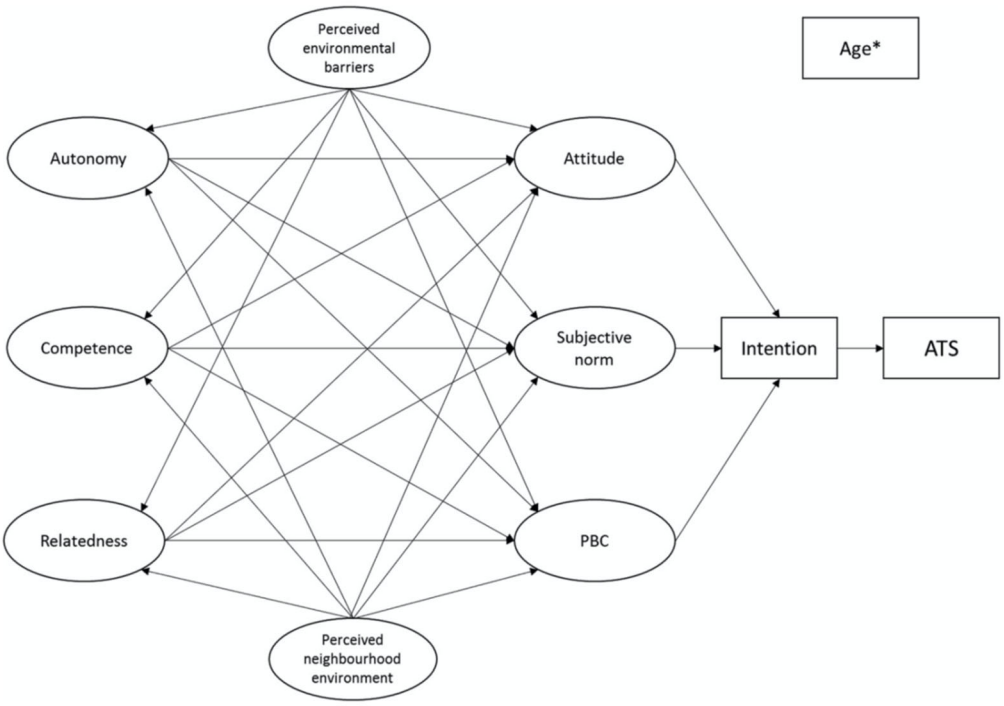


**Fig. 1.** A hypothesized model of associations between children's ATS psychological, social cognitive and perceived environmental factors. A circle means a latent variable and a square indicates an item. ATS = active transport to school, PBC = perceived behavioural control.
*All latent variables and items were regressed on age.

needs (BPNs), autonomy, competence, and relatedness in relation to ATS. Given that previous research proposed relationships between SDT and TPB constructs (Hagger and Chatzisarantis, 2009), it may be warranted to develop a model to understand the mechanism of ATS by integrating TPB and BPNs constructs (Silva et al., 2014; Kinnafick et al., 2014). In addition to psychological and cognitive factors, it is important to consider environmental factors which can explain the context-specific influences of ATS (Sallis et al., 2006). The choice of active transport modes may result from direct or indirect influences of environmental factors and may be mediated by individual cognitive factors (Arvidsson et al., 2012).

Some studies have developed a theoretical model combining TPB and environmental (perceived or objective) variables to explain ATS (Schölmerich and Kawachi, 2016; Wendel-Vos et al., 2007); other studies found that social cognitive and environmental variables were associated with ATS (Molina-García et al., 2019; de Geus et al., 2019). Findings demonstrated the importance of both 'perceived' and 'objective' measurement of the environmental variables (Ding et al., 2011), where different associations were found between the objective and perceived measures of the same environmental attribute (Van Acker et al., 2013).

While some studies have found a negative influence of age (Aarts et al., 2013; Wilson et al., 2010), others studies found that the propensity for choosing active modes of transport increases with age (Ikeda et al., 2019; Su et al., 2013). The effect of age could be restricted to a certain age range, being only significant for children between 5 and 14 years (Hatamzadeh et al., 2017). Notwithstanding the evidence, it seems necessary to consider age as an influence factor to understand ATS.

To our knowledge, no studies have developed and tested a model which comprehensively integrated psychological and social cognitive constructs (i.e., TPB, BPNs) and perceived environmental factors to explain children's ATS. As with a recent study by Ikeda et al. (2019), this study proposed a new model to explore the aforementioned relationships between children's ATS, psychological and social cognitive constructs (i.e., TPB, BPNs) and perceived environmental factors using structural equation modelling (see Fig. 1). The aims of this study were (1) to develop and test a model which conceptualized relationships between children's ATS psychological needs, social cognitive and perceived environments factors; and (2) to assess effects of psychological, social cognitive (i.e., TPB, BPNs) and perceived environments (i.e., neigbourhood environment and environmental barriers) on children's ATS using structural equation

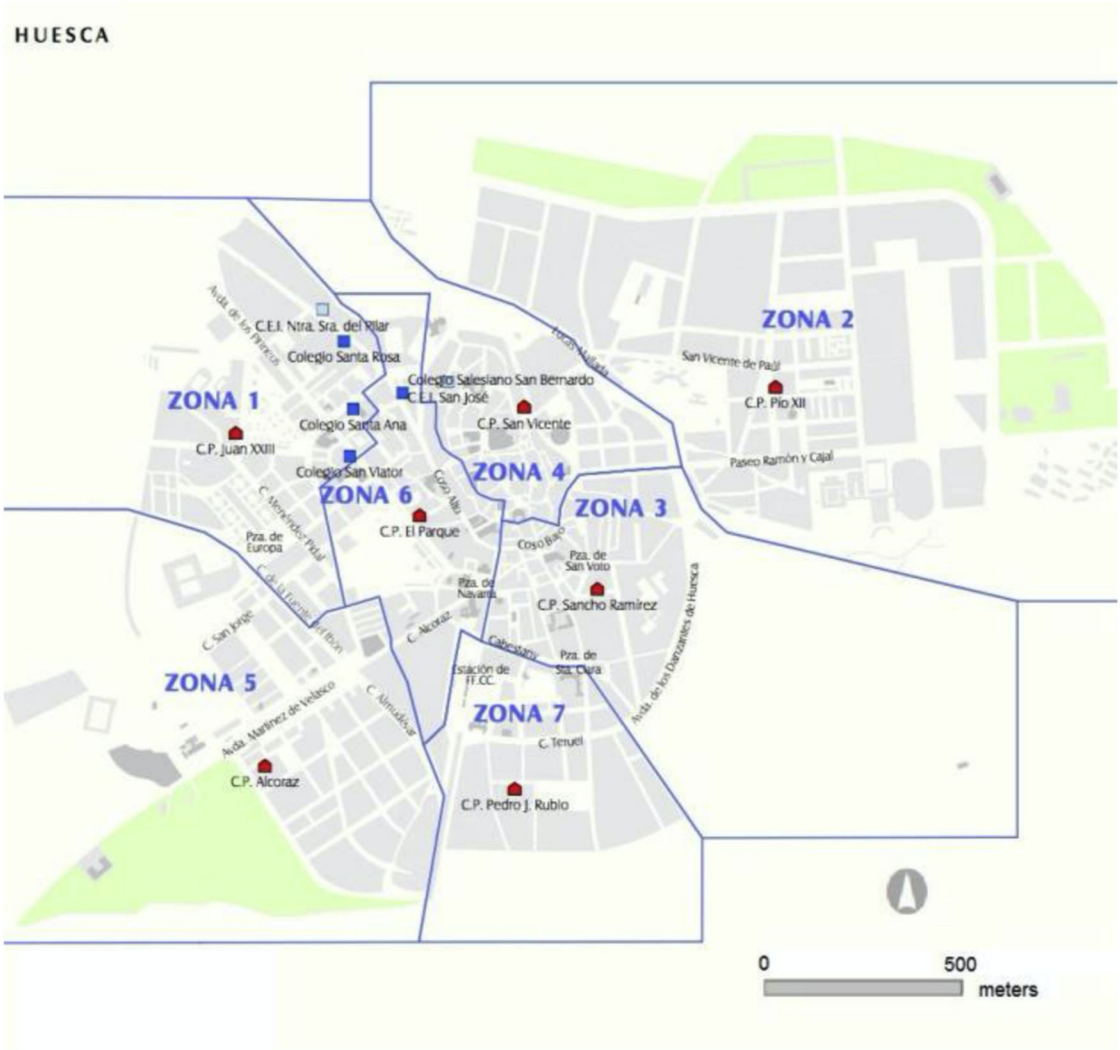


**Fig. 2.** Schools' spatial distribution. Red (public schools), blue (private schools) spots. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

modelling. We hypothesized that (1) children's attitudes, social norms and PBC would be directly associated with their intentions, and subsequently ATS; (2) children's BPNs would have a direct effect on their attitudes, social norms and PBC; (3) children's perceived environments would influence their attitudes, social norms, PBCs and BPNs; and (4) children's attitude, social norms, PBC, BPNs and perceived environments would contribute to explaining the variance of their intentions and ATS.

## 2. Material and methods

### 2.1. Study design, setting and participants

Promote Active Transport to School (Proats) is a cross-sectional study conducted in Huesca, Spain, aimed to increase the prevalence of using active modes of transport to school among children.

The study was conducted in Huesca, a mid-sized city placed in the north-east of Spain. This city has a total population of 52,399 inhabitants and an urban area of 6.75 $km^2$ (4,21 $km^2$ without industrial area), with a population density of 7763 inhabitants/$km^2$ (National Institute of Statistic, 2018).

Children aged 9–12 years (grades 4–6) from 12 primary schools (Fig. 2) in Huesca were invited to participate in the study. Only one school declined their participation. 1560 children were asked to collaborate in the study. Parents were informed about the study, and their written consent was provided for their children to participate in the study. Overall, 1263 parents signed consent (80.96% participation rate). Data were collected between January and June 2018 using a Spanish-version paper-and-pencil self-questionnaire to measure children's mode of transport to school, TPB and BPNs constructs, and environmental perceptions. After excluding incomplete or invalid children's questionnaires and all children who live outside of the city (i.e., households located >4.5 km from child's school) a sample of 1189 children mean age of 10.53 (SD = 0.90) years, (51.1% girls) was included in analyses. Ethical approval to conduct the study was granted by the Ethics Committee on Clinical Research of Aragon region (Spain).

### 2.2. Measures

A self-reported questionnaire was used to measure the following six sections: 1) sociodemographic characteristics, 2) school travel mode, 3) TPB (i.e., attitudes, social norm, PBC, intention to ATS), 4) BPNs (i.e., autonomy, competence, relatedness), 5) perceived neighborhood environments, and 6) perceived environmental barriers.

#### 2.2.1. Sociodemographic characteristics and school travel mode

Children reported their age and sex. The P.A.C.O (*Pedalea y Anda al Colegio*) questionnaire (http://profith.ugr.es/paco) (Chillón et al., 2017), was used for measuring the modes of commuting to and from school. The usual mode of commuting to and from school was analyzed using the following question: "*How do you usually go to and from school?*". Participants were asked to select one of the six response options: walking, cycling, by car, by motorcycle, or by bus. The responses were categorized as ATS (i.e. walking or cycling) or non-ATS (i.e. by car, by motorcycle or by bus) (Chillón et al., 2017).

#### 2.2.2. Theory of planned behavior

A questionnaire to measure the TPB constructs (i.e., attitude, subject norm, PBC and intention) was developed based on the guidelines provided by Fishbein and Ajzen (2011) and previous studies on ATS in children (Murtagh et al., 2012).

*Attitude* was measured by three items consisting of one affective component item (i.e. "For me to walk or cycle to school regularly could be unpleasant/pleasant."), and two instrumental component items (i.e. "For me to walk or cycle to school regularly could be bad or good."; "For me to walk or cycle to school regularly could be/useful or useless.") (Elliott and Thomson, 2010). *Subjective norm* was evaluated using three items (i.e. "My father or mother/my friends/my teachers tell me that I should go on foot or by bike to the school."). *PBC* was measured using three items (e.g., "I could go to the school on foot or by bike everyday if I want."). *Attitude* ($\alpha$ = 0.97), *subjective* norm ($\alpha$ = 0.90) and *PBC* ($\alpha$ = 0.92) showed good internal consistency reliability. *Intention* was measured using one item (i.e., "I want to walk or bike to school every day."). Participants reported their level of agreement using a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

#### 2.2.3. Self-determination theory: basic psychological needs

Nine items of the BPNs in exercise scale were utilised to measure *autonomy* (three items: e.g., "I can choose how I can go to school."), *competence* (three items: e.g., "I am able enough to go on foot to school without problems.") and *relatedness* (three items: e.g., "I feel very comfortable with those who go to school with me") (Moreno et al., 2008; Vlachopoulos and Michailidou, 2006). Participants reported their level of agreement using a five-point Likert scale. Internal consistency reliability was acceptable in all constructs (*autonomy*: $\alpha$ = 0.67, *competence*: $\alpha$ = 0.82 and *relatedness*: $\alpha$ = 0.84).

#### 2.2.4. Perceived neighborhood environment

A Spanish short-version of the adapted ALPHA environmental questionnaire was used to measure perceived neighborhood environment (Spittaels et al., 2010; García-Cervantes et al., 2014). A neighborhood was defined as 'the area around a participant's home that he/she could walk in 10–15 min, approximately 1.5 km' (García-Cervantes et al., 2014; Spittaels et al., 2010). Participants were asked about their perception of security (i.e., "Walking is dangerous due to the level of crime.") and accessibility (i.e., "At home I have small sport equipment such as balls, rackets, etc.") in their neighborhood using a four-point Likert scale (1 = strongly disagree, 2 =

disagree, 3 = agree, 4 = strongly agree) (α = 0.90).

#### 2.2.5. Perceived environmental barriers

Three items of the BATACE (Barriers to Active Transport to Educational Centres) scale were used to measure the perception of environmental barriers to ATS (e.g., "For me it is difficult to walk to school because other children do not go on foot") (Molina-García et al., 2016). A four-point Likert scale was used to measure the level of agreement (α = 0.99).

### 2.3. Statistical analysis

Descriptive statistics were performed for the frequency of ATS and relevant sociodemographic characteristics such as sex, and the mean and standard deviation of age and social cognitive and psychological (i.e., TPB and BPNs constructs) and perceived environmental (i.e. neighborhood environment, environmental barriers) variables.

A two-step modelling approach (i.e., measurement and structural models) was undertaken (Anderson and Gerbing, 1988). First, the measurement model involved a confirmatory factor analysis to test the construct validity of latent variables (i.e., *attitude*, *social norm*, *PBC*, *autonomy*, *competence*, *relatedness*, *perceived neighborhood environments*, *perceived environmental barriers*). Items were loaded only on the corresponding latent variable. Error terms were not free to correlate, and the factor loading of one item was fixed at one to define the scale. The reliability of latent variables was determined using a Cronbach's alpha coefficient (with an acceptable level above 0.7).

Second, the hypothesized model (Fig. 1) was tested using structural equation modelling (i.e., structural model). ATS was regressed on intention. Intention was regressed on TPB variables, which were at the same time regressed on BPNs; in turn BPNs were regressed on perceived environment variables. Each endogenous variable was regressed on age as a control variable. Maximum likelihood parameter estimates with standard errors and chi-square test statistics was used to derive parameters estimates. All structural paths and variances of exogenous latent variables were automatically fixed at one. Five model fit indices were used in both measurement and structural models to define 'good' models (Bollen, 1989): Chi-square ($X^2$), the Comparative Fit Index (CFI; >0.90), the Tucker Lewis Index (TLI; >0.90), the Root Mean Square Error of Approximation (RMSEA; >0.08) and the Standardised Root-Mean-Square Residual (SRMR; >0.05). All statistical analyses were conducted with MPlus version 6.1.

## 3. Results

The options kept in this study were walking (74%), cycling (0.9%). All the other answers had to do with inactive modes of travel (car, motorcycle and public transports 25.1%). Descriptive statistics (means, standard deviations, standardised estimates and standard error) of all items which compose latent variables were presented in Table 1. Just over two thirds (67.1%) of the total sample (10.61 ±

**Table 1**
Descriptive statistics of latent variables and items.

| Latent variable | Item | Mean | Standard deviation | Factor loadings | Standard error |
|---|---|---|---|---|---|
| TPB: *Attitude* | For me to walk or cycle to school regularly could be unpleasant/pleasant | 3.68 | 1.14 | .57 | .03 |
| | For me to walk or cycle to school regularly could be good/bad | 3.95 | .96 | .87 | .03 |
| | For me to walk or cycle to school regularly could be useful/useless. | 4.33 | 1.01 | .61 | .03 |
| TPB: *Subjective norm* | I usually go on foot to the school with my parents | 2.38 | 1.62 | .32 | .05 |
| | My parents usually go on to foot to their workplace | 3.01 | 1.65 | .76 | .11 |
| TPB: *Perceived behavioural control* | I have time to go on foot to the school every day if I wanted | 3.98 | 1.34 | .72 | .03 |
| | I live in a place that allows me to go on foot to the school every day if I wanted | 4.02 | 1.32 | .76 | .03 |
| BPN: *Autonomy* | I go to school using my preferred mode | 3.71 | 1.42 | .69 | .04 |
| | I can choose how I can go to school | 3.30 | 1.41 | .74 | .04 |
| BPN: *Competence* | I am able enough to go on foot to the school without problems | 4.46 | .97 | .67 | .04 |
| | I am skilled to go to school on foot | 4.43 | .94 | .80 | .03 |
| | I feel capable to go on foot to school | 4.48 | .95 | .79 | .03 |
| BPN: *Relatedness* | I feel at home with those who go to the school with me | 4.15 | .94 | .48 | .05 |
| | I feel that I can chat relax with those who go to the school with me | 4.44 | .92 | .69 | .04 |
| | I feel very comfortable with those who go to the school with me | 4.47 | .83 | .65 | .05 |
| *Perceived neighborhood environments* | Security: Walking is dangerous due to the level of crime | 1.22 | .41 | .62 | .06 |
| | Accessibility: At home I have small sport stuffs such as balls, rackets, etc. | 1.18 | .32 | .50 | .05 |
| *Perceived environmental barriers* | For me it is difficult to go walking to school because other children do not go on foot | 1.49 | .96 | .71 | .04 |
| | For me it is difficult to go walking to school because my bag is too heavy | 1.32 | .76 | .52 | .05 |
| | For me it is difficult to walk to school because it is more convenient for someone to drive me there | 1.54 | .96 | .54 | .04 |

BPN = Basic psychological need, TPB = Theory of planned behaviour.

0.93 years old) used active modes of transport to school. The mean and standard deviation of children's intention to ATS showed 4.01 ± 1.27 points (in a five-point Likert scale).

In the measurement model, one item each from subjective norm, PBC and autonomy was removed due to their low factor loadings (<0.50), resulting in acceptable Cronbach's alpha levels in all latent variables ($\alpha > 0.70$; George and Mallery, 1995). This modified model provided good fit indices ($\chi^2$ (142) = 206.470, $p < .001$; $\chi^2$/df. = 1.45; RMSEA = 0.020 (LI 90 = 0.013; LS 90 = 0.025); CFI = 0.98; TLI = 0.97; SRMR = 0.026). All factor loadings ($\lambda$) were significant ($t > 1.96$).

Fig. 3 presents significant direct relationships among the variables in the structural model ($p < .05$). The modified model provided a good fit to the data ($\chi^2(193) = 518.774$, $p < .001$; $\chi^2$/df. = 2.68; RMSEA = 0.038 (LI 90 = 0.0.34; LS 90 = 0.042); CFI = 0.93; TLI = 0.91; SRMR = 0.043), explaining 48% and 47% of the variance of children's ATS and intention, respectively. ATS was positively associated with intention to commute actively to school ($\beta = 0.13$, $p < .001$) and negatively with age ($\beta = -0.67$, $p < .01$). Intention, at the same time, was positively related to PBC ($\beta = 0.69$, $p < .01$). In turn, PBC was positively related to autonomy ($\beta = 0.29$, $p < .001$) and competence ($\beta = 0.34$, $p < .001$), but negatively to perceived environmental barriers ($\beta = -0.40$, $p < .001$).

## 4. Discussion

This study aimed to develop and test a model which conceptualized relationships between children's ATS, psychological, social cognitive and perceived environmental variables, and to assess effects of these variables on children's ATS using structural equation modelling. Social cognitive and perceived environmental variables in modified model explained 48% and 47% of variance of ATS and intention, respectively.

In line with the previous studies, intention was positively associated with ATS (Trapp et al., 2011; Lemieux and Godin, 2009; Armitage and Conner, 2001). The current findings also demonstrated that intention was the most strongly predicted by PBC, which was, in turn, significantly predicted by autonomy, competence and perceived environmental barriers. A few previous studies also reported that PBC was the strongest predictor of children's intentions to actively commute to school (Lemieux and Godin, 2009; Eves et al., 2003). Although the lack of statistically significant associations between attitudes, subjective norms and intentions is somewhat surprising, Ajzen (1991) and Armitage and Conner (2001), have noted some inconsistencies regarding the expected contribution of subjective norms to intentions. Furthermore, the current findings are consistent with previous work by Murtagh et al. (2012), who reported that neither attitudes nor subjective norms predicted intentions to actively commute to school.

For some behaviors, the effect of PBC could overshadow the effect of attitudes and subjective norms on intention. Children's intention and their behaviour at this age, could be more influenced by internal considerations (e.g. PBC) than external influences of other people's opinions (e.g. attitude or subjective norm). Although children's PBC may influence the choice of active transport modes (Carver et al., 2013), parents often govern their children's transport mode decision (Carver et al., 2013). The lack of influence of subjective norm could imply that this construct might have captured only limited perceived social pressure from others, meaning an individual's perception of how others typically behave (i.e., descriptive norm component) might have been overlooked (Ajzen, 1991).

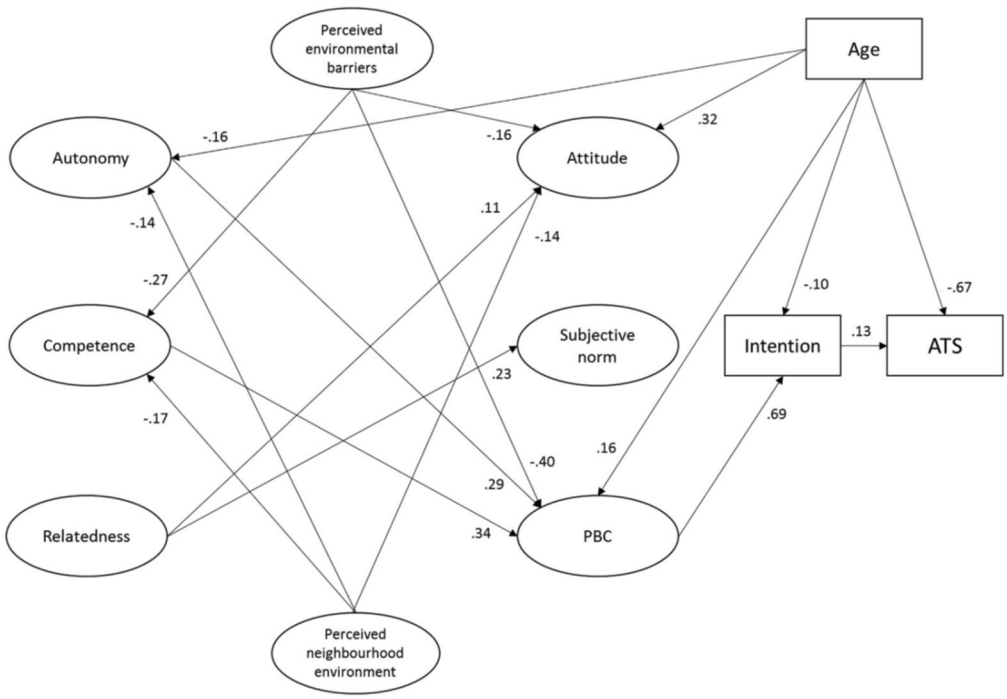


**Fig. 3.** Standardised estimated coefficients of associations between children's ATS and social cognitive, psychological and perceived environmental variables using structural equation modelling. Only significant pathways ($p < .05$) are presented to facilitate readers comprehension. A circle means a latent variable and a square indicates an item. ATS = active transport to school, PBC = perceived behavioural control.

Consistent with the current findings, several reviews on children's PA using TPB have demonstrated inconsistent contribution of children's attitudes to their intentions (e.g., Nelson et al., 2009; Scott et al., 2007). This study only considered the affective component of attitudes (e.g., feelings about ATS) but other components such as cognitive (e.g., safe, fast, convenient) or behavioural (e.g., elements related to the pollution, possibility of sharing with others). Cognitive, affective and behavioral attitudes towards ATS are likely to be associated with intentions to actively commute to school ATS (García et al., 2019). Further, it is likely that different behaviors such as walking and cycling can have unique structures of TPB (Adams et al., 2013; Abrahamse et al., 2009). In terms of walking and cycling for leisure and transport, Eves et al. (2003) reported that intentions of walking were only predicted by PBC; whereas intentions of cycling by attitude and PBC. It is important for studies on transport behavior to consider active modes of transport (i.e., cycling and walking) separately because these modes may be perceived differently by people.

It is evident that BPNs were associated with social cognitive theories including TPB (e.g., attitude, PBC, intention) in the area of PA (Hagger et al., 2006) and ATS (Silva et al., 2014). This study also showed that the constructs of BPNs specifically autonomy and competence were significantly related to PBC, meaning children who were highly satisfied with their need for autonomy and competence might have high control over performing ATS. It might also indicate that BPNs had indirect influences on intention (Hagger et al., 2002; Hagger et al., 2006; Standage et al., 2003).

There is a lack of understanding on the effects of perceived environments on social cognitive pathways when predicting ATS. In accord with previous studies (https://www.sciencedirect.com/science/article/pii/S136984781830679X, Panter and Ogilvie, 2015; Rhodes et al., 2007; Rhodes et al., 2006), the current findings showed that perceived neighborhood environments (i.e. security and accessibility) and perceived environmental barriers to ATS (i.e., environment and safety barriers) were related to TPB (i.e. attitude, PBC) and BPNs (i.e., autonomy, competence) constructs. In line with our results, other studies have shown that individuals with a lower perception of accessibility to PA or unsafe neighborhood perceptions may negatively influence on their perceptions of autonomy, competence, attitudes or PBC (Dowda et al., 2009). The more resources and fewer obstacles individuals perceive, the greater PBC and stronger intentions to perform behaviors they have (Dawson et al., 2001; Kimiecik, 1992). In addition to the direct influence of the perceived environments on ATS (Molina-García et al., 2017), it is possible that these factors could indirectly influence intention and consequently ATS through PBC. In our study perceived environmental barriers was the strongest predictor of PBC (which in turn, was the strongest predictor of intention), suggesting that both skills and abilities to improve ATS behavior and a supportive environment may be required in future interventions. Nevertheless, other environmental components should be incorporated into future studies (i.e., the neighborhood features around the home, the route between home and school, and the environment of the school itself), as possible influences on ATS (Moudon and Lee, 2003).

Age was another predictor of children's intentions and ATS. Consistent with previous research (Silva et al., 2011; Chillón et al., 2009; Butler et al., 2007), an inverse relationship between age and ATS was found in the current study. However, this finding should be cautiously interpreted because children at this age (i.e., 9–12 years) can be influenced by other factors such as maturation, experience and cognitive processing capacity which are potentially associated with their intentions and ATS (Tabibi et al., 2012). Various strategies for different age groups may be required to promote ATS (Hatamzadeh et al., 2017). It may be surprising that the distance from home to school was not addressed in this study. Distance to school is the strongest and most consistently demonstrated determinant of ATS internationally (Curtis et al., 2015; Rothman et al., 2018). However, in our studio the 81% of the subjects live less than 1.5 km away from home to school. This is the reason why this variable has not been considered in this study.

### 4.1. Strengths and limitations

One of the major strengths of this study was the use of a robust structural equation modelling technique to assess the complex interrelationships among children's ATS and social cognitive and perceived environmental factors. This technique allowed the simultaneous integration of psychological, social cognitive and perceived environmental variables to explain children's intentions and ATS. Furthermore, this study included a large representative sample from one mid-size city (11 out of 12 schools from the city) which increased the precision and representativeness of the results in this specific context. Despite these strengths, the current findings cannot be generalized to other urban or rural areas in Spain, or abroad as the participants came from one particular city in Spain. The hypothesized model was tested in a specific environmental context, and contextual differences of children's responses may exist due to their cultural and social background (Laroche et al., 2002). Further empirical investigation will be required to generalize the hypothesized model to other contexts. Causal inferences cannot be made due to the cross-sectional study design. The child self-reported questionnaire might be vulnerable to cognitive, affective and self-presentational biases, and result in under- or overestimating their behavior (Montoye et al., 1996). Notwithstanding, measures of school travel mode and the perceived environment used in this study have been validated in previous studies in Spanish youth. Some results of this study should be considered with caution as some categories (e.g., accessibility) of latent variables are built with just only one item. Future studies should be conducted to replicate our results. The application of a few perceived neighborhood environment measures (i.e. security, accessibility) might be a limitation. Other perceived and objective environmental variables such as the characteristics of destinations and routes between home and school can be considered in future research (Ikeda et al., 2018b). The effect of biological maturation can be a factor of modifying the patterns of children's PA and ATS but was not measured in the current study. Previous studies showed an inverse association between PA and maturation in boys and girls, particularly in children (Davison et al., 2007; Thompson et al., 2003; Sherar et al., 2007). Finally, another possible limitation could be the data collection schedule (i.e., conducted in January and June). ATS may be less amenable due to temporal factors such as weather and determined predominantly by pre-existing built environment and social variables such as time and convenience (Schlossberg et al., 2006). Nevertheless, in our study, we excluded households located >4.5 km from child's school (i.e. households located outside the urban area of Huesca). Considering this fact and based on Kallio et al. (2016), it is possible that the

homogeneity in distance from school (81% lived within 1.5 km of school), do not introduce any bias in the responses although collection dates are different.

## 5. Conclusion

Psychological, social cognitive and perceived environmental factors played influential roles on children's ATS. The model tested also demonstrated a complex structure of associations among these factors. Children's autonomy, competence, relatedness, perceived behavioral control as well as perceived environmental barriers were directly and indirectly related to children's intention and ATS. Our findings have some implications for policy makers and transport planners. Internal factors (e.g. PBC) and a supportive environment should be addressed in future interventions to modify the patterns of ATS. Increasing children's ATS requires action on multiple fronts. Environmental and psychological-cognitive interventions must be integrated and operate within the same system. Policymakers should try to understand people's judgements and interpretations of the environment and acknowledge the reciprocal and dynamic relationships between people and places.

## Availability of data and material

Data are available for research. Any further inquiries can be directed to the authors.

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## Declaration of competing interest

The authors declare no conflict of interest.

## CRediT authorship contribution statement

**Javier Zaragoza:** Writing - original draft, Writing - review & editing, Methodology. **Ana Corral:** Investigation, Data curation. **Erika Ikeda:** Writing - review & editing, Resources. **Enrique García-Bengoechea:** Methodology, Conceptualization. **Alberto Aibar:** Formal analysis, Supervision, Resources.

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## References

Aarts, M.J., Mathijssen, J.J., van Oers, J.A., Schuit, A.J., 2013. Associations between environmental characteristics and active commuting to school among children: a cross-sectional study. Int. J. Behav. Med. 20 (4), 538–555. https://doi.org/10.1007/s12529-012-9271-0.

Abrahamse, W., Steg, L., Vlek, C., Gifford, R., 2009. Factors influencing car use for commuting and the intention to reduce it: a question of self-interest or morality? Transport. Res. F Traffic Psychol. Behav. 12 (4), 317–324. https://doi.org/10.1016/j.trf.2009.04.004.

Adams, E.J., Goodman, A., Sahlqvist, S., Bull, F.C., Ogilvie, D., 2013. Correlates of walking and cycling for transport and recreation: factor structure, reliability and behavioural associations of the perceptions of the environment in the neighbourhood scale (PENS). Int. J. Behav. Nutr. Phys. Activ. 10 (1), 87. https://doi.org/10.1186/1479-5868-10-87.

Ajzen, I., Madden, T.J., 1986. Prediction of goal-directed behavior: attitudes, intentions and perceived behavioral control. J. Exp. Soc. Psychol. 22 (5), 453–474. https://doi.org/10.1016/0022-1031(86)90045-4.

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50 (2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.

Anderson, J.C., Gerbing, D.W., 1988. Structural equation modeling in practice: a review and recommended two-step approach. Psychol. Bull. 103 (3), 411. https://doi.org/10.1037/0033-2909.103.3.411.

Armitage, C.J., Conner, M., 2001. Efficacy of the theory of planned behaviour: a meta-analytic review. Br. J. Soc. Psychol. 40 (4), 471–499. https://doi.org/10.1348/014466601164939.

Arvidsson, D., Kawakami, N., Ohlsson, H., Sundquist, K., 2012. Physical activity and concordance between objective and perceived walkability. Med. Sci. Sports Exerc. 44 (2), 280–287. https://doi.org/10.1249/MSS.0b013e31822a9289.

Aubert, S., Barnes, J.D., Aguilar-Farias, N., Cardon, G., Chang, C.K., Delisle Nyström, C., et al., 2018. Report card grades on the physical activity of children and youth comparing 30 very high human development index countries. J. Phys. Activ. Health 15 (Suppl. 2), S298–S314. https://doi.org/10.1123/jpah.2018-0431.

Bollen, D.A., 1989. Structural Equations with Latent Variables. Wiley, New York.

Butler, G.P., Orpana, H.M., Wiens, A.J., 2007. By your own two feet. Can. J. Public Health 98 (4), 259–264. https://doi.org/10.1007/BF03405399.

Carver, A., Watson, B., Shaw, B., Hillman, M., 2013. A comparison study of children's independent mobility in England and Australia. Child Geogr. 11 (4), 461–475. https://doi.org/10.1080/14733285.2013.812303.

Chillón, P., Herrador-Colmenero, M., Migueles, J.H., Cabanas-Sánchez, V., Fernández-Santos, J.R., Veiga, Ó.L., Castro-Piñero, J., 2017. Convergent validation of a questionnaire to assess the mode and frequency of commuting to and from school. Scand. J. Publ. Health 45 (6), 612–620. https://doi.org/10.1177/1403494817718905.

Chillón, P., Martínez-Gómez, D., Ortega, F.B., Pérez-López, I.J., Díaz, L.E., Veses, A.M., 2013. Six-year trend in active commuting to school in Spanish adolescents. Int. J. Behav. Med. 20 (4), 529–537. https://doi.org/10.1007/s12529-012-9267-9.

Chillón, P., Ortega, F.B., Ruiz, J.R., Pérez, I.J., Martín-Matillas, M., Valtueña, J., et al., 2009. Socio-economic factors and active commuting to school in urban Spanish adolescents: the AVENA study. Eur. J. Publ. Health 19 (5), 470–476. https://doi.org/10.1093/eurpub/ckp048.
Curtis, C., Babb, C., Olaru, D., 2015. Built environment and children's travel to school. Transport Pol. 42, 21–33. https://doi.org/10.1016/j.tranpol.2015.04.003.
Darker, C.D., French, D.P., Eves, F.F., Sniehotta, F.F., 2010. An intervention to promote walking amongst the general population based on an 'extended' theory of planned behavior: a waiting list randomised controlled trial. Psychol. Health 25 (1), 71–88. https://doi.org/10.1080/08870440902893716.
Davison, K.K., Werder, J.L., Trost, S.G., Baker, B.L., Birch, L.L., 2007. Why are early maturing girls less active? Links between pubertal development, psychological well-being, and physical activity among girls at ages 11 and 13. Soc. Sci. Med. 64 (12), 2391–2404. https://doi.org/10.1016/j.socscimed.2007.02.033.
Dawson, K.A., Gyurcsik, N.C., Culos-Reed, S.N., Brawley, L.R., 2001. Perceived control: a construct that bridges theories of motivated behavior. In: Roberts, G.C. (Ed.), Advances in Motivation in Sport and Exercise. Human Kinetics, Champaign, IL, pp. 321–356.
de Geus, B., Wuytens, N., Deliens, T., Keserü, I., Macharis, C., Meeusen, R., 2019. Psychosocial and environmental correlates of cycling for transportation in Brussels. Transport. Res. Pol. Pract. 123, 80–90. https://doi.org/10.1016/j.tra.2018.09.005.
Department of Health and Human Services, 2018. Physical Activity Guidelines Advisory Committee Scientific Report. US, Washington DC.
Ding, C., Chen, Y., Duan, J., Lu, Y., Cui, J., 2017. Exploring the influence of attitudes to walking and cycling on commute mode choice using a hybrid choice model. J. Adv. Transport. 1–8. https://doi.org/10.1155/2017/8749040, 2017.
Ding, D., Sallis, J.F., Kerr, J., Lee, S., Rosenberg, D.E., 2011. Neighborhood environment and physical activity among youth: a review. Am. J. Prev. Med. 41 (4), 442–455. https://doi.org/10.1016/j.amepre.2011.06.036.
Dowda, M., Dishman, R.K., Porter, D., Saunders, R.P., Pate, R.R., 2009. Commercial facilities, social cognitive variables, and physical activity of 12th grade girls. Ann. Behav. Med. 37 (1), 77–87. https://doi.org/10.1007/s12160-009-9080-0.
Elliott, M.A., Thomson, J.A., 2010. The social cognitive determinants of offending drivers' speeding behaviour. Accid. Anal. Prev. 42 (6), 1595–1605. https://doi.org/10.1016/j.aap.2010.03.018.
Eves, F., Hoppéa, R., McLaren, L., 2003. Prediction of specific types of physical activity using the theory of planned behavior. J. Appl. Biobehav. Res. 8 (2), 77–95. https://doi.org/10.1111/j.1751-9861.2003.tb00086.x.
Fishbein, M., Ajzen, I., 2011. Predicting and Changing Behavior: the Reasoned Action Approach. Psychology Press, New York.
García, J., Arroyo, R., Mars, L., Ruiz, T., 2019. The influence of attitudes towards cycling and walking on travel intentions and actual behavior. Sustainability 11 (9), 2554–2571. https://doi.org/10.3390/su11092554.
García-Cervantes, L., Martínez-Gomez, D., Rodríguez-Romo, G., Cabanas-Sánchez, V., Marcos, A., Veiga, Ó.L., 2014. Fiabilidad y validez de una versión adaptada del cuestionario ambiental ALPHA para la actividad física en la juventud española. Nutr. Hosp. 30 (5), 1118–1124. https://doi.org/10.3305/nh.2014.30.5.7769.
George, D., Mallery, P., 1995. SPSS/PC+ Step by Step: A Simple Guide and Reference. Wadsworth Publishing Company, Belmont, CA, p. 168.
Hagger, M., 2010. Current issues and new directions in psychology and health: physical activity research showcasing theory into practice. Psychol. Health 25 (1), 1–5. https://doi.org/10.1080/08870440903268637.
Hagger, M.S., Chatzisarantis, N.L., 2016. The trans-contextual model of autonomous motivation in education conceptual and empirical issues and meta-analysis. Rev. Educ. Res. 86, 360–407. https://doi.org/10.3102/0034654315585005.
Hagger, M.S., Chatzisarantis, N.L., 2009. Integrating the theory of planned behaviour and self-determination theory in health behaviour: a meta-analysis. Br. J. Health Psychol. 14, 275–302. https://doi.org/10.1348/135910708X373959.
Hagger, M.S., Chatzisarantis, N.L., Biddle, S.J., 2002. A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: predictive validity and the contribution of additional variables. J. Sport Exerc. Psychol. 24 (1), 3–32. https://doi.org/10.1123/jsep.24.1.3.
Hagger, M.S., Chatzisarantis, N.L., Harris, J., 2006. From psychological need satisfaction to intentional behavior: testing a motivational sequence in two behavioral contexts. Pers. Soc. Psychol. Bull. 32 (2), 131–148. https://doi.org/10.1177/0146167205279905.
Hatamzadeh, Y., Habibian, M., Khodaii, A., 2017. Effective factors in walking mode choice of different age groups for school trips. Transport. Res. Procedia 25, 2297–2308. https://doi.org/10.1016/j.trpro.2017.05.441.
Ikeda, E., Hinckson, E., Witten, K., Smith, M., 2018a. Associations of children's active school travel with perceptions of the physical environment and characteristics of the social environment: a systematic review. Health Place 54, 118–131. https://doi.org/10.1016/j.healthplace.2018.09.009.
Ikeda, E., Hinckson, E., Witten, K., Smith, M., 2019. Assessment of direct and indirect associations between children active school travel and environmental, household and child factors using structural equation modelling. Int. J. Behav. Nutr. Phys. Activ. 16 (1), 32–49. https://doi.org/10.1186/s12966-019-0794-5.
Ikeda, E., Mavoa, S., Hinckson, E., Witten, K., Donnellan, N., Smith, M., 2018b. Differences in child-drawn and GIS-modelled routes to school: impact on space and exposure to the built environment in Auckland, New Zealand. J. Transport Geogr. 71 (C), 103–115. https://doi.org/10.1016/j.jtrangeo.2018.07.005.
Kallio, J., Turpeinen, S., Hakonen, H., Tammelin, T., 2016. Active commuting to school in Finland, the potential for physical activity increase in different seasons. Int. J. Circumpolar Health 75 (1), 33319–33326. https://doi.org/10.3402/ijch.v75.33319.
Kimiecik, J., 1992. Predicting vigorous physical activity of corporate employees: comparing the theories of reasoned action and planned behavior. J. Sport Exerc. Psychol. 14 (2), 192–206. https://doi.org/10.1123/jsep.14.2.192.
Kinnafick, F.E., Thogersen-Ntoumani, C., Duda, J.L., Taylor, I., 2014. Sources of autonomy support, subjective vitality and physical activity behaviour associated with participation in a lunchtime walking intervention for physically inactive adults. Psychol. Sport Exerc. 15, 190–197. https://doi.org/10.1016/j.psychsport.2013.10.009.
Laroche, M., Tomiuk, M.A., Bergeron, J., Barbaro-Forleo, G., 2002. Cultural differences in environmental knowledge, attitudes, and behaviours of Canadian consumers. Can. J. Adm. Sci. Rev. Canad. Sci. Adm. 19 (3), 267–282. https://doi.org/10.1111/j.1936-4490.2002.tb00272.x.
Larouche, R., Saunders, T.J., Faulkner, G., Colley, R., Tremblay, M., 2014. Associations between active school transport and physical activity, body composition, and cardiovascular fitness: a systematic review of 68 studies. J. Phys. Activ. Health 11 (1), 206–227. https://doi.org/10.1123/jpah.2011-0345.
Lemieux, M., Godin, G., 2009. How well do cognitive and environmental variables predict active commuting? Int. J. Behav. Nutr. Phys. Activ. (1), 12–21. https://doi.org/10.1186/1479-5868-6-12.
Lu, W., McKyer, E.L.J., Lee, C., Goodson, P., Ory, M.G., Wang, S., 2014. Perceived barriers to children's active commuting to school: a systematic review of empirical, methodological and theoretical evidence. Int. J. Behav. Nutr. Phys. Activ. 11 (1), 140. https://doi.org/10.1186/s12966-014-0140-x.
Mandic, S., Hopkins, D., Bengoechea, E.G., Flaherty, C., Williams, J., Sloane, L., et al., 2017. Adolescents' perceptions of cycling versus walking to school: understanding the New Zealand context. J. Transport Health 4, 294–304. https://doi.org/10.1016/j.jth.2016.10.007.
Molina-García, J., García-Massó, X., Estevan, I., Queralt, A., 2019. Built environment, psychosocial factors and active commuting to school in adolescents: clustering a self-organizing map analysis. Int. J. Environ. Res. Publ. Health 16 (1), 83–97. https://doi.org/10.3390/ijerph16010083.
Molina-García, J., Queralt, A., Adams, M.A., Conway, T.L., Sallis, J.F., 2017. Neighborhood built environment and socio-economic status in relation to multiple health outcomes in adolescents. Prev. Med. 105, 88–94. https://doi.org/10.1016/j.ypmed.2017.08.026.
Molina-García, J., Queralt, A., Estevan, I., Álvarez, O., Castillo, I., 2016. Barreras percibidas en el desplazamiento activo al centro educativo: fiabilidad y validez de una escala. Gac. Sanit. 30, 426–431. https://doi.org/10.1016/j.gaceta.2016.05.006.
Montoye, H.J., Kemper, H.C.G., Saris, W.H., Washburn, R.A., 1996. Measuring Physical Activity and Energy Expenditure, first ed. Human Kinetics, Champaign, IL, USA.
Moreno, J.A., González-Cutre, D., Chillón, M., Parra, N., 2008. Adaptación a la educación física de la escala de las necesidades psicológicas básicas en el ejercicio. Rev. Mexic. Psicolog. 25 (2), 295–303. Available from: http://www.redalyc.org/articulo.oa?id=243016308009.
Moudon, A.V., Lee, C., 2003. Walking and bicycling: an evaluation of environmental audit instruments. Am. J. Health Promot. 18 (1), 21–37. https://doi.org/10.4278/0890-1171-18.1.21.
Murtagh, S., Rowe, D.A., Elliott, M.A., McMinn, D., Nelson, N.M., 2012. Predicting active school travel: the role of planned behavior and habit strength. Int. J. Behav. Nutr. Phys. Activ. 9 (1), 65. https://doi.org/10.1186/1479-5868-9-65.
National Institute of Statistic, 2018. Official population figures from Spanish municipalities: revision of the municipal register. Recovered from. https://www.ine.es/en/welcome.shtml.

Nelson, T.D., Benson, E.R., Jensen, C.D., 2009. Negative attitudes toward physical activity: measurement and role in predicting physical activity levels among preadolescents. J. Pediatr. Psychol. 35 (1), 89–98. https://doi.org/10.1093/jpepsy/jsp040.
Panter, J., Ogilvie, D., 2015. Theorising and testing environmental pathways to behaviour change: natural experimental study of the perception and use of new infrastructure to promote walking and cycling in local communities. BMJ Open 5 (9), e007593. https://doi.org/10.1136/bmjopen-2015-007593.
Rhodes, R.E., Brown, S.G., McIntyre, C.A., 2006. Integrating the perceived neighborhood environment and the theory of planned behavior when predicting walking in a Canadian adult sample. Am. J. Health Promot. 21 (2), 110–118. https://doi.org/10.4278/0890-1171-21.2.110.
Rhodes, R.E., Courneya, K.S., Blanchard, C.M., Plotnikoff, R.C., 2007. Prediction of leisure-time walking: an integration of social cognitive, perceived environmental, and personality factors. Int. J. Behav. Nutr. Phys. Activ. 4 (1), 51–62. https://doi.org/10.1186/1479-5868-4-51.
Román-Viñas, B., Zazo, F., Martínez-Martínez, J., Aznar-Lain, S., Serra-Majen, L.L., 2018. Results from Spain's 2018 Report card on physical activity for children and youth. J. Phys. Activ. Health 15 (S2), S411–S412. https://doi.org/10.1123/jpah.2018-0464.
Rothman, L., Macpherson, A.K., Ross, T., Buliung, R.N., 2018. The decline in active school transportation (AST): a systematic review of the factors related to AST and changes in school transport over time in North America. Prev. Med. 111, 314–322. https://doi.org/10.1016/j.ypmed.2017.11.018.
Ryan, R.M., Deci, E.L., 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am. Psychol. 55 (1), 68–78. https://doi.org/10.1037/0003-066x.55.1.68, 10.1037110003-066X.55.1.68.
Sallis, J.F., Cervero, R.B., Ascher, W., Henderson, K.A., Kraft, M.K., Kerr, J., 2006. An ecological approach to creating active living communities. Annu. Rev. Publ. Health 27, 297–322. https://doi.org/10.1146/annurev.publhealth.27.021405.102100.
Schlossberg, M., Greene, J., Phillips, P.P., Johnson, B., Parker, B., 2006. School trips: effects of urban form and distance on travel mode. J. Am. Plann. Assoc. 72 (3), 337–346. https://doi.org/10.1080/01944360608976755.
Schölmerich, V.L., Kawachi, I., 2016. Translating the social-ecological perspective into multilevel interventions for family planning: how far are we? Health Educ. Behav. 43 (3), 246–255. https://doi.org/10.1177/1090198116629442.
Scott, E.J., Eves, F.F., French, D.P., Hoppé, R., 2007. The theory of planned behaviour predicts self-reports of walking, but does not predict step count. Br. J. Health Psychol. 12 (4), 601–620. https://doi.org/10.1348/135910706X160335.
Sherar, L.B., Esliger, D.W., Baxter-Jones, A.D., Tremblay, M.S., 2007. Age and gender differences in youth physical activity: does physical maturity matter? Med. Sci. Sports Exerc. 39 (5), 830–835. https://doi.org/10.1249/mss.0b013e3180335c3c.
Silva, K.S., Pizarro, A.N., García, L.M.T., Mota, J., Santos, M.P., 2014. Which social support and psychological factors are associated to active commuting to school? Prev. Med. 63, 20–23. https://doi.org/10.1016/j.ypmed.2014.02.019.
Silva, K.S., Vasques, D.G., Martins, C.D.O., Williams, L.A., Lopes, A.S., 2011. Active commuting: prevalence, barriers, and associated variables. J. Phys. Activ. Health 8 (6), 750–757. https://doi.org/10.1123/jpah.8.6.750.
Sniehotta, F.F., 2009. Towards a theory of intentional behaviour change: plans, planning, and self-regulation. Br. J. Health Psychol. 14 (2), 261–273. https://doi.org/10.1348/135910708X389042.
Sniehotta, F.F., Presseau, J., Araújo-Soares, V., 2014. Time to retire the theory of planned behavior. Health Psychol. Rev. 8 (1), 1–7. https://doi.org/10.1080/17437199.2013.869710.
Spittaels, H., Verloigne, M., Gidlow, C., Gloanec, J., Titze, S., Foster, C., et al., 2010. Measuring physical activity-related environmental factors: reliability and predictive validity of the European environmental questionnaire ALPHA. Int. J. Behav. Nutr. Phys. Activ. 7 (1), 48–67. https://doi.org/10.1186/1479-5868-7-48.
Standage, M., Duda, J.L., Ntoumanis, N., 2003. A model of contextual motivation in physical education: using constructs from self-determination and achievement goal theories to predict physical activity intentions. J. Educ. Psychol. 95 (1), 97–110. https://doi.org/10.1037/0022-0663.95.1.97.
Stark, J., Berger, W.J., Hössinger, R., 2018. The effectiveness of an intervention to promote active travel modes in early adolescence. Transport. Res. F Traffic Psychol. Behav. 55, 389–402. https://doi.org/10.1016/j.trf.2018.03.017.
Su, J.G., Jerrett, M., McConnell, R., Berhane, K., Dunton, G., Shankardass, K., et al., 2013. Factors influencing whether children walk to school. Health Place 22, 153–161. https://doi.org/10.1016/j.healthplace.2013.03.011.
Sun, Y., Liu, Y., Tao, F.B., 2015. Associations between active commuting to school, body fat, and mental well-being: population-based, cross-sectional study in China. J. Adolesc. Health 57 (6), 679–685. https://doi.org/10.1016/j.jadohealth.2015.09.002.
Tabibi, Z., Pfeffer, K., Sharif, J.T., 2012. The influence of demographic factors, processing speed and short-term memory on Iranian children's pedestrian skills. Accid. Anal. Prev. 47, 87–93. https://doi.org/10.1016/j.aap.2012.01.013.
Thompson, A.M., Baxter-Jones, A.D., Mirwald, R.L., Bailey, D.A., 2003. Comparison of physical activity in male and female children: does maturation matter? Med. Sci. Sports Exerc. 35 (10), 1684–1690. https://doi.org/10.1249/01.MSS.0000089244.44914.1F.
Trapp, G.S., Giles-Corti, B., Christian, H.E., Bulsara, M., Timperio, A.F., McCormack, G.R., Villaneuva, K.P., 2011. On your bike! a cross-sectional study of the individual, social and environmental correlates of cycling to school. Int. J. Behav. Nutr. Phys. Activ. 8 (1), 123–133. https://doi.org/10.1186/1479-5868-8-123.
Vallerand, R.J., Losier, G.F., 1999. An integrative analysis of intrinsic and extrinsic motivation in sport. J. Appl. Sport Psychol. 11, 142–169. https://doi.org/10.1080/10413209908402956.
Van Acker, V., Derudder, B., Witlox, F., 2013. Why people use their cars while the built environment imposes cycling. J. Transport Land Use 6 (1), 53–62. https://doi.org/10.5198/jtlu.v6i1.288.
Vlachopoulos, S.P., Michailidou, S., 2006. Development and initial validation of a measure of autonomy, competence, and relatedness in exercise: the Basic Psychological Needs in Exercise Scale. Meas. Phys. Educ. Exerc. Sci. 10 (3), 179–201. https://doi.org/10.1207/s15327841mpee1003_4.
Warburton, D.E., Bredin, S.S., 2017. Health benefits of physical activity: a systematic review of current systematic reviews. Curr. Opin. Cardiol. 32 (5), 541–556. https://doi.org/10.1097/HCO.0000000000000437.
Wendel-Vos, W., Droomers, M., Kremers, S., Brug, J., van Lenthe, F., 2007. Potential environmental determinants of physical activity in adults: a systematic review. Obes. Rev. 8, 425–440. https://doi.org/10.1111/j.1467-789X.2007.00370.x.
Wilson, E.J., Marshall, J., Wilson, R., Krizek, K.J., 2010. By foot, bus or car: children's school travel and school choice policy. Environ. Plann. 42 (9), 2168–2185. https://doi.org/10.1068/a435.
World Health Organization (WHO), 2018. Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World. http://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf.

# Estudio 4. *Effect of distance and psychosocial variables on active mode of commuting to and from school as independent behaviors in children*

**Corral-Abós, A.,** Pizarro, A.N., Santos, M.P., Zaragoza, J., Aibar, A., Mota, J. (202x). Effect of distance and psychosocial variables on active mode of commuting to and from school as independent behaviors in children, *Journal of Transport and Health,* Submitted.

# Effect of distance and psychosocial variables on active mode of commuting to and from school as independent behaviors in children

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**Abstract**

**Introduction.** Despite the well-known benefits associated with active transport to school, less than half of children worldwide engage in it. Differences between factors associated with the mode of commuting to and from school are not well known. Studying factors that especially affect children who live far away from school could help future interventions in terms of motivating them to increase their frequency of ATS at both moments in time. The aim of this research is to explore the psychological and environmental factors that influence frequency of ATS to and from school, as independent behaviors in children living above the threshold distance. **Method.** A cross-sectional study conducted in the city of Huesca (Aragon, Spain) with 800 children aged 9–12 years between January and June 2018. A child self-reported questionnaire was used to assess ATS frequency to and from school and possible influencing factors. **Results.** Distance to school, mothers' attitudes and number of cars emerged as influencing aspects in both variables, i.e., ATS to and from school. Autonomy and perceived behavior control are variables that only revealed a positive influence on ATS. **Conclusion.** Influences on both trip directions of the mode and frequency of commuting to and from school should be studied further, as identifying these influences could help to develop more effective and sustainable interventions.

Keywords:

Active commuting to school; children; distance; autonomy; perception of behavior control; parents' attitudes.

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Declaration of Interest statement:

**Ana Corral-Abós**: Writing - original draft, Writing - review & editing, Methodology, Formal analysis, Data curation. **Andreia Pizarro**: Supervision. Writing - review & editing. **Maria Paula Santos**: Review & editing.: **Javier Zaragoza**: Methodology, Supervision, Investigation, Review & editing. **Alberto Aibar**: Conceptualization, Supervision, Investigation, Review & editing. Resources. **Jorge Mota**: Review & editing.

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## 1. Introduction

Active transport to and from school (ATS) is an alternative behavior geared towards increasing daily physical activity (PA) (Pizarro et al., 2017; Reynolds et al., 2014), which has demonstrated its benefits for health (Dinu et al., 2019). ATS in children is a behavior that is associated with higher levels of PA on schooldays (Kek et al., 2019), less time spent on sedentary pursuits (Uddin et al., 2019), as well as having social and mental benefits (Waygood et al., 2017). Moreover, a decrease in motorized transport around schools could improve impacts on health by reducing greenhouse gas emissions, air and water pollution, and traffic congestion in those areas and in the rest of the city (Faulkner et al., 2009). Getting young people to be physically active during their trips from home to school and back is currently one of the main priorities of the Global Action Plan on Physical Activity 2018–2030 (World Health Organization, 2018), and the 2030 Agenda for Sustainable Development, promoted by the United Nations (United Nations, 2015).

Despite these benefits, over the last decades there have been no changes in the low rates of ATS in Spanish youths (Gálvez-Fernández et al., 2021). Specifically, in Spain, about 50% of young people reported walking to school and only 0.3% reported cycling to school (Herrador-Colmenero et al., 2019).

ATS in children is influenced by complex interactions of multiple factors at individual, social and environmental levels (Ikeda et al., 2019; J. Zaragoza et al., 2020). For instance, intra-individual factors, including demographic and psychosocial factors (e.g., income, age, intention of commuting, perception of competence, etc.), built and social/cultural environment (e.g., distance, parents' attitudes, family composition, etc.), are commonly related to higher levels of ATS (Souza et al., 2019).

Social cognitive theories are theorical models that are widely used to explain ATS (Garnham-Lee et al., 2016; Ikeda et al., 2019). The Theory of Planned Behavior (TPB), which is a socio-psychological model for the prediction of planned behavior, is applied to analyze children's attitudes and behavior, and it has been used to explain the decision making for ATS (Ding et al., 2017). An individual's intention, according to TPB, is the most proximal predictor of a health-related behavior (e.g., ATS), while attitudes, subjective norms and perceived behavioral control (PBC) influence these effects (Ajzen, 1991). In ATS behavior, intentions are the most influential factors on the actual use of each travel mode (García et al., 2019) these was also found in our sample' setting (J. Zaragoza et al., 2020). Limited research has explored the role that subjective norms, PBC and children's attitudes may play in explaining children's ATS (Larouche, 2018). In some studies, these psychological variables seem to be associated with ATS (Panter et al., 2010), also showing indirect effects on this behavior (García et al., 2019), or moderating (e.g., children's attitudes) relationships with ATS (Rothman et al., 2018).

To develop a more comprehensive theoretical model to explain ATS, psychological variables such as psychological needs have been integrated into larger theoretical frameworks (Hagger & Chatzisarantis, 2016). Promising ATS interventions suggest that the integration of behavior change frameworks, such as the social-ecological model (SEM) (Sallis et al., 2008) and self-determination theory (SDT) (Deci & Ryan, 1985), in different phases of the intervention, may enhance the initiation and maintenance of ATS

behaviors (Ntoumanis et al., 2021). In this sense, the satisfaction of basic psychological needs (BPNs) (i.e., autonomy, competence, and relatedness), as SDT postulates (Deci & Ryan, 2000), improve psychological well-being, and indirectly increase interest, attitude or intention to carry out ATS. Besides, BPNs are widely used to develop strategies to promote health-related behaviors (e.g., ATS) (Gillison et al., 2019). Despite the positive effects that satisfaction of autonomy, competence, and relatedness have had on improving PA behavior, its influence had not been thoroughly analyzed in the specific ATS context (Burgueño et al., 2020).

In addition to psychological and cognitive factors, it is important to consider environmental factors, which may explain the context-specific influences of ATS (Sallis et al., 2006). Sociodemographic variables (e.g., age, gender or socioeconomic status [SES]), social factors (e.g., parents' attitudes) (Mandic et al., 2015), and environmental factors (e.g., distance) could have direct or indirect influences on the choice of active transport modes (Rothman et al., 2018). A literature review showed that some sociodemographic factors may be associated with ATS, especially gender, age and socioeconomic level (Pinto et al., 2017). However, in some studies, age, gender or SES, and number of vehicles at home did not show any significant association with ATS (Mandic et al., 2016). Mixed results were found in other research studies, for instance, people with low incomes tend to use active travel, but there are no significant differences between boys and girls (Ding et al., 2017). Mobility options, such as access to private motor vehicles also facilitate or impose constraints on the choice of ATS (Mitra, 2013), and families with high SES tend to have greater access to private motor vehicles, indirectly relating SES to ATS (Rothman et al., 2018).

Current theoretical models (Mandic et al., 2015) postulate that social factors, such as parents' attitudes, are important variables to promote ATS in children (Ikeda, Hinckson, et al., 2018; Rothman et al., 2018). Parents make decisions about their children's travel mode based on a number of factors, including attitudes (Seraj et al., 2012). In their review paper, Rothman et al. (2018) found that parents' attitudes toward ATS had a moderate relationship with ATS. Previous research conducted in our study context showed that only mothers' attitudes seem to play a significant influence (Corral-Abós et al., 2021). Further research focused on attitudes and social norms around ATS is likely to be useful for different contexts (Mitra & Buliung, 2014).

Distance between home and school, as an environmental factor, is clearly the strongest and most consistent correlate of ATS (Ikeda, Hinckson, et al., 2018; Ikeda, Stewart, et al., 2018; Larouche, 2018). Distances from home to school have increased during the last 20 years (Rothman et al., 2018), raising the probability of using motorized transport to school (Beck & Nguyen, 2017). The association between distance and ATS is clear, as participants living further from school are more unlikely to walk to school (Rodríguez-López et al., 2017). Similarly to previous studies (Rodríguez-López et al., 2017), to identify the distance that best discriminates walkers and passive commuters, a threshold distance with Receiver Operating Characteristic (ROC) curve analyses was calculated in our study context (Corral-Abós et al., 2021). A distance of 725 m from home to school was found to be the best cut-off distance for the ages and context of our sample (Corral-Abós., 2021).

The differences between the mode of commuting to and from school are not known. Only two studies have assessed the differences between the mode of commuting to and from school (Herrador-Colmenero et al., 2019; van Sluijs et al., 2009). For example, Herrador-Colmenero et al. (2019) found differences between to and from school trip patterns, with more ATS usually taking place during from school trips. Specifically, these authors reported 3% more walkers on the way from school compared to the way to school, and 3% more car commuters on the way to school compared to the way from school. However, since the mode of commuting is related to the geographical (Oyeyemi & Larouche, 2018) and built environment (Molina-García et al., 2019), more studies in different populations are needed to verify these differences.

Despite the well-known benefits associated with ATS, less than half of children worldwide use ATS (Aubert et al., 2018). This paper is motivated by previous works (Corral-Abós et al., 2021; Zaragoza et al., 2020). In our setting, the factors that influenced normal ATS behavior had already been tested (Zaragoza et al., 2020), together with influencing factors (i.e., distance, mothers' attitudes, SES) in weekly ATS frequency, showing preliminary differences between children who lived below and above the threshold distance of 725m (Corral-Abós et al., 2021). Studying factors that affect children living far from that, in their to and from school trips, could help future interventions to motivate them to increase their ATS frequency at both moments in time (i.e., to and from school trips), and consequently enhance their levels of PA. Thus, the aim of this research is to explore the psychological and environmental factors that influence ATS frequency to and from school, as independent behaviors in children living farther away than 725 m from school.

## 2. Material and methods

### 2.1. Study design, setting and participants.

This research forms part of a larger study called Promote Active Transport to School (ProATs), a cross-sectional study conducted in the city of Huesca. Huesca is a mid-sized city located in the northeast of Spain with a total population of 53,656 inhabitants, and an urban area of 4.21 km2, with no industrial area, and with a population density of 7,763 inhabitants/km2 (National Institute of Statistics, 2018). Data were collected between January and June 2018.

The participants' recruitment procedure has already been described elsewhere (omitted for anonymity). All children aged 9–12 years (grades 4–6) from 12 Huesca primary schools were invited to participate in this study. Only one school declined participation. 1,560 children from the other 11 schools were asked to collaborate in the study. After excluding missing or incomplete data as well as the participants who did not sign the informed consent, a final sample of 800 children from 11 schools (52.0% girls) with a mean age of 10.60 (SD=0.92) years, was analyzed (Figure 1). This study was approved by the Ethics Committee for Clinical Research of Aragon (CEICA) (Ethical code: C1P117/0018).

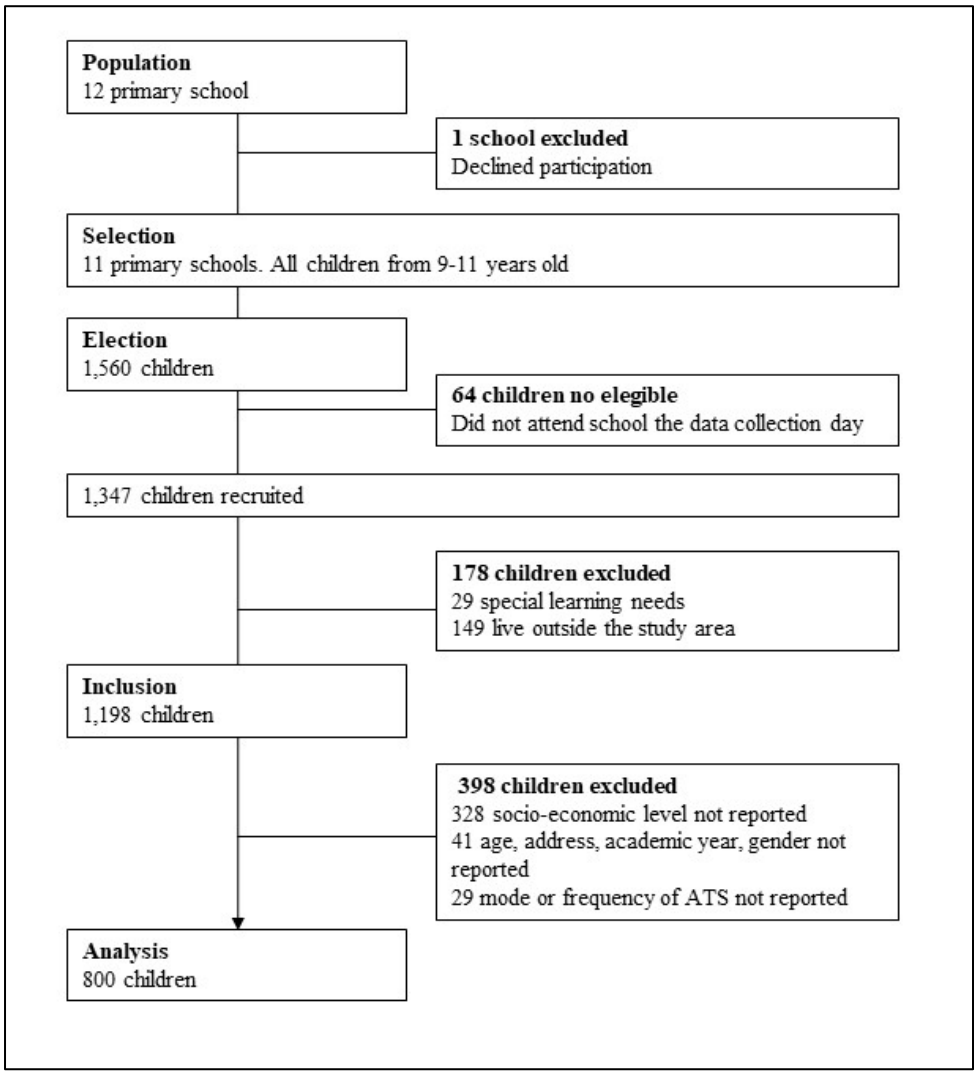


Figure 1. Flowchart of participants selection for the study.

2.2. Variables

2.2.1. Sociodemographic characteristics: gender, age, distance.

Sociodemographic variables (i.e., gender, age, school, zip code, and home address), were self-reported by students. Distance to school was objectively estimated using Google Maps, selecting the shortest route on foot option between the home address and the school's main entrance.

2.2.1.1. Calculation of the threshold distance

From the different analytical and geographic methods available to obtain the threshold, the Receiver Operating Characteristic (ROC) curve analysis was used to calculate the threshold distance for active commuting, based on the distance from home to school and the mode of commuting to school (active vs. passive), in a similar manner to a previous study (Corral-Abós., 2021). The ROC curve analysis showed a threshold distance of 725 m (area under the curve: 0.834; $p < .000$), resulting in the subsample of students who lived above the threshold distance ($n$=326).

2.2.2. Weekly ATS frequency: Total, to and from school.

The P.A.C.O (Pedalea y Anda al Colegio) questionnaire (http://profith.ugr.es/paco) was used to measure weekly ATS frequency to and from school every day of the week (i.e., Monday to Friday). This questionnaire has been previously validated with accelerometry in Spanish children and adolescents (Palma Chillón et al., 2017), and its reliability has been recently assessed showing good results (Segura-Díaz et al., 2020). Children self-reported all their weekly trips to and from school using a single item for each travel day: "How do you commute to school on 'Mondays'?" and "How do you commute from school on 'Mondays'?", repeating this question for every weekday. The answer options were walking, cycling, by car, motorcycle, or bus. As a result, 10 different modes of travel were obtained, 5 modes to and 5 modes from school, respectively. Walking and cycling were categorized as active trips. All other answer options were categorized as passive trips. Weekly active trips to school were summed into a single variable (i.e., commuting to school) ranging from 0 to 5, and weekly active trips from school were also summed into a single variable (i.e., commuting from school) also ranging from 0 to 5. All weekly active trips were summed into a single variable ranging from 0 to 10 (i.e., total school commuting).

2.2.2. Individual variables: TPB and BPN variables.

A questionnaire to measure the TPB and BPN variables was used following previous research procedures (Zaragoza et al., 2020). Intention was measured using one item (i.e., "I want to walk or bike to school every day"). Attitude was evaluated by three items consisting of two instrumental component items (i.e., "For me walking or cycling to school regularly could be good or bad"; "For me walking or cycling to school regularly could be/useful or useless"), and one affective component item (i.e., "For me walking or cycling to school regularly could be unpleasant/pleasant"). Subjective norm was measured using three items (i.e., "My father or mother/my friends/my teachers tell me that I should go to school on foot or by bike"). PBC was evaluated using three items (e.g., "I could go to the school on foot or by bike everyday if I wanted"). Nine items from the BPNs in exercise scale (Burgueño et al., 2020) were used to measure autonomy, competence and relatedness. Children reported their answers using a five-point Likert scale (1: strongly disagree - 5: strongly agree). Internal consistency reliability was calculated with Cronbach's alpha and was acceptable in all constructs measured (attitude: Cronbach's $\alpha$=0.97, subjective norm: Cronbach's $\alpha$=0.90, PBC: Cronbach's $\alpha$=0.90, autonomy: Cronbach's $\alpha$= 0.67, competence: Cronbach's $\alpha$ = 0.82 and relatedness: Cronbach's $\alpha$=0.84).

2.2.3. Family variables: SES, number of cars, and mothers' attitudes.

Socioeconomic status (SES) was reported by mothers using the Family Affluence Scale (FAS II) questionnaire for children (Boyce et al., 2006). To know the number of family cars, one item of the FAS II was used: (1) Car: does your family own a car, van or truck? (Codes: No = 1; One = 2; Two or more = 3). Based on previous and published research (omitted for anonymity), ten questions (e.g., "It is interesting for my child to walk to school alone or with friends"), with a five-point Likert scale (1: strongly disagree - 5: strongly agree), were used to assess mothers' attitudes toward ATS (mother's attitudes: Cronbach's $\alpha$= 0.74).

2.3. Statistical analysis

Sociodemographic characteristics and explaining variables were analyzed using descriptive statistics for the entire sample and for the two sub-samples according to their threshold distance (i.e., children who lived above and below the threshold distance).

Differences between frequency of weekly active trips to and from school (i.e., commuting to and from school) were tested using a dependent sample t-test for the entire sample and for two sub-samples. Only sub-samples that showed statistical differences in to and from school patterns, were considered in the following analysis.

We initially considered the nested nature of data (students in schools) at the very beginning of the study. However, after conducting three initial null models (i.e., one for each behavior pattern: commuting to school, commuting from school, and total school commuting), ICC values (0.071; $p = .204$. for commuting to school; .047; $p=.303$ for commuting from school; 0.08; $p = .179$ for total school commuting) showed that a two-level multilevel structure (i.e., students in schools) was not required. Then, three independent stepwise linear regression models (i.e., commuting to school, commuting from school, and total school commuting) were used to test the influence of TPB variables (i.e., intention, PBC, subjective norm, attitudes of children and mothers), BPNs variables (i.e., autonomy, competence, relatedness), SES, number of cars, and distance on weekly frequency of ACS. Moreover, age and gender were also included as control variables in all models. The Nagelkerke R Square values were provided as a goodness-of-fit measure.

All significant levels were established at $p < .05$. All analyses were conducted using SPSS V.26.

3. Results

Data from 800 children (52.0% girls, 43.5% private school) were included in the descriptive statistical analysis (Table 1). 40.75% of the total sample lived above the threshold distance (i.e., 50.6 % girls, 66.9% private school).

Table 1. Descriptive statistics of children participants

| | Total (*n*=800) | Below threshold distance (725 m) (*n*=474) | Above threshold distance (725 m) (*n*=326) |
|---|---|---|---|
| | M (SD) | M(SD) | M (SD) |
| Age | 10.60 (.92) | 10.56 (.92) | 10.66 (.93) |
| Distance to school (m) | 752.28 (533.99) | 396.89 (172.00) | 1269.02 (453.76) |
| Number of vehicles at home | 2.46 (.56) | 2.44 (.57) | 2.50 (.56) |
| BPN variables | | | |
| Autonomy | 3.28 (1.07) | 3.45 (1.05) | 3.02 (1.06) |
| Competence | 4.47 (.80) | 4.62 (.60) | 4.26 (.99) |
| Relatedness | 4.38 (.69) | 4.37 (.68) | 4.40 (.71) |
| TPB variables | | | |
| PBC | 4.08 (1.10) | 4.37 (.87) | 3.66 (1.25) |
| Intention | 4.02 (1.26) | 4.23 (1.15) | 3.71 (1.36) |
| Attitudes | 4.01 (.77) | 3.99 (.76) | 4.03 (.78) |
| Mothers' attitudes | 4.04 (.66) | 4.19 (.58) | 3.82 (.72) |

Note. BPN: basic psychological needs; TPB: Theory of Planned Behavior; PBC: perception behavior control.

Significant differences were only found (t=- 2.468; p=.014) between the number of active trips to (M=2.52, SD=2.33) and from (M=2.79, SD=2.21) school in those students who lived above the threshold distance (i.e., 725m). No significant differences were found in students who lived below the threshold distance (t=-1.915; p=.056) between the number of trips to (M=2.52, SD=2.33) and from (M=2.79, SD=2.21) school.

Table 2 shows three stepwise linear regression models (i.e., one for each behavior pattern) for the subsample of students who lived above the threshold distance (*n*=326). The final model shows a statistically significant negative influence from distance and number of cars, and a positive influence from mother's attitudes and autonomy, on total weekly frequency of ATS (i.e., total school commuting). For weekly frequency to school (i.e., commuting to school), the final model also included a statistically significant positive influence from PBC. For weekly frequency from school (i.e., Commuting from school), neither autonomy nor PBC showed a statistically significant influence.

Table 2. Linear stepwise regression models on weekly frequency of ATS for each behavior pattern.

| | | FINAL LINEAR REGRESSION MODEL | | | |
|---|---|---|---|---|---|
| | | B | $\beta$ | $p$ | $R^2$ |
| Commuting to school | Constant | 1.85 | | .054 | .68 |
| | Distance | -.002 | -.332 | <.001 | |
| | Mothers' attitudes | .767 | .246 | <.001 | |
| | Autonomy | .429 | .198 | <.001 | |
| | Number of cars | -.753 | -.188 | <.001 | |
| | PBC | .235 | .124 | .031 | |
| Commuting from school | Constant | 5.44 | | <.001 | .28 |
| | Distance | -.002 | -.474 | <.001 | |
| | Mothers' attitudes | .412 | .142 | .012 | |
| | Number of cars | -.423 | -.113 | .035 | |
| Total school commuting | Constant | 7.44 | | <.001 | .47 |
| | Distance | -.004 | -.459 | <.001 | |
| | Mothers' attitudes | 1.17 | .221 | <.001 | |
| | Autonomy | .742 | -.196 | <.001 | |
| | Number of cars | -1.14 | -.167 | <.001 | |

Note. $\beta$: standardized coefficient. B: non-standardized coefficient. PBC: perception behavior control.

## 4- Discussion

Within school transport literature, separate analyses for the choice of travel mode to and from school as independent variables have not usually been conducted. The aim of this research was to explore the psychological and environmental factors that influence frequency of ATS to and from school as different behaviors in children living above a threshold distance previously found of 725m. Only those students who lived above the threshold distance had statistical differences in ATS frequency to and from school in our study. In such cases, we found a significantly higher frequency of active trips from school than to school. In addition, results relating to these students also showed that active transport to and from school were influenced by different factors. Distance, mothers' attitudes, and number of cars appeared in both models (i.e., ATS to and from school) as influencing variables. Autonomy and PBC were variables that only revealed a positive influence on ATS to school.

As in other studies carried out in our country (Herrador-Colmenero et al., 2019), there are differences between the mode of commuting to school and from school. It seems that some children are driven to school in the mornings by their parents, and that they walk back home in the afternoons. Similar results were obtained for Canadian (Larsen et al., 2012), North American (McDonald et al., 2014; Seraj et al., 2012), and Iranian (Samimi & Ermagun, 2013) young people, reporting 8%, 4%, and 6%, respectively, more walkers on the trip from school than on the trip to school. Different factors could explain ATS behavior to and from school separately.

Differences between commuting to school and from school may be partially explained by parents' schedules and their resource accessibility. Family convenience and planning for children to arrive on time for school could explain a lower frequency of active trips (Pizarro et al., 2016). Household access to a private motor vehicle (Chillon et al., 2009), having a parent available for escorting, and being able to link up different trips (i.e., coordinating parents' travel to work, in addition to meeting other household commitments for example, driving children to school) has been previously reported as a main correlate in the mode of commuting to school (Ghekiere et al., 2016; Lu et al., 2014; Mitra, 2013).

Fathers and mothers may also report different barriers to ATS (Aibar-Solana et al., 2018). Empirical findings show that mothers and fathers play different roles in a family's planning (Chesley & Flood, 2017). In the study context, only mothers' positive attitudes had an influence on a higher frequency of ATS. Mothers' attitude traits have a higher influence on several behaviors, because their role in the family structure is still as the primary caregiver (Schoeppe, Duncan, et al., 2016), which could have a greater influence on their children's behavior. That result is similar to previous studies (Corral-Abós et al., 2021; Rothman et al., 2018).

Distance is clearly associated with ATS (Rodríguez-López et al., 2017). Study results only showed significant differences in the frequency of ATS between going to and from school in those subjects who lived above the threshold distance. Nevertheless, in Spain, elementary schools are usually located closer to students' homes, so elementary school students had significantly shorter travel times than secondary school students (Mayor, 2017). Study results demonstrated that distance had the strongest negative influence on both models, as postulated in different literature reviews (Ikeda, Hinckson, et al., 2018; Ikeda, Stewart, et al., 2018; Larouche, 2018). Distance to school is a key constraint on active travel to school, but evidence from a range of sources indicates that "too far to walk or cycle", needs to be understood not just in terms of quantitative distance, but also in terms of the environmental, psychological, and cultural factors that shape perceptions of "too far". That is, if active school travel routes are considered to be safe, the trip to school may be less likely to be perceived by parents as "too far" to walk or cycle.

This study explored the psychological and environmental factors that influence frequency of ATS to and from school, as independent behaviors in children living above the threshold. Results showed that autonomy and PBC are variables that have a positive influence on the commuting to school model. However, other studies (Herrador-Colmenero et al., 2014) pointed out that there were no differences in the influences of commuting to school versus commuting from school - the influence of these two variables on the ATS (i.e., to and from school) has been previously documented. Children's autonomy and PBC have been directly and indirectly related to children's intention and ATS (J. Zaragoza et al., 2020). Time constraints in the morning and the influence of variables such as autonomy and PBC could be reasons that explain the difference in the mode of commuting to and from school. These time constraints in the mornings could explain the use of passive modes to travel to school through the influence of variables such as PBC and autonomy. Perhaps, to overcome these time constraints, a significantly higher level of autonomy and PBC is necessary.

Further research is required to examine the accuracy of children's PBC and their autonomy over behavior (i.e., commuting to school in the morning), and the role of parental decision-making control in this situation. If autonomy, PBC, in addition to distance, mothers' attitudes and the number of cars, are the variables that have a positive influence on the commuting to school model, future interventions should design strategies to increase these determinants. This would benefit those students who live at greater distances, potentially increasing their PA levels, since their ATS trips are longer than those of their peers who live below the threshold distance.

**Study strengths.** The manuscript (Zaragoza et al., 2020) was written and finally published in 2020 to answer the initial research question: "What factors influence behavior in the study context?". However, from that research, a new gap was subsequently detected in the literature, and we realized that travel to and from school behaviors could be different (Herrador-Colmenero et al., 2019). This was not assessed in the first paper, and we believed that it was a highly relevant issue. Moreover, other papers also led us to suspect that the way in which the dependent variable was framed might have implications for the influencing factors (omitted for anonymity). That is why we decided to incorporate this research question into this current paper. Therefore, this paper helps, firstly, to have more comprehensive information on this behavior and secondly, to select the most effective intervention strategies. Knowing whether a factor influences the travel mode or travel frequency, or both, or if it only does so at the time of going to or from school can also help to select strategies based on how far away the student lives.

**Study limitations**. Study results showed a lower variance explained in the commuting from school model in comparison to the commuting to school model. This may indicate the existence of potential factors that might influence this behavior that have not been considered in the study. For example, elementary school students with mothers who commuted to work in the morning could be less likely to walk/bike to school, suggesting that a parent's temporal constraints and desire for convenience affect school travel mode choice (McDonald, 2008). This can be particularly pronounced for those students who live far away, because they must spend more time on school trips (Pizarro et al., 2016). Nevertheless, the school timetable can also be a factor to consider. In the study context, the common school schedule is between 9.00 a.m. to 12.00 p.m. and between 15.00 p.m. to 17.00 p.m. This schedule requires considerable planning and could increase barriers to ATS, resulting in different travel behaviors at different times of the school day (Wong et al., 2011). Focusing on differences between commuting to and from school raises the consideration of whether interventions might be more effective by targeting either the morning or afternoon periods. Family convenience in terms of driving children to school and the lack of time in the morning, could be reasons that explain the difference in the mode of commuting to and from school (Larsen et al., 2012; Panter et al., 2013; Samimi & Ermagun, 2013).

## 5- Conclusions

In this paper, we carried out an empirical research that explores the psychological and environmental factors that influence ATS frequency to and from school, as independent behaviors in children who live more than 725 m from school. The main findings are listed below as follows. We found a significantly higher frequency of active trips from school than to school. Active transport to and from school was influenced by different factors.

While in previous studies, parents who drive their children to school for convenience and lack of time in the morning, are the reasons that explain the difference between on the ATS frequency to and from school, we find that distance, mothers' attitudes, and number of cars appeared as influencing variables in both models (i.e., ATS to and from school) while autonomy and PBC were variables that only revealed a positive influence on ATS to school. For this reason, we recommend assessing the commuting frequency, including both trip directions (i.e., to and from school), and to exploring the factors that influence ATS frequency to and from school, as independent behaviors, in order to identify a similar or different pattern, and provide a more accurate knowledge. Identifying these influences could help to develop more effective interventions.

## 6- References

Aibar-Solana, A., Mandic, S., Generelo-Lanaspa, E., Gallardo, L. O., & Zaragoza Casterad, J. (2018). Parental barriers to active commuting to school in children: does parental gender matter? Journal of Transport & Health, 9, 141–149. https://doi.org/10.1016/j.jth.2018.03.005

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Aubert, S., Barnes, J. D., Abdeta, C., Abi Nader, P., Adeniyi, A. F., Aguilar-Farias, N., Andrade Tenesaca, D. S., Bhawra, J., Brazo-Sayavera, J., Cardon, G., Chang, C.-K., Delisle Nyström, C., Demetriou, Y., Draper, C. E., Edwards, L., Emeljanovas, A., Gába, A., Galaviz, K. I., González, S. A., … Tremblay, M. S. (2018). Global Matrix 3.0 Physical Activity Report Card Grades for Children and Youth: Results and Analysis From 49 Countries. Journal of Physical Activity and Health, 15(s2), S251–S273. https://doi.org/10.1123/jpah.2018-0472

Beck, L. F., & Nguyen, D. D. (2017). School transportation mode, by distance between home and school, United States, ConsumerStyles 2012. Journal of Safety Research, 62, 245–251. https://doi.org/10.1016/j.jsr.2017.04.001

Boyce, W., Torsheim, T., Currie, C., & Zambon, A. (2006). The family affluence scale as a measure of national wealth: Validation of an adolescent self-report measure. Social Indicators Research, 78(3), 473–487. https://doi.org/10.1007/s11205-005-1607-6

Burgueño, R., González-Cutre, D., Sevil-Serrano, J., Herrador-Colmenero, M., Segura-Díaz, J. M., Medina-Casaubón, J., & Chillon, P. (2020). Validation of the Basic Psychological Need Satisfaction in Active Commuting to and from School (BPNS-ACS) Scale in Spanish young people. Journal of Transport & Health, 16(February 2019), 100825. https://doi.org/10.1016/j.jth.2020.100825

Chesley, N., & Flood, S. (2017). Signs of Change? At-Home and Breadwinner Parents' Housework and Child-Care Time. Journal of Marriage and Family, 79(2), 511–534. https://doi.org/10.1111/jomf.12376

Chillón, P., Herrador-Colmenero, M., Migueles, J. H., Cabanas-Sánchez, V., Fernández-Santos, J. R., Veiga, Ó. L., Castro-Piñero, J., Marcos, A., Bandrés, F., Martínez-Gómez, D., Ruiz, J. R., Carbonell-Baeza, A., Gomez-Martinez, S., Santiago, C., Nova, E., Díaz, E. L., Zapatera, B., Veses, A. M., Mujico, J. R., … Gómez-Gallego, F. (2017). Convergent validation of a questionnaire to assess the mode and frequency of commuting to and from school. Scandinavian Journal of Public Health, 45(6), 612–620. https://doi.org/10.1177/1403494817718905

Chillon, P., Ortega, F. B., Ruiz, J. R., Perez, I. J., Martin-Matillas, M., Valtuena, J., Gomez-Martinez, S., Redondo, C., Rey-Lopez, J. P., Castillo, M. J., Tercedor, P., & Delgado, M. (2009). Socio-economic factors and active commuting to school in urban Spanish adolescents: the AVENA study. The European Journal of Public Health, 19(5), 470–476. https://doi.org/10.1093/eurpub/ckp048

Corral-Abós, A., Aibar, A., Estrada-Tenorio, S., Julián, J. A., Ibor, E., & Zaragoza, J. (2021). Implications of school type for active commuting to school in primary education students. Travel Behaviour and Society, 24(April), 143–151. https://doi.org/10.1016/j.tbs.2021.03.007

Deci, E. L., & Ryan, R. M. (1985). The general causality orientations scale: Self-determination in personality. Journal of Research in Personality, 19(2), 109–134. https://doi.org/10.1016/0092-6566(85)90023-6

Deci, E. L., & Ryan, R. M. (2000). The "What" and "Why" of goal pursuits: Human needs and the self-determination of behavior. Psychological Inquiry, 11(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Ding, C., Chen, Y., Duan, J., Lu, Y., & Cui, J. (2017). Exploring the Influence of Attitudes to Walking and Cycling on Commute Mode Choice Using a Hybrid Choice Model. Journal of Advanced Transportation, 2017, 1–8. https://doi.org/10.1155/2017/8749040

Dinu, M., Pagliai, G., Macchi, C., & Sofi, F. (2019). Active Commuting and Multiple Health Outcomes: A Systematic Review and Meta-Analysis. Sports Medicine, 49(3), 437–452. https://doi.org/10.1007/s40279-018-1023-0

Faulkner, G. E. J., Buliung, R. N., Flora, P. K., & Fusco, C. (2009). Active school transport, physical activity levels and body weight of children and youth: A systematic review. Preventive Medicine, 48(1), 3–8. https://doi.org/10.1016/j.ypmed.2008.10.017

Gálvez-Fernández, P., Herrador-Colmenero, M., Esteban-Cornejo, I., Castro-Piñero, J., Molina-García, J., Queralt, A., Aznar, S., Abarca-Sos, A., González-Cutre, D., Vidal-Conti, J., Fernández-Muñoz, S., Vida, J., Ruiz-Ariza, A., Rodríguez-Rodríguez, F., Moliner-Urdiales, D., Villa-González, E., Barranco-Ruiz, Y., Huertas-Delgado, F. J., Mandic, S., & Chillón, P. (2021). Active commuting to school among 36,781 Spanish children and adolescents: A temporal trend study. Scandinavian Journal of Medicine & Science in Sports, 31(4), 914–924. https://doi.org/10.1111/sms.13917

García, J., Arroyo, R., Mars, L., & Ruiz, T. (2019). The Influence of Attitudes towards Cycling and Walking on Travel Intentions and Actual Behavior. Sustainability, 11(9), 2554. https://doi.org/10.3390/su11092554

Garnham-Lee, K. P., Falconer, C. L., Sherar, L. B., & Taylor, I. M. (2016). Evidence of moderation effects in predicting active transport to school. Journal of Public Health (United Kingdom), 39(1), 153–162. https://doi.org/10.1093/pubmed/fdw016

Ghekiere, A., Van Cauwenberg, J., Carver, A., Mertens, L., de Geus, B., Clarys, P., Cardon, G., De Bourdeaudhuij, I., & Deforche, B. (2016). Pyschosocial factors associated with children's cycling for transport: A cross-sectional moderation study. Preventive Medicine, 86, 141–146. https://doi.org/10.1016/j.ypmed.2016.03.001

Gillison, F. B., Rouse, P., Standage, M., Sebire, S. J., & Ryan, R. M. (2019). A meta-analysis of techniques to promote motivation for health behaviour change from a self-determination theory perspective. Health Psychology Review, 13(1), 110–130. https://doi.org/10.1080/17437199.2018.1534071

Hagger, M. S., & Chatzisarantis, N. L. D. (2016). The Trans-Contextual Model of autonomous motivation in education. Review of Educational Research, 86(2), 360–407. https://doi.org/10.3102/0034654315585005

Herrador-Colmenero, M., Escabias, M., Ortega, F., McDonald, N., & Chillón, P. (2019). Mode of Commuting TO and FROM School: A Similar or Different Pattern? Sustainability, 11(4), 1026. https://doi.org/10.3390/su11041026

Herrador-Colmenero, M., Pérez-García, M., Ruiz, J. R., & Chillón, P. (2014). Assessing modes frequency of commuting to school in youngsters: A systematic review. Pediatric Exercise Science, 26(3), 291–341. https://doi.org/10.1123/pes.2013-0120

Ikeda, E., Hinckson, E., Witten, K., & Smith, M. (2018). Associations of children's active school travel with perceptions of the physical environment and characteristics of the social environment: A systematic review. Health and Place, 54(August), 118–131. https://doi.org/10.1016/j.healthplace.2018.09.009

Ikeda, E., Hinckson, E., Witten, K., & Smith, M. (2019). Assessment of direct and indirect associations between children active school travel and environmental, household and child factors using structural equation modelling. International Journal of Behavioral Nutrition and Physical Activity, 16(1), 1–17. https://doi.org/10.1186/s12966-019-0794-5

Ikeda, E., Stewart, T., Garrett, N., Egli, V., Mandic, S., Hosking, J., Witten, K., Hawley, G., Tautolo, E. S., Rodda, J., Moore, A., & Smith, M. (2018). Built environment associates of active school travel in New Zealand children and youth: A systematic meta-analysis using individual participant data. Journal of Transport & Health, 9(February), 117–131. https://doi.org/10.1016/j.jth.2018.04.007

Kek, C. C., García Bengoechea, E., Spence, J. C., & Mandic, S. (2019). The relationship between transport-to-school habits and physical activity in a sample of New Zealand adolescents. Journal of Sport and Health Science, 8(5), 463–470. https://doi.org/10.1016/j.jshs.2019.02.006

Larouche, R. (2018). Children's Active Transportation. In Children's Active Transportation (1st Editio). Elservier.

Larsen, K., Gilliland, J., & Hess, P. M. (2012). Route-Based Analysis to Capture the Environmental Influences on a Child's Mode of Travel between Home and School. Annals of the Association of American Geographers, 102(6), 1348–1365. https://doi.org/10.1080/00045608.2011.627059

Lu, W., McKyer, E. L. J., Lee, C., Goodson, P., Ory, M. G., & Wang, S. (2014). Perceived barriers to children's active commuting to school: A systematic review of empirical, methodological and theoretical evidence. International Journal of Behavioral Nutrition and Physical Activity, 11(1), 1–20. https://doi.org/10.1186/s12966-014-0140-x

Mandic, S., Flaherty, C., Pocock, T., Mintoft-Jones, A., Frater, J., Chillón, P., & García Bengoechea, E. (2016). Attitudes towards cycle skills training in New Zealand adolescents. Transportation Research Part F: Traffic Psychology and Behaviour, 42, 217–226. https://doi.org/10.1016/j.trf.2016.08.002

Mandic, S., Leon de la Barra, S., García Bengoechea, E., Stevens, E., Flaherty, C., Moore, A., Middlemiss, M., Williams, J., & Skidmore, P. (2015). Personal, social and environmental correlates of active transport to school among adolescents in Otago, New Zealand. Journal of Science and Medicine in Sport, 18(4), 432–437. https://doi.org/10.1016/j.jsams.2014.06.012

Mayor, D. (2017). Effects of School Choice on Students' Mobility: Evidence from Madrid. https://www.comunidad.madrid/sites/default/files/doc/educacion/sgea_estudio_efecto_incremento_libertad_eleccion_centro_en_movilidad_estud.pdf

McDonald, N. C. (2008). Household interactions and children's school travel: the effect of parental work patterns on walking and biking to school. Journal of Transport Geography, 16, 324–331. https://doi.org/10.1016/j.jtrangeo.2008.01.002

McDonald, N., Steiner, R., Lee, C., Rhoulac-Smith, T., Zhu, X., & Yang, Y. (2014). Impact of the Safe Routes to School Program on Walking and Bicycling. Journal of the American Planning Association, 80(2), 153–167. https://doi.org/10.1080/01944363.2014.956654

Mitra, R. (2013). Independent Mobility and Mode Choice for School Transportation: A Review and Framework for Future Research. Transport Reviews, 33(1), 21–43. https://doi.org/10.1080/01441647.2012.743490

Mitra, R., & Buliung, R. N. (2014). The influence of neighborhood environment and household travel interactions on school travel behavior: An exploration using geographically-weighted models. Journal of Transport Geography, 36, 69–78. https://doi.org/10.1016/j.jtrangeo.2014.03.002

Molina-García, J., García-Massó, X., Estevan, I., & Queralt, A. (2019). Built environment, psychosocial factors and active commuting to school in adolescents: Clustering a self-organizing map analysis. International Journal of Environmental Research and Public Health, 16(1). https://doi.org/10.3390/ijerph16010083

National Institute of Statistic. (2018). Official population figures from Spanish municipalities: revision of the municipal register. https://www.ine.es/uc/Hhy4Lse2

Ntoumanis, N., Ng, J. Y. Y., Prestwich, A., Quested, E., Hancox, J. E., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Lonsdale, C., & Williams, G. C. (2021). A meta-analysis of self-determination theory-informed intervention studies in the health domain: effects on motivation, health behavior, physical, and psychological health. Health Psychology Review, 15(2), 214–244. https://doi.org/10.1080/17437199.2020.1718529

Oyeyemi, A. L., & Larouche, R. (2018). Prevalence and Correlates of Active Transportation in Developing Countries Prevalence and Correlates of Active. In R. Larouche (Ed.), Children's Active Transportation (pp. 173–191). El Servier.

Panter, J., Corder, K., Griffin, S. J., Jones, A. P., & van Sluijs, E. M. (2013). Individual, socio-cultural and environmental predictors of uptake and maintenance of active commuting in children: longitudinal results from the SPEEDY study. International Journal of Behavioral Nutrition and Physical Activity, 10(1), 83. https://doi.org/10.1186/1479-5868-10-83

Panter, J. R., Jones, A. P., van Sluijs, E. M. ., & Griffin, S. . (2010). Attitudes, social support and environmental perceptions as predictors of active commuting behaviour in school children. Journal of Epidemiology & Community Health, 64(01), 41–48. https://doi.org/10.1136/jech.2009.086918

Pinto, A. de A., Claumann, G. S., Angelo, H. C. C. de, Menezes, E. C., Dias, D. T., & Pelegrini, A. (2017). ACTIVE COMMUTING TO SCHOOL AND ASSOCIATED FACTORS AMONG ADOLESCENTS: A SYSTEMATIC REVIEW. Journal of Physical Education, 28(1), 1–11. https://doi.org/10.4025/jphyseduc.v28i1.2859

Pizarro, A. N., Schipperijn, J., Andersen, H. B., Ribeiro, J. C., Mota, J., & Santos, M. P. (2016). Active commuting to school in Portuguese adolescents: Using PALMS to detect trips. Journal of Transport & Health, 3(3), 297–304. https://doi.org/10.1016/j.jth.2016.02.004

Pizarro, A. N., Schipperijn, J., Ribeiro, J. C., Figueiredo, A., Mota, J., & Santos, M. P. (2017). Gender Differences in the Domain-Specific Contributions to Moderate-to-Vigorous Physical Activity, Accessed by GPS. Journal of Physical Activity and Health, 14(6), 474–478. https://doi.org/10.1123/jpah.2016-0346

Reynolds, R., McKenzie, S., Allender, S., Brown, K., & Foulkes, C. (2014). Systematic review of incidental physical activity community interventions. Preventive Medicine, 67, 46–64. https://doi.org/10.1016/j.ypmed.2014.06.023

Rodríguez-López, C., Salas-Fariña, Z. M., Villa-González, E., Borges-Cosic, M., Herrador-Colmenero, M., Medina-Casaubón, J., Ortega, F. B., & Chillón, P. (2017). The Threshold Distance Associated With Walking From Home to School. Health Education and Behavior, 44(6), 857–866. https://doi.org/10.1177/1090198116688429

Rothman, L., Macpherson, A. K., Ross, T., & Buliung, R. N. (2018). The decline in active school transportation (AST): A systematic review of the factors related to AST and changes in school transport over time in North America. Preventive Medicine, 111, 314–322. https://doi.org/10.1016/j.ypmed.2017.11.018

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. Annu. Rev. Public Health, 27, 297–322. https://doi.org/10.1146/annurev.publhealth.27.021405.102100

Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological models of health behaviour. In N. Owen, B. Heart, & E. B. Fisher (Eds.), Health behaviour and health education. Theory, Research and Practice (4th Editio, Issue December 2015, pp. 465–485). Jossey-Bass.

Samimi, A., & Ermagun, A. (2013). Students' Tendency to Walk to School: Case Study of Tehran. Journal of Urban Planning and Development, 139(2), 144–152. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000141

Schoeppe, S., Duncan, M. J., Badland, H. M., Rebar, A. L., & Vandelanotte, C. (2016). Too far from home? Adult attitudes on children's independent mobility range. Children's Geographies, 14(4), 482–489. https://doi.org/10.1080/14733285.2015.1116685

Segura-Díaz, J. M., Rojas-Jiménez, Á., Barranco-Ruiz, Y., Murillo-Pardo, B., Saucedo-Araujo, R. G., Aranda-Balboa, M. J., Herrador-Colmenero, M., Villa-González, E., & Chillón, P. (2020). Feasibility and Reliability of a Questionnaire to Assess the Mode, Frequency, Distance and Time of Commuting to and from School: The PACO Study. International Journal of Environmental Research and Public Health, 17(14), 5039–5053. https://doi.org/10.3390/ijerph17145039

Seraj, S., Sidharthan, R., Bhat, C. R., Pendyala, R. M., & Goulias, K. G. (2012). Parental Attitudes toward Children Walking and Bicycling to School. Transportation Research Record: Journal of the Transportation Research Board, 2323(1), 46–55. https://doi.org/10.3141/2323-06

Souza, S., Carvalho, W., Matos, A. P., Silva, A., Oliveira, E., Soares, I., Bezerra, S., & Pereira, B. (2019). Modes of commuting to school among 5th and 6th grade schoolchildren. April, 287–296. https://doi.org/http://dx.doi.org/10.5007/1980-0037.2019v21e55564

Uddin, R., Mandic, S., & Khan, A. (2019). Active commuting to and from school among 106,605 adolescents in 27 Asia-Pacific countries. Journal of Transport & Health, 15(August), 100637. https://doi.org/10.1016/j.jth.2019.100637

United Nations. (2015). Transforming our world: the 2030 Agenda for Sustainable Development Transforming our world: the 2030 Agenda for Sustainable Development. General Assembly 70 Session. https://www.unfpa.org/resources/transforming-our-world-2030-agenda-sustainable-development

van Sluijs, E. M. F., Fearne, V. A., Mattocks, C., Riddoch, C., Griffin, S. J., & Ness, A. (2009). The contribution of active travel to children's physical activity levels: Cross-sectional results from the ALSPAC study. Preventive Medicine, 48(6), 519–524. https://doi.org/10.1016/j.ypmed.2009.03.002

Waygood, E. O. D., Friman, M., Olsson, L. E., & Taniguchi, A. (2017). Transport and child well-being: An integrative review. Travel Behaviour and Society, 9, 32–49. https://doi.org/10.1016/j.tbs.2017.04.005

Wong, B. Y.-M., Faulkner, G., Buliung, R., & Irving, H. (2011). Mode shifting in school travel mode: examining the prevalence and correlates of active school transport in Ontario, Canada. BMC Public Health, 11(1), 618–630. https://doi.org/10.1186/1471-2458-11-618

World Health Organization. (2018). Global action plan on physical activity 2018–2030: more active people for a healthier world. https://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf?ua=1

Zaragoza, J., Corral, A., Ikeda, E., García-Bengoechea, E., & Aibar, A. (2020). Assessment of psychological, social cognitive and perceived environmental influences on children's active transport to school. Journal of Transport and Health, 16. https://doi.org/10.1016/j.jth.2020.100839

# CAPÍTULO III. Programa de intervención multinivel e interdisciplinar para aumentar los viajes activos al centro escolar

Reto 3: Aumentar la calidad de las intervenciones

"Patines y bicis para ir al cole". Dibujo realizado por Inés Sánchez Huerga. 6 años.

# Estudio 5. *Applying the Intervention Mapping Protocol to promote Active Transport to School in primary school students: the ProATs intervention*

**Corral-Abós, A.,** Zaragoza, J., Aibar, A., Ibor, E., & Julián, J.A. (2022). Applying the Intervention Mapping Protocol to promote Active Transport to School in primary school students: the ProATs intervention. *Retos, 46*, 76-90. Accepted.

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# Applying the Intervention Mapping Protocol to promote Active Transport to School in primary school students: the ProATs intervention
# Aplicación del Protocolo de Mapeo de Intervención para promover el Transporte Activo a la Escuela en alumnos de primaria: la intervención ProATs

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**Abstract.** The school setting is presented as an ideal context for behavioral interventions. Accordingly, evidence shows that school-based interventions positively impact on Active Transportation to School (ATS). However, behavioral interventions are rarely developed in a systematic way. The aim of this manuscript is to describe the content and development process of the ProATS (Promoting Active Transportation to School) intervention. For this purpose, an Intervention Mapping Protocol (IMP) is used for the design, implementation, and evaluation of ProATS. This intervention aims to increase ATS in children aged 10 to 12 years is used. ProATS is based on a literature review and is developed by a multidisciplinary team. There is input from experts (Local Working Group), school representatives (Planning Committee), and a facilitator in each school (a member of the research team). The ProATs intervention results in the following two components (i) curricular path, (ii) non-curricular path. In parallel, a guide is elaborated, which includes the strategies and activities to design and implement the ProATs project. The results of the pilot study seem promising, showing a significant increase in ATS (i.e., the frequency of ATS). IMP, targeting behavioral changes such as ATS, is a complex and time-consuming process. Yet, it helped us to carry out the planning and development of the ProATs intervention to make it feasible, effective, and sustainable. The process explanation followed with the IMP allows replication of the intervention in other school contexts.
**Keywords**: active transport to school, children, school-based intervention, behavior change, sustainability.

**Resumen.** El entorno escolar se presenta como un contexto ideal para las intervenciones que buscan cambios comportamentales. A su vez, los estudios muestran que las intervenciones desde el contexto escolar tienen un impacto positivo en los desplazamientos activos. Sin embargo, este tipo de intervenciones rara vez se desarrollan de forma sistemática. El objetivo de este manuscrito es describir el contenido y el proceso de desarrollo de la intervención ProATS (*Promoting Active Transport to School).* Para ello, se utiliza el *Intervention Mapping Protocol* (IMP) para su diseño, implementación y evaluación. Esta intervención tiene como objetivo aumentar la frecuencia de desplazamiento activos en niños de 10 a 12 años. ProATS se basa en una revisión de la literatura y es desarrollado por un equipo multidisciplinar. Hay aportaciones de expertos (Grupo de Trabajo Local), representantes de las escuelas (Grupo de Planificación) y un facilitador en cada escuela (un miembro del equipo de investigación). La intervención de ProATs resulta en los siguientes dos componentes: (i) vía curricular, (ii) vía no curricular. Paralelamente, se elabora una guía que incluye las estrategias y actividades para diseñar e implementar ProATs. Los resultados del estudio piloto parecen prometedores, ya que muestran un aumento significativo en la frecuencia de los desplazamientos activos. El IMP, utilizado para promover los cambios de comportamiento como el desplazamiento activo al centro escolar, es un proceso complejo y que requiere de mucho tiempo. Sin embargo, ayudó a llevar a cabo la planificación y el desarrollo de la intervención de ProATs para que fuera fiable, eficaz y sostenible. La explicación del proceso con el IMP permite replicar la intervención en otros contextos escolares.

**Palabras clave**: transporte activo a la escuela, alumnado de primaria, intervención en la escuela, cambio de comportamiento, sostenibilidad.

## Background

Active transport to school (ATS) (e.g., walking and cycling to/from school) is associated with several physical and social benefits for children (Henriques-Neto et al., 2020; Ikeda et al., 2018), and their communities (Mandic et al., 2019). Despite these benefits, the prevalence of ATS has markedly decreased over the last few decades in many countries all around the world (Chillón et al., 2013; Haug et al., 2021; Rothman et al., 2018). In Spain, youth rates of ATS did not change significantly in the last decade (Gálvez Fernández et al., 2021).

Given that ATS is influenced by complex interactions of multiple factors at individual, social and environmental levels (Mandic et al., 2017), it is critical to obtain insights into these influences to develop effective interventions. Some predictive theoretical models have been tested (e.g., Ikeda et al., 2019; Zaragoza et al., 2020) to understand influences on ATS, including variables from socio-ecological models and social cognitive theories (Lu et al., 2014; Sniehotta et al., 2014). For instance, some individual factors (e.g., age, intention of commuting, perception of competence, etc.) or social/cultural and built environment factors (e.g., distance, parents' attitudes, family composition, etc.), are commonly related to higher levels of ATS (Souza et al., 2019).

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Although some studies have focused on developing strategies based on social and environmental factors that influence children's ATS, those interventions have proven to be insufficient for promoting ATS (Pang et al., 2017; Chillon et al., 2011). The inconsistent evidence about the positive impacts of ATS interventions is potentially attributable to differences in study design and methodological quality (e.g., varying outcome measures and evaluation criteria, lack of controlled comparisons), as well as to differences between intervention content and program theory (e.g., reported cognitive and behavioral techniques) (Grimshaw et al., 2004).

The school setting provides several opportunities to modify behaviors as evidence shows that school-based interventions have a positive effect on ATS (Jones et al., 2019; Ginja et al., 2017; Carlin et al., 2016). However, school factors such as time (e.g., competing requirements, teacher overload), academic performance pressure, resource availability, and supportive school climate, might affect implementation of those educational strategies (Naylor et al., 2015). That is why transferring evidence-based interventions into routine practice is one of the great challenges that schools currently face (Kearns et al., 2019). Designing school-based ATS interventions (i.e., an intervention program integrated into the curriculum) can be challenging, as the intervention should be effectively incorporated into the school environment, and be easy to deliver and maintain by the school (Innerd et al., 2019). Previous studies have shown considerable promise in promoting ATS, when interventions incorporate the use of a theoretical framework, a systematic design, as well as the engagement of different agents and settings in the co-construction process (Carlin et al., 2016; Pang et al., 2017; Schoeppe et al., 2013). Our study tries to consider all this evidence in the design, implementation, and evaluation of a ProATs intervention program.

ProATs is a multicomponent school-based intervention program to promote ATS in children aged 10 to 12 years-old in the city of Huesca (Spain), which is developed within the CAPAS-City project (Zaragoza et al., 2019). ProATs, as previous literature suggests, entails the structured and evidence-based development of intervention programs (Brug et al., 2005). In this sense, ProATs has followed a theoretical framework (i.e., IMP) (Bartholomew et al., 2006, 2016)) to overcome design limitations and guide the development of ProATs. IMP is both a framework and a structured way of planning, implementing, and evaluating health promotion programs (Bartholomew et al., 2016). IMP integrates the target group and agents (i.e., decision-makers or actors) with the planners to ensure cultural acceptability, appropriateness and program implementation (Kok et al., 2017), providing a detailed description of the program rationale, its objectives, content, implementation, strategies, and evaluation plan. IMP is an iterative process encompassing 6 key stages.

This study describes in detail the step-by-step development of the ProATS intervention using Intervention Mapping Protocol. ProATS was designed to increase frequency of ATS among schoolchildren aged 10–12 years.

## Methods

### *Setting and participants*

ProATs project was carried out in Huesca (Spain). Huesca is a city situated in northern Spain and has approximately 55,000 inhabitants. All primary schools (N= 12, grade 4 and 5) in the city of Huesca (Spain) were invited to participate in the project. Schools were invited to participate in a meeting co-organized with the Department of Education of Aragon (i.e., administrative region that Huesca belongs to).

Consistent with the findings and recommendations of previous systematic reviews on school-based ATS intervention programs (Jones et al., 2019; Villa-González et al., 2018), ProATs was developed from the beginning in partnership with school community stakeholders. Stakeholders were identified by the CAPAS-city research team through a brainstorming session, answering questions like: *«Who is affected positively and negatively by the project?; «Who has the power to make it succeed (or fail)?; «Who are the end users?»; «Who has special skills that are crucial to the project?».* Finally, a multi-sectoral group of experts (i.e., Local Working Group) with representatives from the municipal agencies (i.e., municipal sports technician of local government), and from the main services in the areas of health (i.e., a representative of the Department of Health Government of Aragon), education (i.e., a representative of the Department of Education Government of Aragon), together with two representatives from CAPAS-city project (i.e., two researchers), was established in order to give advice about questions related to the intervention. In addition, a communication plan was determined to be discussed with them. A co-design process was established at each meeting, whereby key stakeholders provided input into the design and development of the ProATs intervention.

In addition, a Planning Committee was established in each of the participant schools (i.e., schools that received the intervention), which was involved in each step of the process. It comprised two teachers, one physical education teacher, the school principal, and one representative from the CAPAS-city project. Another key characteristic in this project was the assignment of a facilitator (i.e., CAPAS-city Project researcher with a leading role), one for each school where the intervention was carried out (n=2). This facilitator led and coordinated the intervention, fostering a collaborative approach with the working groups of students,

teachers and families in the design, implementation, and evaluation of the intervention.

Once the schools had accepted to participate (*n*= 11 schools; N=1560 children aged 9-11 years), at the beginning of the project, families of all children were invited to an initial meeting at school to receive direct information about the project. Parents signed an informed consent about their participation and gave signed permission for their children to participate (*n*=1347 children). The Ethics Committee for Clinical Research of Aragon (CEICA) approved all procedures of this project (Ethics code: C1P117/0018).

***Step 1: Needs assessment***

The needs assessment of the present study focused on the target group of the ProATs project (i.e., 10 to 12-year-old children).

(1) A pertinent literature review was conducted to identify the determinants and correlates of childhood ATS and the effective interventions to promote ATS. This literature analysis was conducted by the CAPAS-city research team. The search strategy included use of the following databases: PubMed, SPORTDiscus, PsycInfo, MEDLINE Complete, ERIC, Dimensions, and Academic Search Complete. The search strategy was built on the systematic review protocol established by Li et al. (2021).

(2) To develop a city context evaluation, one report was ordered by Huesca City Council and carried out by CAPAS-city research team, called «The patterns of ATS of primary school students in the city of Huesca: diagnostic evaluation». This report provided a clear picture of ATS patterns in the local context. Further, two studies were carried out by the CAPAS-city research team, with different objectives; a) to compare mothers' and fathers' barriers to ATS (Aibar-Solana et al., 2018), b) to develop and test a model that conceptualized relationships between children's ATS, and psychological, social cognitive and perceived environmental variables (Zaragoza et al., 2020).

During this step, two meetings were held with the Local Working Group and one with the Planning Committee at each of the schools where the intervention was carried out. At the first meeting with the Local Working Group, the research team presented the results of the two studies conducted in the local context, as well as the conclusions of the literature review carried out. At the second meeting (i.e., with the Planning Committee), local needs were defined by group members. At the meeting held with the Planning Committee, researchers from CAPAS-City provided initial suggestions and proposals to be considered as grounds for discussing the IMP task, and to ensure and coordinate the intervention planning.

(3) In addition, focus groups were planned at each intervention school. Focus groups were selected as the preferred methodology due to the promotion of group interaction, which encourages in-depth discussion (Gibson, 2007). The focus groups took place at the schools to ensure pupils remained in a familiar and convenient setting. Two parents, the teachers involved in the project and two representatives of the students participated in each focus group. A lead moderator and an assistant moderator belonging to the CAPAS-City research team, facilitated the focus groups to ensure the discussion remained on the topic of interest. A topic guide which reflected the study's aims to ensure consistency across all focus groups and to provide triggers for discussion was used. This guide had six parts: 1) Introduction; 2) ATS patterns; 3) individual, social, and environmental perceptions related to ATS; 4) attitudes to ATS; 5) intervention proposals; and 6) other contributions and summing up. All the sessions were audio-recorded and fully transcribed to ensure the accuracy of the participants' insights.

***Step 2: Formulation of behavioral change objectives***

The second step involved giving shape to and specifying in detail the desired outcomes of the intervention. First, given that the overall desired outcome of the intervention was to increase children's ATS, different program and performance objectives were formulated to obtain behavioral outcomes that the intervention sought to accomplish. However, it is widely recognized that ATS has many different influences at different levels (e.g., personal, interpersonal, and environmental factors), so program and performance objectives were structured according to those levels of influence. Based on the literature review, the information derived from our research and the focus groups, and influences of ATS were listed by the researchers, specifying the intervention outcomes for each level of influence (i.e., children, parents, and teachers). Second, the influences selected were crossed with the performance objectives at each level of influence to create matrices with change objectives. These change objectives helped to specify what needed to be changed in the determinants of ATS in order to accomplish the performance objectives. All performance objectives, intervention outcomes, and change objectives were discussed and agreed at different meetings held by the Planning Committees of each school.

***Step 3: Selection of theory-based methods and practical strategies***

The ProATs intervention program design was based on the Social-Ecological Model for health promotion (Naylor

et al., 2015), Social Cognitive Theory (Bandura, 2004), Theory of Planned Behavior (Ajzen, 1991), Self-Determination Theory (Deci & Ryan, 2000) and Taxonomy of Behavior Change Methods (TBCM) (Kok et al., 2016).

The final selection of theory-based methods and strategies was initially performed Local Working Group researches consensus. Parents' focus groups were conducted to request their views on methods and strategies. Parents were asked to: a) review the methods and strategies selected by the Local Working Group, and b) make a list of what they believed were the most relevant methods and strategies. Finally, each Planning Committee selected the methods and strategies to be used at each intervention school.

***Step 4: Program development***

A first proposal of the main components of the intervention program was reached, based on the discussions of 4 meetings of the Local Working Group. The ProATs intervention was structured around the following two components: (1) the curricular path, (2) the non-curricular path. Subsequently, two meetings were held with the Planning Committee of each school where the pilot study was conducted to discuss and determine the final strategies for each program component.

The strategies used from the curricular path were:

a) Training teachers.
b) Introducing activities such as a questionnaire on commuting mode, self-reported y families (parents or grandparents).
c) Developing ATS-related learning in different curricular areas.
d) Designing ATS-related curricular materials.

The strategies used from the non-curricular path were:

a) Parental information.
b) Walking School Bus.
c) Participation in institutional events.
d) Dissemination.
e) Cycling infrastructure changes.

Later, a pilot study was conducted to test these strategies and their respective materials, and to investigate the effects of ProATs intervention program on ATS. The aim of this pilot study was to explore the effectiveness, viability, fidelity, acceptability, and feasibility of ProATs intervention project.

*Setting and participants of the pilot study*

After the diagnostic evaluation and the presentation of reports to the different schools, the priority schools for intervention were identified. The priority centers was identified due to their low levels of ATS and its consequences for both the students in the schools and the surrounding environment (Corral-Abós et al., 2021). Based on previously published findings (Dobbins et al., 2013), a minimum sample size of 40 children per intervention is required to detect changes across groups in PA. Therefore, a total of 150 students from four different private schools were chosen to participate. In particular, two classes per school took part in this study, and were assigned by convenience (i.e., schools that could commit, based on their conditions, to implement the intervention) to the intervention (IG) or control group (CG). Both, IG and CG had similar characteristics (e.g., socioeconomic level, located in the same neighborhood). After excluding incomplete or invalid children's' questionnaires as well as all children who lived outside the city (i.e., households located >4.5 km from the child's school), two independent analysis were calculated (one control compared to one intervention respectively) to exactly compare data collected in the same days. The baseline sample of the first comparison included in the analyses was 128 students (48.9% girls; 10.42 ± 2.05 years; control group: n/ =/ 43, 61.4% girls; experimental group: n/ =/ 85, 37.0% girls). The second comparison was composed by 61 students (48.1% girls; 10.46 ± 1.75 years; control group: n/ =/ 36, 61.4% girls; experimental group: n/ =/ 25, 37.0% girls).

*Measurements and instruments of the pilot study*

Children' ATS was assessed at baseline and immediately after the 12-week intervention program with objective and subjective instruments. ATS was measured subjectively using a self-reported questionnaire about school travel mode and frequency (Segura-Díaz et al., 2020). The effect size of the repeated measures ANOVA analysis was analyzed to see how much the change in travel frequency before and after the intervention was affected because of the intervention. Moreover, ActiGraph GT3X+ accelerometer (ActiGraph Pensacola Florida, USA) for one week were using for an objective perspective.

For more information on the evaluation design of the program, see section 3.6.

*Implementation, fidelity, acceptability, and feasibility of the pilot study.*

Both, teachers and facilitator implemented the intervention program at each experimental school. The intervention period lasted for 3 months, from January to March. Implementation fidelity was controlled through the presence of the facilitator at all practical sessions. Implementation of strategies was registered during or immediately after the session through a comprehensive checklist.

Acceptability and feasibility of interventions should, therefore, be examined with the experiences and views of key agents, such as teachers or children, using qualitative methods (Laine et al., 2017). Different focus groups were

conducted with children, parents, teachers, the principal, and the facilitator of each school to assess acceptability and feasibility of the intervention at every school. The contributions of the different focus groups were analyzed by the Planning Committee of each school followed by an in-depth discussion about what successful contributions could be incorporated in future interventions.

***Step 5: Adoption, implementation, and sustainability of the program***

Several barriers and facilitators are common across the adoption, implementation, and sustainability (Cassar et al., 2019).

First, regarding the adoption of the interventions, previous works suggest: a) the importance of having a real social problem that can be solved by an intervention (Huijg et al., 2013); and b) the importance of social and political support (Huijg et al., 2013).

Second, with respect to the implementation of health-related interventions, it is important for the professionals leading the project to be capable (i.e., have sufficient knowledge and skills) of delivering the intervention, and for them to experience the intervention's efficacy (Bartholomew et al., 2011). Also, at school-level, organizational factors, which include support from the school principal, coordination with other agents, and specific staffing considerations, are key determining factors of successful implementation in the education sector (Huijg et al., 2013).

Third and finally, sustainability requires the empowerment of the main agents involved in the implementation of school-based interventions (e.g., school teachers, families, policy-makers, etc.) to sustain the intervention effects over time (Mikkelsen et al., 2016).

Consequently, the adoption, implementation, and sustainability of the ProATs project was an overarching concern that we wished to incorporate in every step of the development process.

***Step 6: Evaluation design***

Consistent with the five previous steps, increased frequency of ATS was selected as the main behavioral change objective to be achieved in children. As previously mentioned in steps 3 and 4, other performance objectives were put forward, such as overcoming barriers, improving their knowledge, or increasing their intention to carry out ATS. All these objectives should be evaluated to determine the effectiveness of the program.

An initial evaluation plan was drafted by the CAPAS-City researchers and discussed during two meetings of the Local Working Group in order to produce a final version. This plan permitted, (1) assessing the impact of the ProATs project, and providing a specific measure for its effectiveness and, (2) assessing its potential to maintain the strategies and actions implemented during the intervention.

## Results

### *Step 1: Needs assessment*

*Literature review*

A review of literature revealed the complexity of the factors that impact ATS. Individual factors included gender differences (males more than females), and age (less likelihood of actively travelling to school in the case of younger children and adolescents) (Egli et al., 2018; Wilson et al., 2018). At family level, access to cars and bikes, family structure, parents' perceptions, and socio-economic status, are consistently related to ATS (Smith et al., 2019). At community level, school policies, socio-cultural norms, and physical environments have proven to have an important influence on active school travel as shown in literature (Egli et al., 2018). School involvement is an organization level factor that is causally related to successfully increasing ATS (Lindqvist et al., 2015). Consequently, in our intervention, teachers were highly involved in the development of the design, implementation, and evaluation of the program. The most common barriers to ATS in children that are reported in literature are distance to school, traffic volume and dangerous intersections (Ahlport et al., 2008; Lu et al., 2014). In addition, different systematic literature reviews, which have provided information about the effectiveness of the ATS interventions (Chillon et al., 2011; Jones et al., 2019; Pang et al., 2017), have highlighted lack of theory, weak methodological designs, and a lack of reliable and valid measurement tools to conduct ATS intervention programs.

Considering the different levels of the socio-ecological model, parents are an important factor at an interpersonal level in the type of intervention sample. Given that the children participating in the ProATs intervention were only 10 to 12 years-old, their parents became the gatekeepers of their behavior in terms of ATS. Consistent with the central factor in SCT (i.e., social support) (Van Lippevelde et al., 2012), parental attitudes must be used as a starting point, and be included in the development of intervention programs.

*City context evaluation*

The main results obtained showed that children from private schools used less active modes to commute to school (i.e., 57.7% walk to school) than children from public schools (i.e., 79.9% walk to school). Moreover, less than 1% of children cycled to and from school, (report results: «The patterns of ATS of primary school stu-

dents in the city of Huesca: diagnostic evaluation» (see, https://capas-c.eu/inicio/profesionales/); a) although some barriers to ATS were similar for both parents (i.e., distance, driving convenience, and parental mode of commuting to work), other barriers were only specific to mothers (i.e., organization of children's extra-curricular activities, and lack of children's interest in walking to school) (Aibar-Solana et al., 2018); b) social cognitive (i.e., perceived behavioral control was the strongest predictor of intention, and influenced by autonomy, competence, and perceived environment), and perceived environmental variables (i.e., safety, accessibility of the neighborhood) explained about 50% of variance of ATS (Zaragoza et al., 2020).

*School context evaluation*

Finally, according to Bardin, (2002) a superficial reading was carried out which is included within the first pre-analysis phase, prior to the realization of the category system. The results of the focus groups carried out in step 1 revealed that it is very important for parents to understand that the roads are safe, at their children's age. The focus groups revealed how social support could have a reassuring effect on families. For example, one of the teachers expressed, «*depending on the family, if the mother is afraid, she will not let her child go alone*».

Factors such as distance, heavy traffic, dangerous intersections, lack of police at those intersections, or bad or nonexistent bike paths, were important barriers commented by parents and teachers. One mother proposed that, «*for example, local police at zebra crossings may mean that people walk to school*». Finally, one teacher said repeatedly that, «*the bike path is very bad, it stops and starts all the time*».

Social factors were also commented in the focus groups. One mother said, «*family, the family organization, (…) we can walk there in the morning, but then, I have to go to work, or to after-school activities, and (…) we must go by car if we want to arrive on time*». Both parents and teachers also talked about the weight of backpacks as a barrier to ATS, insisting that «*it's annoying having to listen to your child protesting about his/her backpack for the 25 minutes the trip lasts*».

***Step 2: Formulation of change objectives***

Based on the information obtained in the first step of the IMP, several program objectives to increase ATS were set. After that, the performance objectives for each of the program objectives were specified in this step (see table 1). Researches from The Local Working Group listed all the steps that would need to be taken in order to achieve the program objectives. Later, this list was validated by the Planning Committees of each school.

Table 1. Overview of the program and performance objectives set for each intervention level.

Finally, different matrices of change objectives were developed for each level of influence (see supplementary material, Appendix A). Different behavioral outcomes were identified for each level of influence according to the possibility of achieving the specific performance objective. Then, different change objectives were established for each determinant in order to impact the performance objective.

***Step 3: Selection of theory-based methods and practical strategies***

Linked to theoretical frameworks and theory-based methods, different practical strategies were defined to cope with the change objectives at each level of influence.

Table 1.
Overview of the program and performance objectives set for each intervention level

| Level | Target group | Program objective | Performance objective |
|---|---|---|---|
| Individual | Children | C1. Encourage children to use active school commuting (ATS) | C.1. PO.1. Increase their frequency of walking and cycling to school<br>C.1. PO.2. Overcome barriers to increase ATS |
| | | C2. Children's knowledge about ATS | C.2. PO.3. Improve their knowledge of ATS (benefits, safety rules etc.) |
| | | C3. Children's motivation towards ATS | C.3. PO.4. Increase their intention to use ATS, by improving their attitudes, and developing their competence and autonomy in the use of active forms of commuting |
| Interpersonal | Parents | P.1. Involve parents in the planning process | P1. PO.1. Get them to participate in focus groups organized at each school. Offer ideas for the intervention program. |
| | | P.2. Parental support for ATS, developing their knowledge and motivation | P2. PO.2. Motivate their children to go to school on foot or by bike<br>P2. PO.3. Be a role model for their children using active ways of commuting |
| | | P.3. Identify the main barriers and possible solutions | P3. PO.4. Overcome barriers to increase children's ATS. |
| Organizational | Teachers | T1. Empowerment of school principal and teachers | T1. PO.1. Integrate ATS into the curriculum and take part in the teaching and learning process at school.<br>T1. PO. 2. Participate in the planning of strategies and assignments, which were directly connected to the curriculum (school principal and teachers). Get involved in the development of the design, implementation, and evaluation of the program (teachers) |
| | | T2. Promote knowledge and motivation of teachers | T.2. PO.3. Improve their knowledge by providing training in different behavioral change strategies<br>T2. PO.4. Use different strategies to increase children's ATS<br>T2. PO.5. Encourage children to carry out ATS<br>T2. PO.6. Be a role model for the children |

Note. PO: Performance Objetives.

Moreover, different practical implications of these strategies were highlighted to improve their application (see supplementary material, Appendix B).

***Step 4: Program development***

An overview of the whole ProATs intervention program has been shown previously in Appendix B, where all strategies are portrayed. The development and timing of the activities can be consulted in the guide elaborated in the project (Ibor et al., 2019).

The strategies used from the curricular path were:

a) Training teachers. Teachers and the facilitator from the experimental intervention schools were invited to attend four training sessions (20h). In the first training session (4 hours' duration), a general introduction was given about ATS. The aim of the second training session (6h) was to improve the teaching staff's capacity in terms of motivating and influencing students' behavior. The aim of the third training session (6h) was to establish potential links between ATS behavior and curricular learning of different curricular subjects. Possible strategies to encourage implementation in the school curriculum were discussed. Finally, in the fourth training session (4h), teachers and the facilitator initially designed the main learning activities of the project linked to ATS.

b) Introductory activities such as a questionnaire on commuting mode reported by families (parents or grandparents).

c) Develop learning related to ATS in different curricular areas. Given that ATS-related contents can help to fulfil national curriculum requirements in a variety of subject areas (e.g., social science, math, physical education, expressive arts), six specific modules were designed to include ATS. More specifically, those modules were: 1) high impact presentation of the project (2 lessons); visit by local police and high school students (2 lessons); bicycle didactic unit (8 lessons); exploring the route to school using photo-voice (3 lessons); design of safe routes to school (6 lessons); ATS week (2 lessons).

d) Curricular materials. A logo and a t-shirt with that logo were designed by students to identify the ProATs project brand at each school to empower students. Bracelets to foster engagement in ATS were also designed by students as a way of emphasizing responsibility and belonging to the project.

The strategies used from the not curricular path were:

a) Parental information. Different and periodic meetings were held with mothers and fathers. Parents were provided with information to improve their knowledge about how to increase children's ATS.

b) Walking School Bus. Parents, teachers, or adult volunteers act as 'drivers' or 'conductors' to escort a group of children who walk to and from school.

c) Participation in institutional events. All students, parents and teachers who took part in the ProATs project were invited to participate in an event called ITB. The ITB is an annual test of bicycle safety, roadworthiness aspects, and cycling-related skills and knowledge. This activity addressed the whole population of the city (i.e., Huesca), and young people (primary, high school, and university students) [see Zaragoza et al., (2019)].

d) Dissemination included different elements used during the intervention such as thematic infographics and letters to families, publications in the local newspaper, and interviews in the local TV.

e) Cycling infrastructure changes. Secure bicycle parking facilities. In collaboration with the City Council, different bicycle racks were installed in the schools.

*Results of effectiveness of the pilot study*

The results of the pilot study were promising, showing a significant increase in ATS (i.e., frequency of ATS), when comparing experimental and control school students (overall effect size range from 0.09 to 0.53 ($\eta p2$) in both analysis). Thus, ProATs school-based intervention program could be an effective program for increasing ATS in children.

*Results of fidelity, acceptability and feasibility of the pilot study*

The facilitator, through the check list, was able to verify that the fidelity of the program was acceptable. 90% of the strategies were implemented in one of the schools and 80% in the other.

A superficial reading during pre-analysis phase (Bardin, 2002) were carry out with qualitative data from participating children, the school principal, teachers, facilitator and parents to explored the acceptability and feasibility of each intervention component.

Children recognized the perceived benefits of the different activities carried out, which further reinforced the acceptability of the intervention. Most of the children seemed to associate the activities with significative learning, and they perceived they had learned through the activities. One boy said. «*I've learned to make tighter turns with my bike*», one girl said, «*I've learned the signals to cycle safer*». The children provided some interesting suggestions for changes to the intervention, including the use of videos, and they also proposed carrying out activities to connect their neighborhood to the school, for example walking or cycling.

Despite the training received, teachers still found it challenging to engage students in activities. Teachers did report a lack of confidence in delivering some of the activities. Teachers talked about a positive implementation of the strategies when the ATS topics were compatible with the curriculum. The teachers felt the activities were enjoyed by the children, appropriately linked to the curriculum, and that they would be beneficial as a whole-school scheme for sustainability and continuity throughout the year. However, the hours spent on the design and preparation of activities was suggested to be too time-demanding by the participating teachers. One teacher said, «*I acknowledge all the work that we have done, but I enjoyed the project because I like ATS as a subject-matter*».

The lack of family involvement was acknowledged by the facilitator and teachers as a barrier to implementation. They also pointed out that a significant weakness of the project was the capacity to encourage parents to become involved with their children. One teacher said «*It is a project that required important family engagement, but this did not take place*». Several modifications to the intervention were proposed by teachers and facilitators. These are as follows: increase training to be able to implement the project with greater competence and develop the project throughout the school year and not for a few months.

Despite the low parental attendance rates, they commented that the intervention was beneficial to children and schools. Parents felt that the school should be mainly responsible for supporting their children's ATS project, and they pointed out that they did not have much time to get involved. One mother explained. «*Parents do not participate because of the timetable, because they really cannot, or because they are not interested*». Some modifications to the intervention were proposed by the parents; for example, replacing some face-to-face meetings with other means of communication, such as reports, messages, infographics, etc., to facilitate their participation in the project.

***Step 5: Adoption, implementation, and sustainability***

To maximize the potential for adoption, implementation, and sustainability of the ProATs project, we took advantage of the structure of CAPAS-City, which was created to promote PA in Huesca (Spain) and Tarbes (France) (Zaragoza et al., 2019).

CAPAS-City provided professional staff and financial support to adopt and implement the ProATs project. Examples of this support could be: (1), the creation and coordination of structures such as the Local Working Group, (2) the Planning Committees, and (3) the facilitator. All this information is provided through a variety of digital and printed resources and materials, available on the CAPAS-City website (https://capas-c.eu).

In order to guarantee the project sustainability, the researchers responsible for CAPAS-City signed an agreement to include the ProATs project within the local «Planning for Sustainable Mobility (https://www.huesca.es/)» of the city of Huesca. This Planning aims to develop policies in order to favor more accessible, friendlier, and safer cities, where pedestrians and cyclists are expected to be the main users of the city's public spaces, instead of drivers of motorized vehicles.

***Step 6: Evaluation design***

The evaluation plan allowed us to analyze both the effectiveness and the potential sustainability of the ProATs intervention program.

*Evaluation design to test the effectiveness of ProATs*

The aim of the effectiveness evaluation was to provide evidence about the potential of the ProATs intervention program to achieve its target outcomes by: (1) determining the program efficacy on modifying and increasing the mode and frequency of ATS, and (2) measuring the effect of ProATs on the targeted psychosocial variables such as attitudes, social norm, autonomy, perceived competence, intention, etc. A quasi-experimental trial design was planned with an IG from the school involved in the intervention process following the ProATs program, and a CG from a different, but similar school in the city of Huesca. IG was assigned by the local government and municipalities. CG was selected by the researchers, based on having similar characteristics to the selected IG (socioeconomic level and similar neighborhood). Outcomes were planned to be measured at baseline and at the end of the intervention program (12-weeks intervention period). A self-reported questionnaire was used to measure the following six aspects: 1) sociodemographic characteristics, 2) school travel mode and frequency compared to the previous week (Monday to Friday), 3) TPB (i.e., attitudes, social norm, PBC, intention to ATS), 4) BPNs (i.e., autonomy, competence, relatedness), 5) perceived neighborhood environments, and 6) perceived environmental barriers (Zaragoza et al., 2020).

*Evaluation design to test the sustainability of ProATs*

A process evaluation was designed through focus groups with different agents such as the school principal, teachers, facilitator, and children, to further assess issues related to the sustainability of the ProATs intervention program. Questions were designed to assess, for example, the extent to which participants found the program interesting and worthy, or questions regarding the degree to which the grantees found the sustainability intervention helpful, and which aspects they found most and least valuable. Specifically, one single ques-

tion was asked to assess the likelihood of program sustainability: *«Which category most accurately describes your opinion about the organization's situation regarding sustaining ProATs? (definitely will; hope to; very little chance; no chance)»*. One question was used to assess the potential adaptations to the programs required to improve the likelihood of sustainability: *«If you are planning to sustain, are you: (using the original program format; making minor adaptations; making major adaptations)»*.

## Discussion

Many behavioral interventions lack the level of detail required hindering not only its evaluation, but also its replicability and the subsequent scaling-up of effective interventions (Hanson et al., 2016). The insufficient description of intervention programs and processes represents a real problem (Reis et al., 2016).To fill this gap, this paper describes the evidence-based development of an intervention program focused on ATS. IMP was used as the conceptual framework for developing the ProATs project design to promote ATS among children aged 10-12 years old. This project was based on relevant theory and available evidence and developed in collaboration with stakeholders, to increase the potential efficacy and sustainability of the intervention (Thompson et al., 2002).

It is broadly known that the school setting has the potential to influence children's health (Bonell et al., 2013). However, is therefore necessary to consider the challenges associated with school interventions, bearing in mind that each school has its own dynamics, shaped by a large number of microsystems and agents that interact and impact changes at school (e.g., children's home environment, and neighborhood) (Gubbels et al., 2014). Researchers convey that the nature of large and complex school-based programs produces problems in the design, implementation, evaluation, and sustainability of interventions (Hammerschmidt et al., 2011), and they indicate that collaboration among the different 'stakeholders' involved in the program is a key influencing factor for program efficiency and success (Lawson et al., 2007).

This collaboration may facilitate the process of translating research evidence into practice and policy (Koorts et al., 2018). Within the context of our ProATs project, it sought to actively engage a variety of stakeholders in the intervention. A multi-sectoral group of experts (i.e., Local Working Group) was established at the start of the project to provide inputs into all project phases. At the start of the project, in addition different planning committees were established, comprised of teachers, school principals, and CAPAS-city representatives, who participated and helped in the contextualization of the proposals at each school within each of the phases.

Two key stakeholder groups were parents and teachers, given that their role is critical for underpinning any intervention feasibility, acceptability, and overall performance (Downs et al., 2012). Several studies have attempted to conduct interventions using both parents and teachers together, with a view to generating improved health outcomes (Haerens et al., 2006; Rhodes et al., 2020). For example, an increase in teachers' intrinsic motivation could decrease barriers to ATS and increase active travel to schools (Cerro-Herrero et al., 202x). However, increasing the number of social agents involved also increases the complexity of the intervention (Moore et al., 2019). Recruiting stakeholders to engage in a research project is considered to be the most challenging aspect of the research process (Leask et al., 2019). For example, in ProATS project, recruiting parents to participate in the intervention was the hardest part. Despite having held an initial meeting to explain the project, and that during the design and implementation phases, parents' participation was requested, many parents pointed out that the main barrier to participation was lack of time. This highlights the importance of exploring other methods of participation and feedback. Maybe, it is convenient to take advantage of other meetings programmed by the school (for example, the evaluation meetings), or to explore other methods, such as e-mail or a website. Previous studies suggested that, when trying to engage parents in interventions, support services such as personalized mail, may be the most acceptable method (McSweeney et al., 2017; Wolfenden et al., 2012). In addition to lack of time, it could also speculate that the low participation of parents is due to the feeling that the school is mainly responsible for supporting their children in the ProATs project. These finding are in agreement with Patino-Fernandez et al. (2013), who reported that parents felt the school was responsible for the project development, while the researchers and the school staff think that it is, or at least it should be, a shared responsibility.

Teachers reported high levels of acceptability and feasibility, and that the ProATs project fit well with their school climate. However, they sometimes reported not having sufficient time to correctly prepare the material and implement it. This may be attributed to the participatory approach we followed throughout all the project phases, co-developing intervention components with them (Jones et al., 2017). Further, teachers indicated that the main success factor was the availability of external agents and structures to support the project. However, the relationship and communication between teachers and PE teacher was suboptimal. They had to get used to each other, and their mutual responsibilities were not completely clear. Maybe limited time available for formal meetings imped-

ed a good collaboration and communication (Bartelink et al., 2019). To improve this, some schools promised to review the organization of meetings for the following school year.

The facilitator was also an essential figure in the ProATs intervention program, assisting the teachers at each school. Facilitators are defined as actors who, with their presence or absence, improve functioning, and increase the opportunity for children to participate in PA interventions (World Health Organization, 2007). They provided personal support and guidance to overcome possible environmental, social, and psychological barriers that appeared in the process of the intervention. This figure was highly appreciated in the ProATs project, and both schools indicated it was essential for the success of the intervention.

Some lessons can be derived from the authors' experiences in developing this intervention. The first lesson is the time necessary for its development and implementation. Although we found IMP useful, we think that, like other previous studies (Abraham & Michie, 2008; Lloyd et al., 2011), its main limitation is the time-consuming nature of the protocol. A significant amount of time was required by the school community and other structures to draft it. In fact, we estimate that this process required about six weeks of full-time work by the research team (especially the facilitator), and a total of 15 work meetings (i.e., 30h) of the Local Working Group. In addition, each Planning Committee spent an average of 30h at the different coordination and follow-up meetings established throughout the program. But, despite the time spent, we strongly believe that it allowed us to create an effective and sustainable intervention. Second, IMP offered a new perspective in ATS interventions, since ATS interventions are usually designed and implemented by experts and researchers. This protocol contained the concern to include and engage stakeholders from different levels of the local ecology (Kutywayo et al., 2018). Third, IMP provides guidelines to ensure that an ATS promotion program is based on empirical evidence and sound theories. IMP helps planners to apply theories by linking social-cognitive determinants of behavior to behavioral methods, and by linking methods for behavioral change to practical applications that operationalize these methods (Fernandez et al., 2019). Fourth, planners of future interventions should take into consideration that planning an intervention using IMP requires the coordination of different structures and necessary funding. The presence and participation of CAPAS-City appears to be a structure that is able to respond to the main needs and challenges of this intervention to increase ATS levels. However, its presence implies a cost that should be inescapably provided when an intervention of this nature is to be applied. Fifth, although IMP provides guidance to identify needs and develop interventions, additional research and approaches are needed to more accurately address the questions posed by each of the steps; in particular, the identification of determinants and the selection of methods of behavioral change. Additional research is needed to build the evidence base for the effectiveness of certain methods to address ATS determinants (Crutzen et al., 2017). Sixth and final lesson, IMP enabled a flexible application of the protocol that helped teachers select and adapt the program to their needs and interests. All schools differed in the way they worked day-by-day, and it is possible that what worked well in one school may not work in another. School-based research is highly influenced by contexts, which differ significantly from one school to another, such as staff, teaching methods, budgets, leadership, and support (Berliner, 2002), so educational research should consider all these elements.

Some strengths and limitations of the ProATs intervention program should be considered. The collaboration between researchers and stakeholders, the standardization of the intervention materials and teacher training sessions, as well as the process of implementing the protocols, are the major strengths of this intervention. Due to the application of IMP, it was possible to document the development process of the program in detail, and therefore, information can now be made available to other researchers wanting to develop interventions such as this.

Regarding limitations, parental involvement in all process steps should be improved. Further, it should also be highlighted that this intervention did not include changes to the physical environment, and only included some minor changes to the environment (e.g., having a facilitator and fostering an ATS-supportive environment). Future interventions should give special consideration to attend to these environmental changes.

## Conclusions

Real-world interventions require a better understanding of the complex systems in which contextual factors, including organizations, intervention agents, target population, and social influences show a more reduced control. In this paper, we have provided the development process of a school-based intervention program aimed at encouraging children, aged 10-12 years, to engage in ATS. We have shown in detail, through the different steps guided by IMP, the complex protocol to develop the ProATs intervention program. The IMP explained in this study allowed us to develop a structured proposal to increase ATS that may be successfully applied in other school contexts.

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**Declaration of conflicting interests**

The authors declare no conflict of interest.

**References**

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. *Health Psychology*, *27*(3), 379–387. https://doi.org/10.1037/0278-6133.27.3.379

Ahlport, K. N., Linnan, L., Vaughn, A., Evenson, K. R., & Ward, D. S. (2008). Barriers to and facilitators of walking and bicycling to school: Formative results from the non-motorized travel study. *Health Education & Behavior*, *35*(2), 221–244. https://doi.org/10.1177/1090198106288794

Aibar-Solana, A., Mandic, S., Generelo-Lanaspa, E., Gallardo, L. O., & Zaragoza Casterad, J. (2018). Parental barriers to active commuting to school in children: does parental gender matter? *Journal of Transport & Health*, *9*, 141–149. https://doi.org/10.1016/j.jth.2018.03.005

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, *31*(2), 143–164. https://doi.org/10.1177/1090198104263660

Bardin, L. (2002). *El análisis de contenido* (3.a edició). Akal, Madrid.

Bartelink, N. H. M., van Assema, P., Jansen, M. W. J., Savelberg, H. H. C. M., Moore, G. F., Hawkins, J., & Kremers, S. P. J. (2019). Process evaluation of the Healthy Primary School of the Future: the key learning points. *BMC Public Health*, *19*(1), 698. https://doi.org/10.1186/s12889-019-6947-2

Bartholomew, L. K., Markham, C. M., Ruiter, R. A. C., Fernández, M. E., Kok, G., & Parcel, G. S. (2016). *Planning health promotion programs/ : an intervention mapping approach* (Fourth). Jossey-Bass.

Bartholomew, L. K., Parcel, G. S., Kok, G., & Gottlieb, N. H. (2006). *Planning health promotion programs: An Intervention Mapping approach*. https://iums.ac.ir/files/hshe-soh/files/PLANNING_HEALTH(1).pdf

Bartholomew, L. K., Parcel, G. S., Kok, G., Gottlieb, N. H., & Fernández, M. E. (2011). *Planning health promotion programs/ : an intervention mapping approach* (Third). Jossey-Bass.

Berliner, D. C. (2002). Educational research:the hardest science of all. *Educational Researcher*, *31*(8), 18–20. https://doi.org/10.3102/0013189X031008018

Bonell, C., Parry, W., Wells, H., Jamal, F., Fletcher, A., Harden, A., Thomas, J., Campbell, R., Petticrew, M., Murphy, S., Whitehead, M., & Moore, L. (2013). The effects of the school environment on student health: A systematic review of multi-level studies. *Health & Place*, *21*, 180–191. https://doi.org/10.1016/j.healthplace.2012.12.001

Brug, J., Oenema, A., & Ferreira, I. (2005). Theory, evidence and Intervention Mapping to improve behavior nutrition and physical activity interventions. *International Journal of Behavioral Nutrition and Physical Activity*, *2*(2), 1–7. https://doi.org/10.1186/1479-5868-2-2

Carlin, A., Murphy, M. H., & Gallagher, A. M. (2016). *Do interventions to increase walking work? A systematic review of interventions in children and adolescents*. *46*(4), 515–530. https://doi.org/10.1007/s40279-015-0432-6

Cassar, S., Salmon, J., Timperio, A., Naylor, P.-J., van Nassau, F., Contardo Ayala, A. M., & Koorts, H. (2019). Adoption, implementation and sustainability of school-based physical activity and sedentary behaviour interventions in real-world settings: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(1), 120. https://doi.org/10.1186/s12966-019-0876-4

Cerro-Herrero, D., Tapia-Serrano, M. ., Vaquero-Solís, M., Prieto-Prieto, J., & Sánchez-Miguel, P. A. (n.d.). Motivation and barriers to active communting in teachers: An exploratory study. *Revista Internacional de Medicina y Ciencias de La Actividad Física y El Deporte*, *x*(x), xx. Retrieved May 11, 2022, from http://cdeporte.rediris.es/revista/___*

Chillon, P., Evenson, K. R., Vaughn, A., & Ward, D. S. (2011). A systematic review of interventions for promoting active transportation to school. *International Journal of Behavioral Nutrition and Physical Activity*, *8*. http://www.ijbnpa.org/content/8/1/10%5Cnhttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed10&NEWS=N&AN=2011130231

Chillón, P., Martínez-Gómez, D., Ortega, F. B., Pérez-López, I. J., Díaz, L. E., Veses, A. M., Veiga, O. L., Marcos, A., & Delgado-Fernández, M. (2013). Six-year trend in active commuting to school in Spanish adolescents: The AVENA and AFINOS studies. *International Journal of Behavioral Medicine*, *20*(4), 529–537. https://doi.org/10.1007/s12529-012-9267-9

Corral-Abós, A., Aibar, A., Estrada-Tenorio, S., Julián, J. A., Ibor, E., & Zaragoza, J. (2021). Implications of school type for active commuting to school in primary education students. *Travel Behaviour and Society*, *24*(April), 143–151. https://doi.org/10.1016/j.tbs.2021.03.007

Crutzen, R., Peters, G.-J. Y., & Noijen, J. (2017). Using Confidence Interval-Based Estimation of Relevance to Select Social-Cognitive Determinants for Behavior Change Interventions. *Frontiers in Public Health*, *5*(JUL), 165. https://doi.org/10.3389/fpubh.2017.00165

Deci, E. L., & Ryan, R. M. (2000). The «What» and «Why» of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227–268. https://doi.

org/10.1207/S15327965PLI1104_01

Dobbins, M., Husson, H., DeCorby, K., & LaRocca, R. L. (2013). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.CD007651.pub2

Downs, S. M., Farmer, A., Quintanilha, M., Berry, T. R., Mager, D. R., Willows, N. D., & McCargar, L. J. (2012). From paper to practice: barriers to adopting nutrition guidelines in schools. *Journal of Nutrition Education and Behavior*, *44*(2), 114–122. https://doi.org/10.1016/j.jneb.2011.04.005

Egli, V., Ikeda, E., Stewart, T., & Smith, M. (2018). Interpersonal correlates of active transportation. In *Children's Active Transportation* (pp. 115–125). Elsevier. https://doi.org/10.1016/B978-0-12-811931-0.00008-9

Fernandez, M. E., Ruiter, R. A. C., Markham, C. M., & Kok, G. (2019). Intervention Mapping: Theory- and evidence-based health promotion program planning: Perspective and examples. *Frontiers in Public Health*, *7*(AUG), 209. https://doi.org/10.3389/fpubh.2019.00209

Gálvez Fernández, P., Herrador Colmenero, M., Esteban Cornejo, I., Castro Piñero, J., Molina García, J., Queralt, A., Aznar, S., Abarca Sos, A., González Cutre, D., Vidal Conti, J., Fernández Muñoz, S., Vida, J., Ruiz Ariza, A., Rodríguez Rodríguez, F., Moliner Urdiales, D., Villa González, E., Barranco Ruiz, Y., Huertas Delgado, F. J., Mandic, S., & Chillón, P. (2021). Active commuting to school among 36,781 Spanish children and adolescents: A temporal trend study. *Scandinavian Journal of Medicine & Science in Sports*, *31*(4), 914–924. https://doi.org/10.1111/sms.13917

Gibson, F. (2007). Conducting focus groups with children and young people: strategies for success. *Journal of Research in Nursing Los Angeles*, *12*(5), 473–483. https://doi.org/10.1177/17449871079791

Ginja, S., Arnott, B., Araujo-Soares, V., Namdeo, A., & McColl, E. (2017). Feasibility of an incentive scheme to promote active travel to school: a pilot cluster randomised trial. *Pilot and Feasibility Studies*, *3*(1), 57. https://doi.org/10.1186/s40814-017-0197-9

Grimshaw, J., Thomas, R., MacLennan, G., Fraser, C., Ramsay, C., Vale, L., Whitty, P., Eccles, M., Matowe, L., Shirran, L., Wensing, M., Dijkstra, R., & Donaldson, C. (2004). Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technology Assessment*, *8*(6), 430–431. https://doi.org/10.3310/hta8060

Gubbels, J. S., Van Kann, D. H., de Vries, N. K., Thijs, C., & Kremers, S. P. (2014). The next step in health behavior research: the need for ecological moderation analyses - an application to diet and physical activity at childcare. *International Journal of Behavioral Nutrition and Physical Activity*, *11*(1), 52. https://doi.org/10.1186/1479-5868-11-52

Haerens, L., Deforche, B., Maes, L., Cardon, G., Stevens, V., & De Bourdeaudhuij, I. (2006). Evaluation of a 2-year physical activity and healthy eating intervention in middle school children. *Health Education Research*, *21*(6), 911–921. https://doi.org/10.1093/her/cyl115

Hammerschmidt, P., Tackett, W., Golzynski, M., & Golzynski, D. (2011). Barriers to and facilitators of healthful eating and physical activity in low-income schools. *Journal of Nutrition Education and Behavior*, *43*(1), 63–68. https://doi.org/10.1016/j.jneb.2009.11.008

Hanson, S., Cross, J., & Jones, A. (2016). Promoting physical activity interventions in communities with poor health and socio-economic profiles: A process evaluation of the implementation of a new walking group scheme. *Social Science & Medicine*, *169*, 77–85. https://doi.org/10.1016/j.socscimed.2016.09.035

Haug, E., Smith, O. R. F., Bucksch, J., Brindley, C., Pavelka, J., Hamrik, Z., Inchley, J., Roberts, C., Mathisen, F. K. S., & Sigmundová, D. (2021). 12-Year trends in active school transport across four european countries—findings from the health behaviour in school-aged children (HBSC) study. *International Journal of Environmental Research and Public Health*, *18*(4), 2118. https://doi.org/10.3390/IJERPH18042118

Henriques-Neto, D., Peralta, M., Garradas, S., Pelegrini, A., Pinto, A. A., Sánchez-Miguel, P. A., & Marques, A. (2020). Active commuting and physical fitness: A systematic review. *International Journal of Environmental Research and Public Health 2020, Vol. 17, Page 2721*, *17*(8), 2721–2736. https://doi.org/10.3390/IJERPH17082721

Huijg, J. M., Crone, M. R., Verheijden, M. W., van der Zouwe, N., Middelkoop, B. J., & Gebhardt, W. A. (2013). Factors influencing the adoption, implementation, and continuation of physical activity interventions in primary health care: a Delphi study. *BMC Family Practice*, *14*(1), 142. https://doi.org/10.1186/1471-2296-14-142

Ibor, E., Zaragoza, J., & Julián Clemente, J. A. (2019). *Promoción del desplazamiento activo desde el centro escolar*. www.capas-c.eu

Ikeda, E., Hinckson, E., Witten, K., & Smith, M. (2018). Associations of children's active school travel with perceptions of the physical environment and characteristics of the social environment: A systematic review. *Health and Place*, *54*(August), 118–131. https://doi.org/10.1016/j.healthplace.2018.09.009

Innerd, A. L., Azevedo, L. B., & Batterham, A. M. (2019). The effect of a curriculum-based physical activity intervention on accelerometer-assessed physical activity in schoolchildren: A non-randomised mixed methods controlled before-and-after study. *PLOS ONE*, *14*(12), e0225997. https://doi.org/10.1371/journal.pone.0225997

Jones, J., Yoong, S. L., Wyse, R., Ward, D. S., & Wolfenden, L. (2017). Improving the impact of obesity prevention interventions in the childcare setting: The need for a systematic application of implementation science. *Journal of Paediatrics and Child Health*, *53*(3), 211–213. https://doi.org/10.1111/jpc.13464

Jones, R. A., Blackburn, N. E., Woods, C., Byrne, M., van Nassau, F., & Tully, M. A. (2019). Interventions promoting active transport to school in children: A systematic review and meta-analysis. *Preventive Medicine*, *123*(March), 232–241. https://doi.org/10.1016/j.ypmed.2019.03.030

Kearns, N. E., Kleinert, J. O., & Dupont Versteegden, E. E. (2019). Implementing multilevel school based physical activity interventions using core implementation components model. *Journal of School Health*, *89*(5), 427–431. https://doi.org/10.1111/josh.12750

Kok, G., Gottlieb, N. H., Peters, G. J. Y., Mullen, P. D., Parcel, G. S., Ruiter, R. A. C., Fernández, M. E., Markham, C., & Bartholomew, L. K. (2016). A taxonomy of behaviour change methods: an Intervention Mapping approach. *Health Psychology Review*, *10*(3), 297–312. https://doi.org/10.1080/17437199.2015.1077155

Kok, G., Peters, L. W. H., & Ruiter, R. A. C. (2017). Planning theory- and evidence-based behavior change interventions: a conceptual review of the intervention mapping protocol. *Psicologia: Reflexão e Crítica*, *30*(1), 19. https://doi.org/10.1186/s41155-017-0072-x

Koorts, H., Eakin, E., Estabrooks, P., Timperio, A., Salmon, J., & Bauman, A. (2018). Implementation and scale up of population physical activity interventions for clinical and community settings: The PRACTIS guide. *International Journal of Behavioral Nutrition and Physical Activity*, *15*(1), 1–11. https://doi.org/10.1186/S12966-018-0678-0/TABLES/3

Kutywayo, A., Yah, C. S., Naidoo, N. P., Malotana, M., Dyani, S., & Mullick, S. (2018). Implementing the good participatory practice guidelines in the girls achieve power trial in South Africa. *SAGE Open*, *8*(4), 215824401880914. https://doi.org/10.1177/2158244018809149

Laine, H., Araújo-Soares, V., Haukkala, A., & Hankonen, N. (2017). Acceptability of strategies to reduce student sitting: A mixed-methods study with college teachers. *Health Promotion Practice*, *18*(1), 44–53. https://doi.org/10.1177/1524839916677209

Lawson, H. A., Claiborne, N., Hardiman, E., Austin, S., & Surko, M. (2007). Deriving theories of change from successful community development partnerships for youths: Implications for school improvement. *American Journal of Education*, *114*(1), 1–40. https://doi.org/10.1086/520690

Leask, C. F., Sandlund, M., Skelton, D. A., Altenburg, T. M., Cardon, G., Chinapaw, M. J. M., De Bourdeaudhuij, I., Verloigne, M., & Chastin, S. F. M. (2019). Framework, principles and recommendations for utilising participatory methodologies in the co-creation and evaluation of public health interventions. *Research Involvement and Engagement*, *5*(1), 1–16. https://doi.org/10.1186/S40900-018-0136-9/FIGURES/4

Li, L., Moosbrugger, M. E., & Liu, Y. (2021). Physical activity participation and the environment in children and adolescents: A systematic review and meta-analysis protocol. *International Journal of Environmental Research and Public Health 2021, Vol. 18, Page 6187*, *18*(12), 6187. https://doi.org/10.3390/IJERPH18126187

Lindqvist, A.-K., Kostenius, C., Gard, G., & Rutberg, S. (2015). Parent participation plays an important part in promoting physical activity. *International Journal of Qualitative Studies on Health and Well-Being*, *10*(1), 27397. https://doi.org/10.3402/qhw.v10.27397

Lloyd, J. J., Logan, S., Greaves, C. J., & Wyatt, K. M. (2011). Evidence, theory and context - using intervention mapping to develop a school-based intervention to prevent obesity in children. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 73. https://doi.org/10.1186/1479-5868-8-73

Lu, W., McKyer, E. L. J., Lee, C., Goodson, P., Ory, M. G., & Wang, S. (2014). Perceived barriers to children's active commuting to school: A systematic review of empirical, methodological and theoretical evidence. *International Journal of Behavioral Nutrition and Physical Activity*, *11*(1), 1–20. https://doi.org/10.1186/s12966-014-0140-x

Mandic, S., Hopkins, D., García Bengoechea, E., Flaherty, C., Williams, J., Sloane, L., Moore, A., & Spence, J. C. (2017). Adolescents' perceptions of cycling versus walking to school: Understanding the New Zealand context. *Journal of Transport and Health*, *4*, 294–304. https://doi.org/10.1016/j.jth.2016.10.007

Mandic, S., Jackson, A., Lieswyn, J., Mindell, J. S., García, E., Mandic, A. S., Jackson, A., Lieswyn, J., Mindell, J. S., Bengoechea, E. G., Spence, J. C., Wooliscroft, B., Wade-brown, C., Coppell, K., & Hinckson, E. (2019). *Turning the tide - from cars to active transport* (University of Otago (ed.)). University of Otago.

McSweeney, L., Araújo-Soares, V., Rapley, T., & Adamson, A. (2017). A feasibility study with process evaluation of a preschool intervention to improve child and family lifestyle behaviours. *BMC Public Health*, *17*(1), 248. https://doi.org/10.1186/s12889-017-4167-1

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, *6*(1), 42. https://doi.org/10.1186/1748-5908-6-42

Mikkelsen, B., Novotny, R., & Gittelsohn, J. (2016). Multi-level, Multi-component approaches to community based interventions for healthy living—A three case comparison. *International Journal of Environmental Research and Public Health*, *13*(10), 1023. https://doi.org/10.3390/ijerph13101023

Moore, G. F., Evans, R. E., Hawkins, J., Littlecott, H., Melendez-Torres, G. J., Bonell, C., & Murphy, S. (2019). From complex social interventions to interventions in complex social systems: Future directions and unresolved questions for intervention development and evaluation. *Evaluation*, *25*(1), 23–45. https://doi.org/10.1177/1356389018803219

Naylor, P.-J., Nettlefold, L., Race, D., Hoy, C., Ashe, M. C.,

Wharf Higgins, J., & McKay, H. A. (2015). Implementation of school based physical activity interventions: A systematic review. *Preventive Medicine*, *72*, 95–115. https://doi.org/10.1016/j.ypmed.2014.12.034

Pang, B., Kubacki, K., & Rundle-Thiele, S. (2017). Promoting active travel to school: A systematic review (2010-2016). *BMC Public Health*, *17*(1). https://doi.org/10.1186/s12889-017-4648-2

Patino-Fernandez, A. M., Hernandez, J., Villa, M., & Delamater, A. (2013). School-based health promotion intervention: Parent and school staff perspectives. *Journal of School Health*, *83*(11), 763–770. https://doi.org/10.1111/josh.12092

Reis, R. S., Salvo, D., Ogilvie, D., Lambert, E. V., Goenka, S., & Brownson, R. C. (2016). Scaling up physical activity interventions worldwide: stepping up to larger and smarter approaches to get people moving. *The Lancet*, *388*(10051), 1337–1348. https://doi.org/10.1016/S0140-6736(16)30728-0

Rhodes, R. E., Guerrero, M. D., Vanderloo, L. M., Barbeau, K., Birken, C. S., Chaput, J. P., Faulkner, G., Janssen, I., Madigan, S., Mâsse, L. C., McHugh, T. L., Perdew, M., Stone, K., Shelley, J., Spinks, N., Tamminen, K. A., Tomasone, J. R., Ward, H., Welsh, F., & Tremblay, M. S. (2020). Development of a consensus statement on the role of the family in the physical activity, sedentary, and sleep behaviours of children and youth. *International Journal of Behavioral Nutrition and Physical Activity 2020 17:1*, *17*(1), 1–31. https://doi.org/10.1186/S12966-020-00973-0

Rothman, L., Macpherson, A. K., Ross, T., & Buliung, R. N. (2018). The decline in active school transportation (AST): A systematic review of the factors related to AST and changes in school transport over time in North America. *Preventive Medicine*, *111*, 314–322. https://doi.org/10.1016/j.ypmed.2017.11.018

Schoeppe, S., Duncan, M. J., Badland, H., Oliver, M., & Curtis, C. (2013). Associations of children's independent mobility and active travel with physical activity, sedentary behaviour and weight status: A systematic review. *Journal of Science and Medicine in Sport*, *16*(4), 312–319. https://doi.org/10.1016/j.jsams.2012.11.001

Segura-Díaz, J. M., Rojas-Jiménez, Á., Barranco-Ruiz, Y., Murillo-Pardo, B., Saucedo-Araujo, R. G., Aranda-Balboa, M. J., Herrador-Colmenero, M., Villa-González, E., & Chillón, P. (2020). Feasibility and Reliability of a Questionnaire to Assess the Mode, Frequency, Distance and Time of Commuting to and from School: The PACO Study. *International Journal of Environmental Research and Public Health*, *17*(14), 5039–5053. https://doi.org/10.3390/ijerph17145039

Smith, M., Ikeda, E., Duncan, S., Maddison, R., Hinckson, E., Meredith-Jones, K., Walker, C., & Mandic, S. (2019). Trends and measurement issues for active transportation in New Zealand's physical activity report cards for children and youth. *Journal of Transport & Health*, *15*(June), 100789. https://doi.org/10.1016/j.jth.2019.100789

Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. *Health Psychology Review*, *8*(1), 1–7. https://doi.org/10.1080/17437199.2013.869710

Souza, S., Carvalho, W., Matos, A. P., Silva, A., Oliveira, E., Soares, I., Bezerra, S., & Pereira, B. (2019). *Modes of commuting to school among 5th and 6th grade schoolchildren*. *April*, 287–296. https://doi.org/http://dx.doi.org/10.5007/1980-0037.2019v21e55564

Thompson, C., McCaughan, D., Cullum, N., Sheldon, T., & Raynor, P. (2002). The value of research in clinical decision-making. *Nursing Times*, *98*(42), 30–34. http://www.ncbi.nlm.nih.gov/pubmed/12432662

Villa-González, E., Barranco-Ruiz, Y., Evenson, K. R., & Chillón, P. (2018). Systematic review of interventions for promoting active school transport. *Preventive Medicine*, *111*(2017), 115–134. https://doi.org/10.1016/j.ypmed.2018.02.010

Wilson, K., Clark, A. F., & Gilliland, J. A. (2018). Understanding child and parent perceptions of barriers influencing children's active school travel. *BMC Public Health*, *18*(1), 1053. https://doi.org/10.1186/s12889-018-5874-y

Wolfenden, L., Bell, C., Wiggers, J., Butler, M., James, E., & Chipperfield, K. (2012). Engaging parents in child obesity prevention: Support preferences of parents. *Journal of Paediatrics and Child Health*, *48*(2), E4–E6. https://doi.org/10.1111/j.1440-1754.2010.01776.x

World Health Organization. (2007). *International classification of functioning, disability, and health-children & youth version*. https://books.google.es/books?hl=es&lr=&id=SWFQDXyU-rcC&oi=fnd&pg=PR5&dq=+International+Classification+of+Functioning,+Disability+and+Health+Children+%26+Youth+Version&ots=G8RKizr0BD&sig=Yxk-mXbIiJ9VTpNGUAcHc6eRqDGU#v=onepage&q=International Classification

Zaragoza-Casterad, J., Sevil-Serrano, J., Bois, J. E., Generelo, E., Lhuisset, L., & Aibar-Solana, A. (2019). Centre for the Promotion of Physical Activity and Health (CAPAS-City): A pyrenean cross-cultural structure to lead the way in the design, implementation, and evaluation of multilevel physical activity interventions. *International Journal of Environmental Research and Public Health*, *16*(19), 3631. https://doi.org/10.3390/ijerph16193631

Zaragoza, J., Corral, A., Estrada, S., Abós, Á., & Aibar, A. (2019). Active or Passive Commuter? Discrepancies in Cut-off Criteria among Adolescents. *International Journal of Environmental Research and Public Health*, *16*(20), 3796. https://doi.org/10.3390/ijerph16203796

Zaragoza, J., Corral, A., Ikeda, E., García-Bengoechea, E., & Aibar, A. (2020). Assessment of psychological, social cognitive and perceived environmental influences on children's active transport to school. *Journal of Transport and Health*, *16*(February), 100839. https://doi.org/10.1016/j.jth.2020.100839

Appendix A

A.1. Matrix of change objectives of the ProATs intervention for children at an individual level

| Performance objectives | Influences | | | | | |
|---|---|---|---|---|---|---|
| | Attitudes | Subjective norms and social support | Perceived behavioral control /Self-efficacy | Perceived barriers | Autonomy | Knowledge |
| C.1. PO.1. Increase the frequency of them walking and cycling to school | A.1. Express positive feelings toward ATS | S.N.1. Feel that the people who are most important to them think they should use ATS | B.1. Express confidence about their ability to use ATS | P.B.1. Be able to make a positive balance between the pros and cons of the ATS | A.1. Decide to participate in the project | K.1. List the learnings they need for safe ATS |
| C.1. PO.2. Overcome barriers to increase ATS | A.2. Point out their predisposition to overcome barriers | S.N.2. Feel that the people who are most important to them will help them overcome barriers | B.2. Express confidence to overcome identified barriers | P.B.2. Be able to provide solutions to overcome barriers | A.2. Feel that their viewpoints are taken into account, allowing them to make choices and to solve problems | K.2. Know how to overcome the specific barriers on their route to school |
| C.2. PO.3. Improve their knowledge of ATS (benefits, safety rules etc.) | A.3. Show interest in learning how to travel safely to school | S.N.3. Feel that the people who are most important to them will help them understand the rules and create a safe route | B.3. Believe they are capable of learning how be active commuters | P.B.3. Express their knowledge of environmental barriers on the route to school | A. 3. Participate in identifying their learning needs | K.3. Know why ATS is recommended (physical, psychological, social, and environmental benefits) |
| P3. PO.4. Overcome barriers to increase children's ATS. | A.4. Express curiosity and attraction to come and go to school on foot or by bike. | S.N.4. Feel that the people who are most important to them will provide support for ATS | B.4. Express their capability and ability to go to school alone | P.B.4. Be willing to implement solutions to identified barriers on the route to school. | A.4. Feel that their interest in relation to ATS is a consequence of their personal initiative | K.4. Express a greater desire to use ATS. |

Note: Attitude is conceptualized as an instrumental component (i.e., extent to which behavior is seen as beneficial and useful); Subjective norm conceptualized as injunctive norms (what significant others think), and descriptive norms (i.e., what significant others do); Perceived behavioral control is conceptualized as self-efficacy (i.e., an individual´s confidence in her/his ability to perform the behavior), and perceived control (i.e., control within the environment).

A2. Matrix of change objectives of the ProATs intervention for parents at an interpersonal level

| Performance objectives | Influences | | | |
|---|---|---|---|---|
| | Attitudes | Perceived barriers | Knowledge | Social influences (social support, social norms) |
| P1. PO.1. Get parents to participate in focus groups organized at each school. Parents contribute to the intervention program with ideas | A.1. Parents express their interest in participating in the project, putting forward ideas to promote ATS | No change objective | No change objective | No change objective |
| P2. PO.2. Parents motivate their children to go to school on foot or by bike | A.2. Parents express their interest in helping towards a change in behavior, and encourage the use of ATS | P.B.2. Parents express their interest and concern for looking for solutions to overcome the barriers that allow promoting their children's ATS | K.2. Parents know the benefits of ATS, both for their children and for the environment | S.I.2. Parents indicate that they are able to motivate their children towards ATS |
| P2. PO.3. Parents are a role model for their children using active modes | A.3. Parents express positive feelings about being role models for their children | No change objective | K.3. Parents know that being a role model for their children, encourages them in ATS | S.I.3. Parents change their own habits and reduce their use of the car |
| P2. PO.4. Parents overcome barriers to increase children's ATS. | A.4. Parents express the need to overcome barriers to children's ATS | P.B.4. Parents discuss their doubts and fears about allowing their children to walk and cycle to school, and propose solutions | K.4. Parents know solutions to overcome the different barriers | S.I.4. Parents understand the importance of supporting, and encouraging their children to overcome the barriers identified on the route to school |

A3. Matrix of change objectives of the ProATs intervention for teachers at an organizational level

| Performance objectives | Influences | | | |
|---|---|---|---|---|
| | Belief about capabilities (perceived behavioral control/self-efficacy) | Knowledge | Attitude | Social influences (social support, social norms) |
| T1.PO.1. Teachers involved in the development of the design, implementation, and evaluation of the program | B.1. Teachers point out the importance of actively participating in the different project phases | K.1. Increase knowledge about other strategies to improve ATS | A.1. Teachers express positive feelings about their participation in the project | No change objective |
| T1.PO.2. ATS is integrated into the curriculum, and is part of the school's teaching and learning | B.2. Teachers point to the importance of identifying the curricular learning that can help to promote ATS | K.2. Teachers know how to optimize interpersonal styles (e.g., autonomy support, self-determined motivation, development of strategies to promote competence and relatedness need satisfaction) | A.2. Show positive attitudes towards ATS in related contents | No change objective |
| T2.PO.3. Teachers use different strategies to increase children's ATS | B.4. Teachers express confidence that they can use different strategies to increase children's ATS | K.3. Teachers know and list different strategies to increase children's ATS | A.3. Teachers express positive feelings about the benefits of using different strategies to increase children's ATS | No change objective |
| T2.PO.4. Teachers encourage children to use ATS | B.5. Teachers express confidence that they can encourage children to use ATS | K.4. Teachers know that ATS is beneficiary for children | A.4. Teachers express positive feelings about the benefits of encouraging children to use ATS | S.I. 4. Teachers encourage children to use ATS |
| T2.PO.5. Teachers are a role model for children | B.6. Teachers express confidence that they are a role model for children to use ATS | K.5. Teachers know that being a role model for children encourages them to increase ATS | A.5. Teachers express positive feelings about being a role model for children's ATS | No change objective |

Appendix B

B1. Theoretical frameworks and methods, and subsequent strategies and practical implications to achieve the change objectives at individual intervention level

| Influence | Change Objectives | Methods | Main related theories | Global strategies | Practical implications Some examples |
|---|---|---|---|---|---|
| Attitudes | A.1. A.2. A.3. A.4. | Provide a rationale | SDT | Use photographs as criticism | Photo-voice to give participants the chance to reflect upon photographs that mirror the social and environmental reality that can influence their lives and their behaviors |
| | | Goal-setting | TPB | Encourage student participation in the development of objectives based on information about individual, social, and environmental consequences of ATS behavior | Brainstorming to create meaningful and realistic goals. Write individual goals. Design a timeline that helps children remember the established objectives and their timing |
| | | Emphasize responsibility | SDT | Encourage children to participate in the different challenges and activities of the project | Children design and participate in Walking School Bus<br>Participation in the community ITB (bicycle safety test) |
| Subjective norms and social support | S.N.1. S.N.2. S.N.3. S.N.4. | Behavioral journalism | TBCM | Disseminate the project to the community | Participation in social media Interviews in local newspaper and on local television |
| | | Use of lay health workers; peer education | TBCM | Involve students from other courses | Invite students from higher courses to share their experiences in ATS |
| Belief about capabilities (perceived behavioral control/self-efficacy) | B.1. B.2. B.3. B.4. | Verbal persuasion to boost self-efficacy | TBCM | Guide children to adopt an idea through the repetition of messages with arguments designed to strengthen positive beliefs | My diary of Active Transport to School |
| | | Provide optimal challenge | SDT | Match challenges to student competences<br>Set tasks in pedestrian and bicycle training | Bicycle teaching unit |
| | | Social support | TPB | Participation of other significant agents for the child | Parental and police involvement in school routes |
| Perceived barriers | P.B.1. P.B.2. P.B.3. P.B.4. | Barrier identification | SDT | Analyze the results of perceived barriers obtained through questionnaires, and plan strategies to overcome them | Photo-elicitation interviews using photo-voice photos and others. |
| Autonomy | A.1., A.2., A.3., A.4 | Choice | SDT | Involve students in decision-making | Children choose and select meeting points for walking school bus |
| Knowledge | K.1., K.2. K.3., K.4. | Elaboration | TBCM | Connect learning with reality | Interview with the local police |
| | | Use Imagery | TBCM | Test learning in a safe environment | Road safety circuit |

B2. Theoretical frameworks and methods, and subsequent strategies and practical implications to achieve the change objectives at interpersonal intervention level

| Influence | Change Objectives | Methods | Main related theories | Global strategies | Practical implications Some examples |
|---|---|---|---|---|---|
| Attitudes | A.1., A.2. A.3., A.4. | Social planning | TBCM | Inform about social and environmental consequences | Presentation and discussion of the data of ATS patterns, and influence factors of their children |
| Perceived barriers | P.B.2. P.B.4. | Participatory problem solving | TBCM | Encourage participation in the walking school bus | Participate in the design of the routes to escort your children to school |
| | | Barrier identification | SDT | Identify barriers on main routes to school | Photo-voice interviews and questionnaires. |
| Knowledge | K.2. K.3. K.4. | Discussion | TBCM | Share information about parents' top concerns | Regular meetings Experts' meetings |
| | | Information | TPB | Raise awareness of the benefits of ATS | Infographics and reports |
| Social influences (social support, social norms) | S.I.2. S.I.3. S.I.4. | Modeling | TPB SCT | Encourage and support, to facilitate ATS behavior | Parents participate in different activities such as a cycling trip outside school. |
| | | System change | TBCM | Make alliances with different agents | Co-organize / co-prepare events (e.g., ATS week) Focus group |

B3. Theoretical frameworks and methods, and subsequent strategies and practical implications to achieve the change objectives at organizational intervention level

| Influence | Change Objectives | Methods | Main related theories | Global strategies | Practical implications Some examples |
|---|---|---|---|---|---|
| Belief about capabilities (perceived behavioral control/self-efficacy) | B.1. B.2. B.3. B.4. B.5. | Enact mastery experiences | TBCM | Review teachers' previous experiences, and adjust needs to implement the project | Create support structures for teachers such as Planning Committees |
| | | Verbal persuasion | TBCM SCT | Record audiovisual resources | City Mayor and representatives from the public health, sport, and culture sectors recorded a video to transmit messages to encourage children to use ATS |
| | | Provide information feedback | SDT | Self-monitoring of behavior | Use diary records to monitor ATS progress |
| | | Goal-setting | TPB | Connect the objectives of the project to those of the curriculum | Education Resource Kit |
| Knowledge | K.2. K.3. K.4. K.5. | Technical assistance | TBCM | Improve the teaching staff's capacity in terms of motivating and influencing students' behavior | Training program for teachers |
| Attitude | A.1., A.3., A.4., A.5. | Entertainment education | TBCM | Promote environmental awareness | Webquest about friendly and sustainable cities |
| Social influences (social support and norms) | S.I.4. | Modeling | TPB SCT | Active participation of teachers | Teachers help at the meeting points |
| | | Social encouragement /support | TPB SCT | Plan collaboration with other city agents | Meeting with the person in charge of city mobility |

# Discusión y conclusiones

# Discusión

El seguimiento de las diferentes fases del *Intervention Mapping Protocol* ayudó en la investigación a identificar las diferentes necesidades y/o retos presentes en la literatura y las propuestas metodológicas de éxito que han sido utilizadas en otras intervenciones (Fernandez et al., 2019). En este sentido, el protocolo fue una guía para planificar y tomar decisiones a la hora de diseñar, implementar y evaluar nuestro proyecto de intervención. Además, y para dar respuesta a todos los retos identificados, se tuvieron en cuenta en todo momento la perspectiva socio-ecológica del problema, el uso de marcos teóricos, la referencia de evidencias científicas y la participación de los agentes sociales (Kok et al., 2017). Este apartado de discusión se articulará desde los diferentes retos identificados.

*Reto 1. Evaluación del transporte activo: La importancia de la distancia.*

Uno de los primeros retos que se plantean en la fase 1 de *Intervention Mapping Protocol* es identificar las necesidades de intervención a través del estudio de los patrones de transporte activo al centro escolar (Fernandez et al., 2019). Durante esta evaluación se detectó, como ya venía diciendo la literatura (Dinu et al., 2019; Herrador-Colmenero et al., 2014b; Lu et al., 2014), que la falta de criterios claros de medición hace difícil la clasificación de la población en activos o pasivos y la comparación de los resultados obtenidos con los de otros estudios. A su vez, la forma en la que se clasifica al alumnado repercute en los factores de influencia identificados (Zaragoza et al., 2019). Como consecuencia, en la tesis doctoral se han evaluado estos patrones y sus factores de influencia en base a la frecuencia (Corral-Abós et al., 2021), al modo (Zaragoza et al., 2020) y al momento de desplazamiento (ir o volver) (ver estudio 4).

La distancia desde el domicilio al centro escolar mostró ser una variable fundamental a la hora de clasificar al alumnado en activo o pasivo en su desplazamiento (Zaragoza et al., 2019) y en consonancia con otros estudios (Chillón et al., 2015; Rodríguez-López et al., 2017), se presentó como uno de los factores más relacionados con los niveles de transporte activo al centro escolar. A este efecto, los criterios de medición y de clasificación del alumnado en base a la frecuencia, al modo o al momento de desplazamiento se establecen en los diferentes estudios de la tesis doctoral, siendo

siempre la distancia un dato relevante que se especifica claramente y que se utiliza para comparar y constatar los resultados.

Atendiendo a todos estos criterios, la evaluación de los patrones de desplazamiento activo dio como resultado la detección de centros prioritarios de intervención. Se identificó que los centros concertados de la ciudad de Huesca tenían niveles de transporte activo estadísticamente inferiores (i.e., M=6,38; SD=3,92) a los de los centros públicos (i.e., M=8,50 SD=2,97). Esta tendencia está en consonancia con estudios anteriores (Merom et al., 2006). Además de estos bajos niveles de desplazamientos activos, los centros concertados de Huesca están ubicados de manera muy próxima en el misma área geográfica, lo que se traduce en problemas de tráfico que a su vez aumentan los niveles de contaminación alrededor de estas escuelas (Keall et al., 2020). Esto, sumado a las implicaciones que los patrones de transporte tienen en los niveles de AF del alumnado (Costa et al., 2020) y las consecuentes implicaciones en su salud (Dinu et al., 2019; Mandic et al., 2019; Singleton, 2014), generó una necesidad prioritaria de intervención en estas escuelas.

Finalmente, teniendo en cuenta estos resultados y en referencia al criterio de la distancia, la ubicación que las escuelas concertadas tienen dentro de la ciudad se traduce en un aumento de la distancia a la hora de desplazarse (Corral-Abós et al., 2021). En este sentido la distancia fue una de las principales barreras para desplazarse activamente, como ya se ha identificado en la literatura (Ikeda, Hinckson, et al., 2018; Ikeda, Stewart, et al., 2018; Larouche, 2018). La necesidad de disminuir esta barrera hizo que en la intervención se tuviesen en cuenta estrategias que aumentasen la percepción de seguridad en los trayectos y el fomento del uso de la bicicleta, ya que en otras poblaciones se ha demostrado como los umbrales de distancia son mayores en el uso de la bicicleta en comparación con el caminar (Chillón et al., 2016).

A modo de resumen, la constatación de que los criterios de evaluación repercuten en los factores de influencia, tuvo como consecuencia el estudio de los patrones desde diferentes perspectivas para comprender mejor las necesidades a las que se enfrentaba la intervención.

*Reto 2. La necesidad de identificar los factores de influencia sobre los que apoyar las estrategias de intervención.*

Otro de los retos que se plantean en la fase 1 del *Intervention Mapping Protocol* es el de identificar los factores que influencian en el tipo de transporte utilizado para ir al centro escolar y las condiciones ambientales asociadas (Fernandez et al., 2019). Si realmente queremos aumentar la eficacia de las intervenciones es fundamental identificar los factores específicos de cada contexto particular para poder plantear los objetivos y las estrategias de intervención específicas durante la fase 2 del *Intervention Mapping Protocol* (Bartholomew et al., 2016).

En nuestro contexto particular se identificaron: (1) la percepción de control —único factor que explicaba directamente la intención de realizar un transporte activo al centro escolar—, (2) la autonomía en los desplazamientos matutinos y (3) las actitudes de las familias, como variables de influencia en la frecuencia, el modo y el momento de desplazamiento.

La percepción de control, tal y como se muestra a lo largo de la tesis doctoral, es una variable que predice la intención de un transporte activo, tanto al centro escolar (Carver et al., 2013), como en el tiempo libre (Eves et al., 2003). Esta variable se explica en el contexto de la intervención en relación a la satisfacción de dos necesidades psicológicas básicas —como son la percepción de autonomía y de competencia—, lo que puede entenderse si la percepción de control se define como la facilidad o dificultad percibida a la hora de realizar el comportamiento (Ajzen, 1991). Podría decirse que los niños que se perciben más autónomos y más competentes en el desplazamiento, sienten una mayor motivación por el comportamiento (Gillison et al., 2019) y perciben que tienen una mayor facilidad de realizarlo. A su vez, esta facilidad percibida (i.e., percepción de control) también está explicada por la percepción de las barreras ambientales (i.e., el ambiente físico y la seguridad), que han mostrado tener una fuerte relación con el transporte activo al centro escolar en otros estudios (D'Haese et al., 2015; Ikeda, Hinckson, et al., 2018; Ross et al., 2017). La formulación de la finalidad del proyecto interdisciplinar aplicado en las escuelas (i.e., fomentar los desplazamientos activos de forma autónoma y con seguridad), hizo posible que la adquisición de los aprendizajes curriculares implicados en el programa de intervención incidiese en estos factores de influencia.

Sin embargo, los diferentes estudios que se han realizado sobre la percepción de control en el transporte activo al centro escolar son limitados (Larouche, 2018). Esta variable, juntamente con la autonomía, podría estar relacionada de forma diferente con el comportamiento, dependiendo del momento en el que se realiza el transporte activo (i.e., para ir o para volver del colegio), algo que ya se planteó recientemente en la literatura (Herrador-Colmenero et al., 2019) y que se recoge en esta investigación (ver estudio 4). A este respecto, para el alumnado que vive lejos parece que el desplazamiento de ida a la escuela es menos propenso a la utilización de un transporte activo, en sintonía con los resultados de otros estudios (Larsen et al., 2012; McDonald et al., 2014; Samimi & Ermagun, 2013; Seraj et al., 2012). Esta diferencia puede estar relacionada con la conveniencia familiar y el tiempo del que se dispone por las mañanas (Pizarro et al., 2016), siendo mayores los niveles en el alumnado con una mayor percepción de control y autonomía. En base a estos resultados, en la intervención se incluyeron situaciones de aprendizaje para la mejora de las habilidades en un ambiente controlado (Bandura, 1998) y situaciones —que buscaban simplificar la organización familiar— en las que se crearon puntos de encuentro y rutas seguras, favoreciendo así la autonomía del alumnado y disminuyendo barreras de planificación (Aibar-Solana et al., 2018; Ross et al., 2017).

Por último, en las edades en las que se ha llevado a cabo la intervención es trascendental la importancia que tienen las familias en la decisión del tipo de transporte que utilizan sus hijos para ir al centro escolar (McMillan, 2005, 2007; Sirard & Slater, 2008). Los resultados de esta tesis doctoral han mostrado la influencia que tienen las actitudes hacia el transporte activo —sobre todo de las madres— en la frecuencia de desplazamientos activos del alumnado, como pasa en muchos otros comportamientos infantiles (Schoeppe, Vandelanotte, et al., 2016). El tipo de trabajos que suelen tener las madres, y la percepción cultural que se tiene de que son ellas las cuidadoras principales (Schoeppe, Vandelanotte, et al., 2016), puede explicar que sean sus percepciones las que expliquen en mayor medida el comportamiento. Sin embargo, el programa de intervención buscó una implicación activa de las familias —tanto madres como padres—debido a la importancia del apoyo familiar en la decisión de utilizar un trasporte activo al centro escolar (Loureiro et al., 2022). Para ello se les hizo partícipes de algunas de las situaciones de aprendizaje (p. ej., detección de barreras en la ruta al

centro escolar con la técnica de "foto voz"[8] o la participación en "el día de la rueda") y de grupos de discusión para conocer sus percepciones e inquietudes (p. ej., barreras hacia el transporte activo o efectividad del programa).

La implicación de las familias en las diferentes actividades fue uno de los mayores retos de la intervención, la escasa participación de éstas es una de las mayores limitaciones identificadas en nuestra investigación, lo que está en consonancia con otros estudios (Leask et al., 2019). Sin embargo, debido al rol critico que desempeñan en la efectividad y sostenibilidad de este tipo de intervenciones, las investigaciones futuras deberían ayudar a comprender los factores que influencian esta participación y qué estrategias podrían ser más efectivas para aumentarla.

Podría decirse que los factores clave identificados en nuestro contexto específico guiaron los aprendizajes más importantes a desarrollar en el alumnado (i.e., su competencia y autonomía), el tipo de estrategias a implementar que pudiesen ser más eficaces (p. ej., putos de encuentro y rutas seguras), y la necesidad de implicar a las familias en el proyecto educativo para, de esta manera, aumentar el impacto de la intervención.

*Reto 3. Calidad de las intervenciones: Perspectiva socio-ecológica, participación de los agentes y la utilización de evidencia científica.*

Una de las necesidades principales reconocidas en las diferentes revisiones sistemáticas realizadas sobre intervenciones para promocionar el transporte activo al centro escolar se refiere a la mejora de la calidad de las intervenciones en términos de efectividad y sostenibilidad (Chillón et al., 2011; Jones et al., 2019; Larouche et al., 2018; Villa-González et al., 2018). En estas revisiones se identifica la necesidad de mejorar los diseños de intervención y su evaluación, motivos por los que en ProATS se ha utilizado el *Intervention Mapping Protocol* como guía de las acciones y decisiones a tomar durante el proceso de intervención.

La heterogeneidad en los diseños de los diferentes estudios, así como de los resultados de las intervenciones para promover el transporte activo al centro escolar, hace que sea difícil identificar los criterios que pueden hacerlas más eficaces (Jones et al., 2019) y sostenibles. Sin embargo, las intervenciones basadas en la evidencia

[8] Del inglés *Photovoice*, es una técnica cualitativa que consiste en proporciona a las personas cámaras para fotografiar sus realidades percibidas permitiéndoles identificar, representar y mejorar su comunidad (Wang, 1999).

científica son más eficaces que aquellas que no lo están (Kok et al., 2017; Peters et al., 2009). Por lo tanto, el programa de intervención ProATS intentó utilizar estrategias que habían demostrado ser eficaces en otras intervenciones. Por ejemplo, una de estas estrategias es apoyar y conectar el programa de intervención con el currículo escolar (Henderson et al., 2013; Hinckson et al., 2011; Hinckson & Badland, 2011; Xu et al., 2015), aspecto que incorpora el programa de intervención a la hora de desarrollar los aprendizajes necesarios con lo que poder aumentar la probabilidad de desplazarse de forma activa.

Otra de las recomendaciones que propone la literatura para aumentar la calidad de las intervenciones de promoción del transporte activo al centro escolar es la utilización de modelos socio-ecológicos adaptados al contexto específico (Larouche et al., 2018; Pang et al., 2017). La perspectiva socio-ecológica (i.e., multinivel) de ProATS se refleja tanto en la utilización de este marco conceptual para el estudio de los factores de influencia del transporte activo al centro escolar para cada uno de los niveles, como en la utilización de los métodos y estrategias de cambio comportamental específicos para cada nivel (Kok et al., 2017). Para basar la intervención en este modelo se ha requerido de una gran cantidad de tiempo y de coordinación de las diferentes estructuras (Innerd et al., 2019; Kok et al., 2017); elementos factibles gracias a la inserción del programa en la Plan de Movilidad de la ciudad de Huesca y la financiación que posibilitó la creación de CAPAS-ciudad.

En la esfera política, la inclusión del proyecto en el Plan de Movilidad de la ciudad que traía consigo políticas asociadas al transporte activo (p. ej., peatonalización del centro de la ciudad o charlas de la policía en los colegios) y el soporte que éste recibió desde la Inspección Educativa, aumentaron las probabilidades de la sostenibilidad de la intervención (Innerd et al., 2019; Jones et al., 2019). La estructura de CAPAS-Ciudad facilitó la cocreación de ProATS, que se llevó a cabo mediante la creación de grupos de trabajo con la ciudad, los investigadores y las escuelas. Este proceso de cocreación hizo que se generase un programa de intervención flexible que pudiera ser fácilmente adaptable en cada centro escolar. El compromiso de las escuelas de adaptarlo como proyecto de centro requirió un cambio a nivel organizacional que se facilitó —mediante la figura del facilitador— con experiencias previas, guías, protocolos y con la formación adaptada al profesorado, mejorando la fiabilidad y por tanto la efectividad de ProATS (Innerd et al., 2019; Kok et al., 2017).

En definitiva, el programa de intervención, además de incidir en un problema social real, respondía a una necesidad del contexto. Esto, juntamente con el uso de metodologías didácticas que promueven aprendizajes contextualizados, hizo que ProATS fuese una intervención exitosa en el alumnado que participó.

## Conclusiones

Las distintas formas de clasificación del alumnado en activo o pasivo en su desplazamiento al centro escolar pueden dar como resultado diferentes factores que determinan el comportamiento. Esto repercute en la selección de las estrategias de intervención más eficaces para aumentar los niveles de transporte activo al centro escolar. En este sentido, se recomienda realizar un estudio de estos determinantes con diferentes tipos de patrones (p. ej., frecuencia semanal, modo habitual…) para tener una radiografía más completa del contexto a intervenir.

Para el alumnado de 4º, 5º y 6º de primaria de la ciudad de Huesca la distancia a las escuelas —sobre todo cuando es superior a 725m— es una de las principales barreras para usar un transporte activo al centro escolar. A su vez, las bajas percepciones del alumnado respecto a su capacidad para poder ir al colegio de forma activa y su percepción de autonomía para realizarlo, hacen que disminuyan sus intenciones de realizar este comportamiento, así como el desplazamiento activo en sí mismo. A nivel familiar, la organización en los diferentes momentos de desplazamiento al colegio y las actitudes de las madres hacia el transporte activo tienen también una clara influencia.

Con el objetivo de disminuir estas dificultades se propuso una intervención educativa que planteó al alumnado las siguientes preguntas fundamentales: ¿qué necesitáis aprender para ir de forma segura y autónoma al centro escolar?, ¿quién os puede ayudar? A partir de aquí, el proyecto interdisciplinar buscó aumentar, desde las diferentes asignaturas curriculares y actividades no curriculares, los conocimientos del alumnado acerca del comportamiento, sus actitudes, su competencia y su autonomía para aumentar los desplazamientos que realizan de forma activa al centro escolar, tanto andando, como en bicicleta —siendo este medio una alternativa al alumnado que vivía lejos—. Con el objetivo de realizar esta intervención más efectiva y sostenible, se buscó la implicación activa en el proyecto de las familias, del profesorado, del alumnado del centro y de los principales agentes externos. Así fue como la intervención realmente se convirtió en un proyecto de centro en el que participó toda la comunidad educativa. Además, la intervención se implementó dentro del Plan de Movilidad de la ciudad de Huesca, en el que se realizaron varios cambios ambientales como la peatonalización del centro de la ciudad o la instalación de aparca bicis en los centros educativos.

La realización de esta investigación ha requerido de recursos económicos y humanos, a la vez que de un compromiso educativo y de ciudad, para poder llevar a cabo el cambio cultural que supone variar la forma en la que las niñas y niños se desplazan al centro escolar en la ciudad de Huesca. En este sentido, la sostenibilidad de la intervención es la perspectiva de futuro más importante de esta investigación ya que su relevancia está alineada con lo expuesto en el actual Real Decreto 157/2022, de 1 de marzo, por el que se establecen la ordenación y las enseñanzas mínimas de la Educación Primaria.

> (…) La sociedad democrática demanda una ciudadanía comprometida y crítica que participe de manera activa en el ámbito escolar y en otras actividades que tengan influencia en el bienestar de la comunidad. En este marco de convivencia, el alumnado debe tomar conciencia de la importancia de las normas de conducta social, la movilidad **segura**, **saludable** y **sostenible**, (…). (Anexo II. Competencias específicas, 9. RD 157/2022, de 29 de diciembre).

Para ello, se espera que la intervención haya sido acogida por las comunidades educativas, satisfaciendo las necesidades del presente sin olvidar durante el proceso el compromiso con su capacidad futura para que sean ellas mismas las que lideren esta u otras futuras propuestas educativas.

## Conclusions

The various ways of classifying students as active or passive in their travel to school can result in different factors that determine behavior. This has implications for the selection of the most effective intervention strategies aimed at increasing active school travel levels. In this sense, a study of these determinants with different kinds of patterns (e.g., weekly frequency, usual mode, etc.) is recommended in order to have a more complete picture of the context to be intervened.

For 4th, 5th and 6th grade primary school students in the city of Huesca, the distance to schools —especially when it is greater than 725m— is one of the main barriers to using active transportation to school. In turn, the low perceptions of students regarding their ability to go to school in an active way and their perception of autonomy to do so, decrease their intentions to engage in this behavior, as well as in active travel itself. At family level, the organization of the different travel times to school and the mothers' attitudes towards active transportation also have a clear influence.

To reduce these difficulties, an educational intervention was proposed that asked the students the following fundamental questions: What do you need to learn to go to school safely and independently?, and, Who can help you? From this point on, the interdisciplinary project sought to increase, from the different curricular subjects and non-curricular activities, the students' knowledge about their behavior, attitudes, competence, and autonomy to increase the number of trips they actively made to school, both on foot and by bicycle, this being an alternative for students who lived far away. To make this intervention more effective and sustainable, we sought the active involvement of families, teachers, students, and principal external agents in the project. This is how the intervention really became a school project in which the entire educational community participated. In addition, the intervention was implemented within the Mobility Plan of the city of Huesca, in which several environmental changes were made such as the pedestrianization of the city center or the installation of bike racks at schools.

Conducting this research has required economic and human resources, as well as educational and city commitment, to carry out the cultural change that involves modifying the way in which children travel to school in the city of Huesca. In this sense, the sustainability of the intervention is the most important future perspective of

this research since its relevance is aligned with that set out in the current Royal Decree 157/2022, of March 1, which establishes the organization and minimum teachings of Primary Education.

> (...) Democratic society demands a committed and critical citizenship that actively participates in the school environment and in other activities that have an influence on the welfare of the community. In this framework of coexistence, students must become aware of the importance of the rules of social conduct, **safe**, **healthy**, and **sustainable mobility**, (...) (Annex II. Specific competences, 9. RD 157/2022, of 29 December).

To this end, it is hoped that the intervention has been welcomed by the educational communities, satisfying the needs of the present, but not forgetting throughout the process, the commitment to their future capacity so that they themselves will be the ones to lead this and other future educational proposals.

# Referencias bibliográficas

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. Health Psychology, 27(3), 379–387. https://doi.org/10.1037/0278-6133.27.3.379

Aguirre, E. (2006). Origen del estar de pie y andar ergido. *Revista de La Real Academia de Ciencias Exactas, Fisicas y Naturales (España), 100*(1), 211–220. https://rac.es/ficheros/doc/00467.pdf

Aibar-Solana, A., Mandic, S., Generelo-Lanaspa, E., Gallardo, L. O., & Zaragoza Casterad, J. (2018). Parental barriers to active commuting to school in children: does parental gender matter? *Journal of Transport & Health, 9,* 141–149. https://doi.org/10.1016/j.jth.2018.03.005

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C., & Norman, M. K. (2010). How learning works: Seven research-based principles for smart teaching. In Jossey-Bass.John Wiley & Sons. https://doi.org/10.1002/mop.21454

Aranda-Balboa, M. J., Huertas-Delgado, F. J., Herrador-Colmenero, M., Cardon, G., & Chillón, P. (2020). Parental barriers to active transport to school: a systematic review. *In International Journal of Public Health* (Vol. 65, Issue 1, pp. 87–98). Springer. https://doi.org/10.1007/s00038-019-01313-1

Armitage, C. J., & Conner, M. (2001). Efficacy of the Theory of Planned Behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*(4), 471–499. https://doi.org/10.1348/014466601164939

Aubert, S., Barnes, J. D., Abdeta, C., Abi Nader, P., Adeniyi, A. F., Aguilar-Farias, N., Andrade Tenesaca, D. S., Bhawra, J., Brazo-Sayavera, J., Cardon, G., Chang, C.-K., Delisle Nyström, C., Demetriou, Y., Draper, C. E., Edwards, L., Emeljanovas, A., Gába, A., Galaviz, K. I., González, S. A., … Tremblay, M. S. (2018). Global Matrix 3.0 Physical Activity Report Card Grades for Children and Youth: Results and Analysis From 49 Countries. *Journal of Physical Activity and Health, 15*(s2), S251–S273. https://doi.org/10.1123/jpah.2018-0472

Ayuntamiento de Huesca. (2014). *Plan de Movilidad Urbana Sostenible de Huesca Seguimiento de la implantación*. https://www.huesca.es/la-ciudad/trafico-y-movilidad/estrategia

Bandura, A. (1998). Health Promotion from the Perspective of Social Cognitive Theory. *Psychology and Health, 13,* 623–649.

Bartholomew, E. L., Highfield, L., Hartman, M., Mullen, P., Leerlooijer, J., & Fernandez, M. (2016). Using Intervention Mapping to Adapt Evidence-Based Interventions. In Eldredge L Bartholomew, C. Markham, R. Ruiter, M. Fernandez, G. Kok, & G. Parcel (Eds.), *Planning health promotion programs : an intervention mapping approach* (pp. 597–649). Jossey-Bass.

Bartholomew, L. K., Markham, C. M., Ruiter, R. A. C., Fernández, M. E., Kok, G., & Parcel, G. S. (2016). *Planning health promotion programs : an intervention mapping approach* (Fourth). Jossey-Bass.

Bartholomew, L. K., Parcel, G. S., Kok, G., & Gottlieb, N. H. (2006). *Planning health promotion programs: An Intervention Mapping approach.* https://iums.ac.ir/files/hshe-soh/files/PLANNING_HEALTH(1).pdf

Beauchamp, M. R., Crawford, K. L., & Jackson, B. (2019). Social cognitive theory and physical activity: Mechanisms of behavior change, critique, and legacy. *Psychology of Sport and Exercise, 42,* 110–117. https://doi.org/10.1016/j.psychsport.2018.11.009

Beck, L. F., & Nguyen, D. D. (2017). School transportation mode, by distance between home and school, United States, ConsumerStyles 2012. *Journal of Safety Research, 62,* 245–251. https://doi.org/10.1016/j.jsr.2017.04.001

Benayas, J., Marcén, C., Meira, P., Barba, M., Pardellas, M., Piñeiro, C., González, M. J., Sintes, M., Ull, M. Á., Suárez, M., Alba, D., Monge, C., Pi, I., De Pablo, B., Vázquez, R., de la Cruz, J. L., Picó, M. J., Ferreras, J., Calvo, S., … Heras, F. (2019). *Hacia una Educación para la Sostenibilidad* (J. Benayas & C. Marcén (eds.); Centro Nacional de Educación Ambiental (CENEAM). NIPO: 650-19-019-1

Bernardo, J., & Calderero, J. F. (2002). *Aprendo a Investigar en Educación*. EDICIONES RIALP S.A.

Bird, E. L., Baker, G., Mutrie, N., Ogilvie, D., Sahlqvist, S., & Powell, J. (2013). Behavior change techniques used to promote walking and cycling: A systematic review. *Health Psychology, 32*(8), 829–838. https://doi.org/10.1037/a0032078

Børrestad, L. A. B., Østergaard, L., Andersen, L. B., & Bere, E. (2012). Experiences from a randomised, controlled trial on cycling to school: Does cycling increase cardiorespiratory fitness? *Scandinavian Journal of Public Health, 40*(3), 245–252. https://doi.org/10.1177/1403494812443606

Boyce, W., Torsheim, T., Currie, C., & Zambon, A. (2006). The family affluence scale as a measure of national wealth: Validation of an adolescent self-report measure. *Social Indicators Research, 78*(3), 473–487. https://doi.org/10.1007/s11205-005-1607-6

Brand, A., Allen, L., Altman, M., Hlava, M., & Scott, J. (2015). Beyond authorship: Attribution, contribution, collaboration, and credit. *Learned Publishing, 28*(2), 151–155. https://doi.org/10.1087/20150211

Brand, C., Goodman, A., Ogilvie, D., Bull, F., Cooper, A., Day, A., Mutrie, N., Powell, J., Preston, J., & Rutter, H. (2014). Evaluating the impacts of new walking and cycling infrastructure on carbon dioxide emissions from motorized travel: A controlled longitudinal study. *Applied Energy, 128*(0), 284–295. https://doi.org/10.1016/j.apenergy.2014.04.072

Brunton, G., Oliver, S., Oliver, K., Lorenc, T., Banister, D., Planning, B., Budd, T., Crombie, H., Franklin, T., Ogilvie, D., Rutter, H., Spink, C., & Williams, S. (2006). *A synthesis of research addressing children's, young people's and parents' views of walking and cycling for transport.* http://eppi.ioe.ac.uk/

Buckley, A., Lowry, M. B., Brown, H., & Barton, B. (2013). Evaluating safe routes to school events that designate days for walking and bicycling. *Transport Policy, 30,* 294–300. https://doi.org/10.1016/j.tranpol.2013.09.021

Buliung, R., Faulkner, G., Beesley, T., & Kennedy, J. (2011). School travel planning: mobilizing school and community resources to encourage active school transportation. *Journal of School Health, 81*(11), 704–712. https://doi.org/10.1111/j.1746-1561.2011.00647.x

Bungum, T. J., Clark, S., & Aguilar, B. (2014). The effect of an active transport to school intervention at a suburban elementary school. *American Journal of Health Education, 45*(4), 205–209. https://doi.org/10.1080/19325037.2014.916635

Burgueño, R., González-Cutre, D., Sevil-Serrano, J., Herrador-Colmenero, M., Segura-Díaz, J. M., Medina-Casaubón, J., & Chillon, P. (2020). Validation of the Basic Psychological Need Satisfaction in Active Commuting to and from School (BPNS-ACS) Scale in Spanish young people. *Journal of Transport & Health, 16*(February 2019), 100825. https://doi.org/10.1016/j.jth.2020.100825

Carlin, A., Murphy, M. H., & Gallagher, A. M. (2016). Do interventions to increase walking work? *A systematic review of interventions in children and adolescents. 46*(4), 515–530. https://doi.org/10.1007/s40279-015-0432-6

Carver, A., Watson, B., Shaw, B., & Hillman, M. (2013). A comparison study of children's independent mobility in England and Australia. *Children's Geographies, 11*(4), 461–475. https://doi.org/10.1080/14733285.2013.812303

Cerin, E., Saelens, B. E., Sallis, J. F., & Frank, L. D. (2006). Neighborhood Environment Walkability Scale. *Medicine & Science in Sports & Exercise, 38*(9), 1682–1691. https://doi.org/10.1249/01.mss.0000227639.83607.4d

Chen, C. H., & Yang, Y. C. (2019). Revisiting the effects of project-based learning on students' academic achievement: A meta-analysis investigating moderators. *Educational Research Review, 26*(October 2018), 71–81. https://doi.org/10.1016/j.edurev.2018.11.001

Chesley, N., & Flood, S. (2017). Signs of change? At-home and breadwinner parents' housework and child-care time. *Journal of Marriage and Family, 79*(2), 511–534. https://doi.org/10.1111/jomf.12376

Chillón, P., Molina-García, J., Castillo, I., & Queralt, A. (2016). What distance do university students walk and bike daily to class in Spain. *Journal of Transport & Health, 3*(3), 315–320. https://doi.org/10.1016/j.jth.2016.06.001

Chillon, P., Ortega, F. B., Ruiz, J. R., Perez, I. J., Martin-Matillas, M., Valtuena, J., Gomez-Martinez, S., Redondo, C., Rey-Lopez, J. P., Castillo, M. J., Tercedor, P., & Delgado, M. (2009). Socio-economic factors and active commuting to school in urban Spanish adolescents: the AVENA study. *The European Journal of Public Health, 19*(5), 470–476. https://doi.org/10.1093/eurpub/ckp048

Chillón, P, Panter, J., Corder, K., Jones, A. P., & Van Sluijs, E. M. F. (2015). A longitudinal study of the distance that young people walk to school. *Health & Place, 31*(July 2008), 133–137. https://doi.org/10.1016/j.healthplace.2014.10.013

Chillón, Palma, Evenson, K. R., Vaughn, A., & Ward, D. S. (2011). A systematic review of interventions for promoting active transportation to school. International *Journal of Behavioral Nutrition and Physical Activity, 8*(1), 10. https://doi.org/10.1186/1479-5868-8-10

Chillón, Palma, Herrador-Colmenero, M., Migueles, J. H., Cabanas-Sánchez, V., Fernández-Santos, J. R., Veiga, Ó. L., Castro-Piñero, J., Marcos, A., Bandrés, F., Martínez-Gómez, D., Ruiz, J. R., Carbonell-Baeza, A., Gomez-Martinez, S., Santiago, C., Nova, E., Díaz, E. L., Zapatera, B., Veses, A. M., Mujico, J. R., … Gómez-Gallego, F. (2017). Convergent validation of a questionnaire to assess the mode and frequency of commuting to and from school. Scandinavian Journal of *Public Health, 45*(6), 612–620. https://doi.org/10.1177/1403494817718905

Christiansen, L. B., Toftager, M., Ersbøll, A. K., & Troelsen, J. (2014). Effects of a Danish multicomponent physical activity intervention on active school transport. *Journal of Transport & Health, 1*(3), 174–181. https://doi.org/10.1016/j.jth.2014.05.002

Coombes, E., & Jones, A. (2016). Gamification of active travel to school: A pilot evaluation of the Beat the Street physical activity intervention. *Health & Place, 39*, 62–69. https://doi.org/10.1016/j.healthplace.2016.03.001

Corder, K., Winpenny, E., Love, R., Brown, H. E., White, M., & Sluijs, E. Van. (2019). Change in physical activity from adolescence to early adulthood: A systematic review and meta-analysis of longitudinal cohort studies. *British Journal of Sports Medicine, 53*(8), 496–503. https://doi.org/10.1136/bjsports-2016-097330

Corral-Abós, A., Aibar, A., Estrada-Tenorio, S., Julián, J. A., Ibor, E., & Zaragoza, J. (2021). Implications of school type for active commuting to school in primary education students. *Travel Behaviour and Society, 24*(April), 143–151. https://doi.org/10.1016/j.tbs.2021.03.007

Costa, J., Adamakis, M., O'brien, W., & Martins, J. (2020). A scoping review of children and adolescents' active travel in Ireland. International Journal of *Environmental Research and Public Health, 17*(6). https://doi.org/10.3390/ijerph17062016

COVID-19 Community Mobility Report. (2020). *Informes de Movilidad Local sobre el COVID-19.* https://www.google.com/covid19/mobility/

Crawford, S., & Garrard, J. (2013). A combined impact-process evaluation of a program promoting active transport to school: Understanding the factors that shaped program effectiveness. *Journal of Environmental and Public Health,* 2013. https://doi.org/10.1155/2013/816961

D'Haese, S., Vanwolleghem, G., Hinckson, E., De Bourdeaudhuij, I., Deforche, B., Van Dyck, D., & Cardon, G. (2015). Cross-continental comparison of the association between the physical environment and active transportation in children: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 12*(1). https://doi.org/10.1186/s12966-015-0308-z

de Geus, B., Wuytens, N., Deliens, T., Keserü, I., Macharis, C., & Meeusen, R. (2019). Psychosocial and environmental correlates of cycling for transportation in Brussels. *Transportation Research Part A: Policy and Practice, 123*, 80–90. https://doi.org/10.1016/j.tra.2018.09.005

Deci, E. L., & Ryan, R. M. (1985). The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality, 19*(2), 109–134. https://doi.org/10.1016/0092-6566(85)90023-6

Deci, E. L., & Ryan, R. M. (2000). The "What" and "Why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Ding, C., Chen, Y., Duan, J., Lu, Y., & Cui, J. (2017). Exploring the influence of attitudes to walking and cycling on commute mode choice using a Hybrid Choice Model. *Journal of Advanced Transportation, 2017,* 1–8. https://doi.org/10.1155/2017/8749040

Dinu, M., Pagliai, G., Macchi, C., & Sofi, F. (2019). Active commuting and multiple health outcomes: a systematic review and meta-analysis. *Sports Medicine, 49*(3), 437–452. https://doi.org/10.1007/s40279-018-1023-0

Ducheyne, F., De Bourdeaudhuij, I., Lenoir, M., & Cardon, G. (2014). Effects of a cycle training course on children's cycling skills and levels of cycling to school. *Accident Analysis & Prevention, 67,* 49–60. https://doi.org/10.1016/j.aap.2014.01.023

Duncan, S., McPhee, J. C., Schluter, P. J., Zinn, C., Smith, R., & Schofield, G. (2011). Efficacy of a compulsory homework programme for increasing physical activity and healthy eating in children: the healthy homework pilot study. *International Journal of Behavioral Nutrition and Physical Activity, 8*. https://doi.org/10.1186/1479-5868-8-127

Eves, F., Hoppéa, R., & McLaren, L. (2003). Prediction of specific types of physical activity using the theory of planned behavior. *Journal of Applied Biobehavioral Research, 8*(2), 77–95. https://doi.org/10.1111/j.1751-9861.2003.tb00086.x

Faulkner, G. E. J., Buliung, R. N., Flora, P. K., & Fusco, C. (2009). Active school transport, physical activity levels and body weight of children and youth: A systematic review. *Preventive Medicine, 48*(1), 3–8. https://doi.org/10.1016/j.ypmed.2008.10.017

Faulkner, G. E. J., Richichi, V., Buliung, R. N., Fusco, C., & Moola, F. (2010). What's "quickest and easiest?": parental decision making about school trip mode. *International Journal of Behavioral Nutrition and Physical Activity, 7*(1), 62. https://doi.org/10.1186/1479-5868-7-62

Fernandez, M. E., Ruiter, R. A. C., Markham, C. M., & Kok, G. (2019). Intervention Mapping: Theory- and evidence-based health promotion program planning: Perspective and examples. *Frontiers in Public Health, 7*(AUG), 209. https://doi.org/10.3389/fpubh.2019.00209

Ferri-García, R., Fernández-Luna, J. M., Rodríguez-López, C., & Chillón, P. (2019). Data mining techniques to analyze the factors influencing active commuting to school. *International Journal of Sustainable Transportation, 0*(0), 1–16. https://doi.org/10.1080/15568318.2018.1547465

Frater, J., Kuijer, R., & Kingham, S. (2017). Why adolescents don't bicycle to school: Does the prototype/willingness model augment the theory of planned behaviour to explain intentions? *Transportation Research Part F: Traffic Psychology and Behaviour, 46,* 250–259. https://doi.org/10.1016/J.TRF.2017.03.005

Fyhri, A., Hjorthol, R., Mackett, R. L., Fotel, T. N., & Kyttä, M. (2011). Children's active travel and independent mobility in four countries: Development, social contributing trends and measures. *Transport Policy, 18*(5), 703–710. https://doi.org/10.1016/j.tranpol.2011.01.005

Gálvez-Fernández, P., Herrador-Colmenero, M., Esteban-Cornejo, I., Castro-Piñero, J., Molina-García, J., Queralt, A., Aznar, S., Abarca-Sos, A., González-Cutre, D., Vidal-Conti, J., Fernández-Muñoz, S., Vida, J., Ruiz-Ariza, A., Rodríguez-Rodríguez, F., Moliner-Urdiales, D., Villa-González, E., Barranco-Ruiz, Y., Huertas-Delgado, F. J., Mandic, S., & Chillón, P. (2021). Active commuting to school among 36,781 Spanish children and adolescents: A temporal trend study. Scandinavian *Journal of Medicine & Science in Sports, 31*(4), 914–924. https://doi.org/10.1111/sms.13917

García-Cervantes, L., Martinez-Gomez, D., Rodríguez-Romo, G., Cabanas-Sánchez, V., Marcos, A., & Veiga, Ó. L. (2014). Reliability and validity of an adapted version of the ALPHA environmental questionnaire on physical activity in Spanish youth. *Nutrición Hospitalaria, 30*(5), 1118–1124. https://doi.org/https://doi.org/10.3305/nh.2014.30.5.7769

García, J., Arroyo, R., Mars, L., & Ruiz, T. (2019). The influence of attitudes towards cycling and walking on travel intentions and actual behavior. *Sustainability, 11*(9), 2554. https://doi.org/10.3390/su11092554

Garnham-Lee, K. P., Falconer, C. L., Sherar, L. B., & Taylor, I. M. (2016). Evidence of moderation effects in predicting active transport to school. *Journal of Public Health (United Kingdom), 39*(1), 153–162. https://doi.org/10.1093/pubmed/fdw016

Garrard, J. (2009). *Active transport: Children and young people An overview of recent evidence*. www.vichealth.vic.gov.au

Ghekiere, A., Van Cauwenberg, J., Carver, A., Mertens, L., de Geus, B., Clarys, P., Cardon, G., De Bourdeaudhuij, I., & Deforche, B. (2016). Pyschosocial factors associated with children's cycling for transport: A cross-sectional moderation study. *Preventive Medicine, 86,* 141–146. https://doi.org/10.1016/j.ypmed.2016.03.001

Gibbons, A. (2020). Oldest Homo sapiens bones found in Europe . *Science, 368*(6492), 697–697. https://doi.org/10.1126/science.368.6492.697

Gillison, F. B., Rouse, P., Standage, M., Sebire, S. J., & Ryan, R. M. (2019). A meta-analysis of techniques to promote motivation for health behaviour change from a self-determination theory perspective. *Health Psychology Review, 13*(1), 110–130. https://doi.org/10.1080/17437199.2018.1534071

Ginja, S., Arnott, B., Namdeo, A., & McColl, E. (2018). Understanding active school travel through the Behavioural Ecological Model. *Health Psychology Review, 12*(1), 58–74. https://doi.org/10.1080/17437199.2017.1400394

Gobierno de España. (2019). *Plan de Acción para la implementación de la Agenda 2030. Hacia una estrategia española de desarrollo sostenible.* https://www.agenda2030.gob.es/sites/default/files/recursos/Plan de Acción para la Implementacion de la Agenda 2030.pdf

González, A. (2003). Los paradigmas de la investigación en ciencias sociales. *Islas, 45*(138), 125–135.

Goodman, A., van Sluijs, E. M. F., & Ogilvie, D. (2016). Impact of offering cycle training in schools upon cycling behaviour: A natural experimental study. *International Journal of Behavioral Nutrition and Physical Activity, 13*(1), 1–12. https://doi.org/10.1186/S12966-016-0356-Z/TABLES/3

Grize, L., Bringolf-Isler, B., Martin, E., & Braun-Fahrländer, C. (2010). Trend in active transportation to school among Swiss school children and its associated factors: Three cross-sectional surveys 1994, 2000 and 2005. *International Journal of Behavioral Nutrition and Physical Activity, 7,* 1–8. https://doi.org/10.1186/1479-5868-7-28

Groesz, L. M. (2007). *A conceptual evaluation of a school-based utilitarian exercise mode*l. http://hdl.handle.net/2152/18343

Gutierrez, C. M., Slagle, D., Figueras, K., Anon, A., Huggins, A. C., & Hotz, G. (2014). Crossing guard presence: Impact on active transportation and injury prevention. *Journal of Transport & Health, 1*(2), 116–123. https://doi.org/10.1016/j.jth.2014.01.005

Hagger, M. S., & Chatzisarantis, N. L. D. (2016). The Trans-Contextual Model of autonomous motivation in education. *Review of Educational Research, 86*(2), 360–407. https://doi.org/10.3102/0034654315585005

Hart, D. (2018). Man the hunted. In *man the hunted: primates, predators, and human evolution*, Expanded Edition. Routledge. https://doi.org/10.4324/9780429499081

Heinrich, K. M., Dierenfield, L., Alexander, D. A., Prose, M., & Peterson, A. C. (2011). Hawai‘i’s Opportunity for Active Living Advancement (HO‘ĀLA): Addressing Childhood Obesity through Safe Routes to School. *Hawaii Medical Journal, 70*(7 suppl 1), 21. /pmc/articles/PMC3158459/

Henderson, S., Tanner, R., Klanderman, N., Mattera, A., Webb, L. M., & Steward, J. (2013). Safe routes to school: A public health practice success story—Atlanta, 2008−2010. *Journal of Physical Activity and Health, 10*(2), 141–142. https://doi.org/10.1123/jpah.10.2.141

Herrador-Colmenero, M., Escabias, M., Ortega, F., McDonald, N., & Chillón, P. (2019). Mode of commuting TO and FROM school: A similar or different pattern? *Sustainability, 11*(4), 1026. https://doi.org/10.3390/su11041026

Herrador-Colmenero, M., Pérez-García, M., Ruiz, J. R., & Chillón, P. (2014). Assessing modes frequency of commuting to school in youngsters: A systematic review. *Pediatric Exercise Science, 26*(3), 291–341. https://doi.org/10.1123/pes.2013-0120

Hinckson, E. A., & Badland, H. M. (2011). School travel plans: Preliminary evidence for changing school-related travel patterns in elementary school children. *American Journal of Health Promotion, 25*(6), 368–371. https://doi.org/10.4278/ajhp.090706-ARB-217

Hinckson, E. A., Garrett, N., & Duncan, S. (2011). Active commuting to school in New Zealand Children (2004-2008): A quantitative analysis. *Preventive Medicine, 52*(5), 332–336. https://doi.org/10.1016/j.ypmed.2011.02.010

Hoelscher, D., Ory, M., Dowdy, D., Miao, J., Atteberry, H., Nichols, D., Evans, A., Menendez, T., Lee, C., & Wang, S. (2016). Effects of funding allocation for safe routes to school programs on active commuting to school and related behavioral, knowledge, and psychosocial outcomes. *Environment and Behavior, 48*(1), 210–229. https://doi.org/10.1177/0013916515613541

Hunter, R. F., De Silva, D., Reynolds, V., Bird, W., & Fox, K. R. (2015). International inter-school competition to encourage children to walk to school: A mixed methods feasibility study. *BMC Research Notes, 8*(1), 1–11. https://doi.org/10.1186/S13104-014-0959-X/FIGURES/4

Ibor Bernalte, E., Julián Clemente José Antonio, Zaragoza Casterad, J., Generelo Lanaspa, E., & Aibar Solana, A. (2018). La ITB o cuando los caminos se encuentran. *Tándem, 61*.

Ikeda, E., Hinckson, E., Witten, K., & Smith, M. (2018). Associations of children's active school travel with perceptions of the physical environment and characteristics of the social environment: A systematic review. *Health and Place, 54*(August), 118–131. https://doi.org/10.1016/j.healthplace.2018.09.009

Ikeda, E., Hinckson, E., Witten, K., & Smith, M. (2019). Assessment of direct and indirect associations between children active school travel and environmental, household and child factors using structural equation modelling. International *Journal of Behavioral Nutrition and Physical Activity, 16*(1), 1–17. https://doi.org/10.1186/s12966-019-0794-5

Ikeda, E., Stewart, T., Garrett, N., Egli, V., Mandic, S., Hosking, J., Witten, K., Hawley, G., Tautolo, E. S., Rodda, J., Moore, A., & Smith, M. (2018). Built environment associates of active school travel in New Zealand children and youth: A systematic meta-analysis using individual participant data. *Journal of Transport & Health, 9*(February), 117–131. https://doi.org/10.1016/j.jth.2018.04.007

Innerd, A. L., Azevedo, L. B., & Batterham, A. M. (2019). The effect of a curriculum-based physical activity intervention on accelerometer-assessed physical activity in schoolchildren: A non-randomised mixed methods controlled before-and-after study. *PLOS ONE, 14*(12), e0225997. https://doi.org/10.1371/journal.pone.0225997

Johnson, R., Frearson, M., & Hewson, P. (2016). Can bicycle training for children increase active travel? Proceedings of the Institution of Civil Engineers - *Engineering Sustainability, 169*(2), 49–57. https://doi.org/10.1680/ensu.14.00067

Jones, R. A., Blackburn, N. E., Woods, C., Byrne, M., van Nassau, F., & Tully, M. A. (2019). Interventions promoting active transport to school in children: A systematic review and meta-analysis. *Preventive Medicine, 123*(March), 232–241. https://doi.org/10.1016/j.ypmed.2019.03.030

Katzmarzyk, P. T., & Mason, C. (2009). The Physical Activity Transition. Journal of *Physical Activity and Health, 6*(3), 269–280. https://doi.org/10.1123/jpah.6.3.269

Keall, M., Hopkins, D., Coppell, K., Sandretto, S., Bengoechea, E. G., Spence, J., Wilson, G., & Mandic, S. (2020). Implications of attending the closest school on adolescents' physical activity and car travel in Dunedin, New Zealand. *Journal of Transport & Health, 18*(June), 100900. https://doi.org/10.1016/j.jth.2020.100900

Kek, C. C., García Bengoechea, E., Spence, J. C., & Mandic, S. (2019). The relationship between transport-to-school habits and physical activity in a sample of New Zealand adolescents. *Journal of Sport and Health Science, 8*(5), 463–470. https://doi.org/10.1016/j.jshs.2019.02.006

Kok, G., Gottlieb, N. H., Peters, G. J. Y., Mullen, P. D., Parcel, G. S., Ruiter, R. A. C., Fernández, M. E., Markham, C., & Bartholomew, L. K. (2016). A taxonomy of behaviour change methods: an Intervention Mapping approach. *Health Psychology Review, 10*(3), 297–312. https://doi.org/10.1080/17437199.2015.1077155

Kok, G., Peters, L. W. H., & Ruiter, R. A. C. (2017). Planning theory- and evidence-based behavior change interventions: a conceptual review of the intervention mapping protocol. *Psicologia: Reflexão e Crítica, 30*(1), 19. https://doi.org/10.1186/s41155-017-0072-x

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools, 19*(3), 267–277. https://doi.org/10.1177/1365480216659733

Kong, A. S., Burks, N., Conklin, C., Roldan, C., Skipper, B., Scott, S., Sussman, A. L., & Leggott, J. (2010). A pilot walking school bus program to prevent obesity in hispanic elementary school children: Role of physician involvement with the school community. *Clinical Pediatrics, 49*(10), 989–991. https://doi.org/10.1177/0009922810370364

Larouche, R. (2018). *Children's Active Transportation. In Children's Active Transportation* (1st Editio). Elservier.

Larouche, R., Chaput, J. P., Leduc, G., Boyer, C., Bélanger, P., Leblanc, A. G., Borghese, M. M., & Tremblay, M. S. (2014). A cross-sectional examination of socio-demographic and school-level correlates of children's school travel mode in Ottawa, Canada. *BMC Public Health, 14*(1). https://doi.org/10.1186/1471-2458-14-497

Larouche, R., Gunnell, K., & Bélanger, M. (2019). Seasonal variations and changes in school travel mode from childhood to late adolescence: A prospective study in New Brunswick, Canada. *Journal of Transport and Health, 12*(February), 371–378. https://doi.org/10.1016/j.jth.2018.08.012

Larouche, R., Mammen, G., Rowe, D. A., & Faulkner, G. (2018). Effectiveness of active school transport interventions: A systematic review and update. *BMC Public Health, 18*(1), 1–18. https://doi.org/10.1186/s12889-017-5005-1

Larouche, R., Sarmiento, O. L., Broyles, S. T., Denstel, K. D., Church, T. S., Barreira, T. V, Chaput, J.-P., Fogelholm, M., Hu, G., Kuriyan, R., Kurpad, A., Lambert, E. V, Maher, C., Maia, J., Matsudo, V., Olds, T., Onywera, V., Standage, M., Tremblay, M. S., … Katzmarzyk, P. T. (2015). Are the correlates of active school transport context-specific? *International Journal of Obesity Supplements, 5*(S2), S89–S99. https://doi.org/10.1038/ijosup.2015.25

Larsen, K., Gilliland, J., & Hess, P. M. (2012). Route-based analysis to capture the environmental influences on a child's mode of travel between home and school. *Annals of the Association of American Geographers, 102*(6), 1348–1365. https://doi.org/10.1080/00045608.2011.627059

Leask, C. F., Sandlund, M., Skelton, D. A., Altenburg, T. M., Cardon, G., Chinapaw, M. J. M., De Bourdeaudhuij, I., Verloigne, M., & Chastin, S. F. M. (2019). Framework, principles and recommendations for utilising participatory methodologies in the co-creation and evaluation of public health interventions. *Research Involvement and Engagement, 5*(1), 1–16. https://doi.org/10.1186/S40900-018-0136-9/FIGURES/4

Loureiro, N., Loureiro, V., Grao-Cruces, A., Martins, J., & Matos, M. G. de. (2022). Correlates of Active Commuting to School among Portuguese Adolescents: An Ecological Model Approach. International Journal of Environmental Research and *Public Health 2022*, Vol. 19, Page 2733, 19(5), 2733. https://doi.org/10.3390/IJERPH19052733

Lu, W., McKyer, E. L. J., Lee, C., Goodson, P., Ory, M. G., & Wang, S. (2014). Perceived barriers to children's active commuting to school: A systematic review of empirical, methodological and theoretical evidence. *International Journal of Behavioral Nutrition and Physical Activity, 11*(1), 1–20. https://doi.org/10.1186/s12966-014-0140-x

Mammen, G., Stone, M. R., Faulkner, G., Ramanathan, S., Buliung, R., O'Brien, C., & Kennedy, J. (2014). Active school travel: An evaluation of the Canadian school travel planning intervention. *Preventive Medicine, 60*(60), 55–59. https://doi.org/10.1016/j.ypmed.2013.12.008

Mandic, S., Flaherty, C., Pocock, T., Mintoft-Jones, A., Frater, J., Chillón, P., & García Bengoechea, E. (2016). Attitudes towards cycle skills training in New Zealand adolescents. *Transportation Research Part F: Traffic Psychology and Behaviour, 42*, 217–226. https://doi.org/10.1016/j.trf.2016.08.002

Mandic, S., Jackson, A., Lieswyn, J., Mindell, J. S., García, E., Mandic, A. S., Jackson, A., Lieswyn, J., Mindell, J. S., Bengoechea, E. G., Spence, J. C., Wooliscroft, B., Wade-brown, C., Coppell, K., & Hinckson, E. (2019). *Turning the tide - from cars to active transport* (University of Otago (Ed.)). University of Otago.

Mandic, S., Leon de la Barra, S., García Bengoechea, E., Stevens, E., Flaherty, C., Moore, A., Middlemiss, M., Williams, J., & Skidmore, P. (2015). Personal, social and environmental correlates of active transport to school among adolescents in Otago, New Zealand. *Journal of Science and Medicine in Sport, 18*(4), 432–437. https://doi.org/10.1016/j.jsams.2014.06.012

Martínez-Gómez, D., Ruiz, J. R., Gómez-Martínez, S., Chillón, P., Rey-López, J. P., Díaz, L. E., Castillo, R., Veiga, O. L., & Marcos, A. (2011). Active commuting to school and cognitive performance in adolescents: The AVENA study. Archives of *Pediatrics and Adolescent Medicine, 165*(4), 300–305. https://doi.org/10.1001/archpediatrics.2010.244

Mayor, D. (2017). *Effects of School Choice on Students' Mobility: Evidence from Madrid.* https://www.comunidad.madrid/sites/default/files/doc/educacion/sgea_estudio_efecto_incremento_libertad_eleccion_centro_en_movilidad_estud.pdf

McDonald, N. C. (2008). Household interactions and children's school travel: the effect of parental work patterns on walking and biking to school. *Journal of Transport Geography, 16*, 324–331. https://doi.org/10.1016/j.jtrangeo.2008.01.002

McDonald, N. C., Brown, A. L., Marchetti, L. M., & Pedroso, M. S. (2011). U.S. School travel, 2009: An assessment of trends. *American Journal of Preventive Medicine, 41*(2), 146–151. https://doi.org/10.1016/j.amepre.2011.04.006

McDonald, N., Steiner, R., Lee, C., Rhoulac-Smith, T., Zhu, X., & Yang, Y. (2014). Impact of the safe routes to school program on walking and bicycling. *Journal of the American Planning Association, 80*(2), 153–167. https://doi.org/10.1080/01944363.2014.956654

McDonald, N., Yang, Y., Abbott, S. M., & Bullock, A. N. (2013). Impact of the Safe Routes to School program on walking and biking: Eugene, Oregon study. *Transport Policy, 29*, 243–248. https://doi.org/10.1016/j.tranpol.2013.06.007

McMillan, T. E. (2005). Urban form and a child's trip to school: the current literature and a framework for future research. *Journal of Planning Literature, 19*(4), 440–456. https://doi.org/10.1177/0885412204274173

McMillan, T. E. (2007). The relative influence of urban form on a child's travel mode to school. *Transportation Research Part A: Policy and Practice, 41*(1), 69–79. https://doi.org/10.1016/j.tra.2006.05.011

McMinn, D., Rowe, D. A., Murtagh, S., & Nelson, N. M. (2012). The effect of a school-based active commuting intervention on children's commuting physical activity and daily physical activity. *Preventive Medicine, 54*(5), 316–318. https://doi.org/10.1016/J.YPMED.2012.02.013

Medrano, M., Cadenas-Sanchez, C., Oses, M., Arenaza, L., Amasene, M., & Labayen, I. (2021). Changes in lifestyle behaviours during the COVID-19 confinement in Spanish children: a longitudinal analysis from the MUGI project. *Pediatric Obesity, 16*(4). https://doi.org/10.1111/IJPO.12731

Mendoza, J. A., Watson, K., Baranowski, T., Nicklas, T. A., Uscanga, D. K., & Hanfling, M. J. (2011). The walking school bus and children's physical activity: A pilot cluster randomized controlled trial. *Pediatrics, 128*(3), e537–e544. https://doi.org/10.1542/PEDS.2010-3486

Merom, D., Tudor- Locke, C., Bauman, A., & Rissel, C. (2006). Active commuting to school among NSW primary school children: implications for public health. *Health and Place, 12*(4), 678–687. https://doi.org/10.1016/j.healthplace.2005.09.003

Metz, C. E. (1978). Basic principles of ROC analysis. *Seminars in Nuclear Medicine, 8*(4), 283–298. https://doi.org/10.1016/S0001-2998(78)80014-2

Mitchell, M. (2007). *The Guide to Low Carbon Lifestyles*. http://www.lowcarbonlifestyle.org/downloadables/TheGuideToLowCarbonLifestyles.pdf

Mitra, R. (2013). Independent mobility and mode choice for school transportation: A review and framework for future research. *Transport Reviews, 33*(1), 21–43. https://doi.org/10.1080/01441647.2012.743490

Mitra, R., & Buliung, R. N. (2014). The influence of neighborhood environment and household travel interactions on school travel behavior: An exploration using geographically-weighted models. *Journal of Transport Geography, 36,* 69–78. https://doi.org/10.1016/j.jtrangeo.2014.03.002

Molina-García, J., García-Massó, X., Estevan, I., & Queralt, A. (2019). Built environment, psychosocial factors and active commuting to school in adolescents: Clustering a self-organizing map analysis. *International Journal of Environmental Research and Public Health, 16*(1). https://doi.org/10.3390/ijerph16010083

Molina-García, J., Queralt, A., Estevan, I., Álvarez, O., & Castillo, I. (2016). Barreras percibidas en el desplazamiento activo al centro educativo: fiabilidad y validez de una escala. *Gaceta Sanitaria, 30*(6), 426–431. https://doi.org/10.1016/j.gaceta.2016.05.006

Molina-García, J., Queralt, A., García Bengoechea, E., Moore, A., & Mandic, S. (2018). Would New Zealand adolescents cycle to school more if allowed to cycle without a helmet? *Journal of Transport and Health, 11*(April), 64–72. https://doi.org/10.1016/j.jth.2018.10.001

National Institute of Statistics. (2018). *Official population figures from Spanish municipalities: revision of the municipal register.* https://www.ine.es/uc/Hhy4Lse2

Ntoumanis, N., Ng, J. Y. Y., Prestwich, A., Quested, E., Hancox, J. E., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Lonsdale, C., & Williams, G. C. (2021). A meta-analysis of self-determination theory-informed intervention studies in the health domain: effects on motivation, health behavior, physical, and psychological health. *Health Psychology Review, 15*(2), 214–244. https://doi.org/10.1080/17437199.2020.1718529

Oliver, M., Parker, K., Witten, K., Mavoa, S., Badland, H. M., Donovan, P., Chaudhury, M., & Kearns, R. (2016). Children's out-of-school independently mobile trips, active travel, and physical activity: A cross-sectional examination from the kids in the city study. *Journal of Physical Activity and Health, 13*(3), 318–324. https://doi.org/10.1123/jpah.2015-0043

Organización Mundial de la Salud. (2019). *Plan de acción mundial sobre actividad física 2018-2030. Más personas activas para un mundo sano.* Organización Panamericana de la Salud.

Østergaard, L., Støckel, J. T., & Andersen, L. B. (2015). Effectiveness and implementation of interventions to increase commuter cycling to school: A quasi-experimental study. *BMC Public Health, 15*(1), 1–8. https://doi.org/10.1186/S12889-015-2536-1/TABLES/4

Oyeyemi, A. L., & Larouche, R. (2018). Prevalence and correlates of active transportation in developing countries prevalence and correlates of active. In R. Larouche (Ed.), *Children's Active Transportation* (pp. 173–191). El Servier.

Pang, B., Kubacki, K., & Rundle-Thiele, S. (2017). Promoting active travel to school: A systematic review (2010-2016). *BMC Public Health, 17*(1). https://doi.org/10.1186/s12889-017-4648-2

Panter, J., Corder, K., Griffin, S. J., Jones, A. P., & van Sluijs, E. M. (2013). Individual, socio-cultural and environmental predictors of uptake and maintenance of active commuting in children: longitudinal results from the SPEEDY study. International *Journal of Behavioral Nutrition and Physical Activity, 10*(1), 83. https://doi.org/10.1186/1479-5868-10-83

Panter, J. R. (2010). *Towards an understanding of the influences on active commuting* (Issue May). University of East Anglia, UK.

Panter, J. R., & Jones, A. (2010). Attitudes and the environment as determinants of active travel in adults: what do and don't we know? *Journal of Physical Activity and Health, 7*(4), 551–561. https://doi.org/10.1123/jpah.7.4.551

Panter, J. R., Jones, A. P., van Sluijs, E. M. ., & Griffin, S. (2010). Attitudes, social support and environmental perceptions as predictors of active commuting behaviour in school children. *Journal of Epidemiology & Community Health, 64*(01), 41–48. https://doi.org/10.1136/jech.2009.086918

Panter, J. R., Jones, A. P., & van Sluijs, E. M. F. (2008). Environmental determinants of active travel in youth: A review and framework for future research. International *Journal of Behavioral Nutrition and Physical Activity, 5*(1), 34–48. https://doi.org/10.1186/1479-5868-5-34

Pavelka, J., Sigmundová, D., Hamřík, V., Kalman, M., Sigmund, E., & Mathisen, F. (2017). Trends in active commuting to school among czech schoolchildren from 2006 to 2014. *Central European Journal of Public Health, 25*(Suppl 1), S21–S25. https://doi.org/https://doi.org/10.21101/cejph.a5095

Peters, L. W. H., Kok, G., Ten Dam, G. T. M., Buijs, G. J., & Paulussen, T. G. W. M. (2009). Effective elements of school health promotion across behavioral domains: a systematic review of reviews. *BMC Public Health, 9*. https://doi.org/10.1186/1471-2458-9-182

Pikora, T., Giles-Corti, B., Bull, F., Jamrozik, K., & Donovan, R. (2003). Developing a framework for assessment of the environmental determinants of walking and cycling. *Social Science & Medicine, 56*(8), 1693–1703. https://doi.org/10.1016/S0277-9536(02)00163-6

Pinto, A. de A., Claumann, G. S., Angelo, H. C. C. de, Menezes, E. C., Dias, D. T., & Pelegrini, A. (2017). Active commuting to school and associated factors among adolescents: a systematic review. *Journal of Physical Education, 28*(1), 1–11. https://doi.org/10.4025/jphyseduc.v28i1.2859

Pizarro, A. N., Schipperijn, J., Andersen, H. B., Ribeiro, J. C., Mota, J., & Santos, M. P. (2016). Active commuting to school in Portuguese adolescents: Using PALMS to detect trips. *Journal of Transport & Health, 3*(3), 297–304. https://doi.org/10.1016/j.jth.2016.02.004

Pizarro, A. N., Schipperijn, J., Ribeiro, J. C., Figueiredo, A., Mota, J., & Santos, M. P. (2017). Gender differences in the domain-specific contributions to moderate-to-vigorous physical activity, accessed by GPS. *Journal of Physical Activity and Health, 14*(6), 474–478. https://doi.org/10.1123/jpah.2016-0346

Pont, K., Ziviani, J., Wadley, D., & Abbott, R. (2011). The Model of Children's Active Travel (M-CAT): A conceptual framework for examining factors influencing children's active travel. Australian Occupational *Therapy Journal, 58*(3), 138–144. https://doi.org/10.1111/j.1440-1630.2010.00865.x

Pontzer, H. (2015). Constrained total energy expenditure and the evolutionary biology of energy balance. *Exercise and Sport Sciences Reviews, 43*(3), 110–116. https://doi.org/10.1249/JES.0000000000000048

Reimers, A. K., Jekauc, D., Peterhans, E., Wagner, M. O., & Woll, A. (2013). Prevalence and socio-demographic correlates of active commuting to school in a nationwide representative sample of German adolescents. *Preventive Medicine, 56*(1), 64–69. https://doi.org/10.1016/j.ypmed.2012.11.011

Reynolds, R., McKenzie, S., Allender, S., Brown, K., & Foulkes, C. (2014). Systematic review of incidental physical activity community interventions. *Preventive Medicine, 67*, 46–64. https://doi.org/10.1016/j.ypmed.2014.06.023

Rhodes, R. E., Brown, S. G., & McIntyre, C. A. (2006). Integrating the perceived neighborhood environment and the Theory of Planned Behavior when predicting walking in a canadian adult sample. *American Journal of Health Promotion, 21*(2), 110–118. https://doi.org/10.4278/0890-1171-21.2.110

Rodríguez-López, C., Salas-Fariña, Z. M., Villa-González, E., Borges-Cosic, M., Herrador-Colmenero, M., Medina-Casaubón, J., Ortega, F. B., & Chillón, P. (2017). The threshold distance associated with walking from home to school. *Health Education and Behavior, 44*(6), 857–866. https://doi.org/10.1177/1090198116688429

Rodríguez-López, C., Villa-González, E., Pérez-López, I. J., Delgado-Fernández, M., Ruiz, J. R., & Chillón, P. (2013). Los factores familiares influyen en el desplazamiento activo al colegio de los niños españoles. *Nutrición Hospitalaria, 28*(3), 756–763. https://doi.org/10.3305/nh.2013.28.3.6399

Ross, A., Rodríguez, A., & Searle, M. (2017). Associations between the physical, sociocultural, and safety environments and active transportation to school. *American Journal of Health Education, 48*(3), 198–209. https://doi.org/10.1080/19325037.2017.1292877

Rothman, L., Buliung, R., To, T., Macarthur, C., Macpherson, A., & Howard, A. (2015). Associations between parents perception of traffic danger, the built environment and walking to school. *Journal of Transport and Health, 2*(3), 327–335. https://doi.org/10.1016/j.jth.2015.05.004

Rothman, L., Macpherson, A. K., Ross, T., & Buliung, R. N. (2018). The decline in active school transportation (AST): A systematic review of the factors related to AST and changes in school transport over time in North America. *Preventive Medicine, 111*, 314–322. https://doi.org/10.1016/j.ypmed.2017.11.018

Ruiz-Ariza, A., Pinillos, F. G., Latorre Román, P. A., & Martínez-López, E. J. (2015). Niveles de desplazamiento activo en jóvenes de 12-16 años. Un estudio de la provincia de jaén. *EmásF, Revista Digital de Educación Física, 6*(34), 72–80. http://emasf.webcindario.com

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annu. Rev. Public Health, 27*, 297–322. https://doi.org/10.1146/annurev.publhealth.27.021405.102100

Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological models of health behaviour. In N. Owen, B. Heart, & E. B. Fisher (Eds.), *Health behaviour and health education. Theory, Research and Practic*e (4th Editio, Issue December 2015, pp. 465–485). Jossey-Bass.

Samimi, A., & Ermagun, A. (2013). Students' Tendency to Walk to School: Case Study of Tehran. *Journal of Urban Planning and Development, 139*(2), 144–152. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000141

Sayers, S. P., LeMaster, J. W., Thomas, I. M., Petroski, G. F., & Ge, B. (2012). A walking school bus program: impact on physical activity in elementary school children in Columbia, Missouri. *American Journal of Preventive Medicine, 43*(5), S384–S389. https://doi.org/10.1016/j.amepre.2012.07.009

Schisterman, E. F., Perkins, N. J., Liu, A., & Bondell, H. (2005). Optimal Cut-point and its corresponding youden index to discriminate individuals using pooled blood samples. *Epidemiology, 16*(1), 73–81. https://doi.org/10.1097/01.ede.0000147512.81966.ba

Schoeppe, S., Duncan, M. J., Badland, H. M., Rebar, A. L., & Vandelanotte, C. (2016). Too far from home? Adult attitudes on children's independent mobility range. *Children's Geographies, 14*(4), 482–489. https://doi.org/10.1080/14733285.2015.1116685

Schoeppe, S., Duncan, M. J., Badland, H., Oliver, M., & Curtis, C. (2013). Associations of children's independent mobility and active travel with physical activity, sedentary behaviour and weight status: A systematic review. *Journal of Science and Medicine in Sport, 16*(4), 312–319. https://doi.org/10.1016/j.jsams.2012.11.001

Schoeppe, S., Vandelanotte, C., Bere, E., Lien, N., Verloigne, M., Kovács, É., Manios, Y., Bjelland, M., Vik, F. N., & Van Lippevelde, W. (2016). The influence of parental modelling on children's physical activity and screen time: Does it differ by gender? *The European Journal of Public Health, 27*(1), 182. https://doi.org/10.1093/eurpub/ckw182

Segura-Díaz, J. M., Rojas-Jiménez, Á., Barranco-Ruiz, Y., Murillo-Pardo, B., Saucedo-Araujo, R. G., Aranda-Balboa, M. J., Herrador-Colmenero, M., Villa-González, E., & Chillón, P. (2020). Feasibility and reliability of a questionnaire to assess the mode, frequency, distance and time of commuting to and from school: The PACO study. *International Journal of Environmental Research and Public Health, 17*(14), 5039–5053. https://doi.org/10.3390/ijerph17145039

Seraj, S., Sidharthan, R., Bhat, C. R., Pendyala, R. M., & Goulias, K. G. (2012). Parental attitudes toward children walking and bicycling to school. Transportation research record: *Journal of the Transportation Research Board, 2323*(1), 46–55. https://doi.org/10.3141/2323-06

Singleton, A. (2014). A GIS approach to modelling CO 2 emissions associated with the pupil-school commute. *International Journal of Geographical Information Science, 28*(2), 256–273. https://doi.org/10.1080/13658816.2013.832765

Sirard, J. R., McDonald, K., Mustain, P., Hogan, W., & Helm, A. (2015). Effect of a school choice policy change on active commuting to elementary school. *American Journal of Health Promotion, 30*(1), 28–35. https://doi.org/10.4278/ajhp.130510-QUAN-236

Sirard, J. R., & Slater, M. E. (2008). Walking and bicycling to school: A review. *American Journal of Lifestyle Medicine, 2*(5), 372–396. https://doi.org/10.1177/1559827608320127

Smith, M., Ikeda, E., Hawley, G., Mavoa, S., Hosking, J., Egli, V., Zhao, J., Mackay, L., Donnellan, N., Amann, R., Mackie, H., & Witten, K. (2020). An integrated conceptual model of environmental needs for New Zealand children ' s active travel to school. *Journal of Transport & Health, 16*(August 2019), 100814. https://doi.org/10.1016/j.jth.2019.100814

Souza, S., Carvalho, W., Matos, A. P., Silva, A., Oliveira, E., Soares, I., Bezerra, S., & Pereira, B. (2019). Modes of commuting to school among 5th and 6th grade schoolchildren. *Revista Brasileira de Cineantropometria & Desempenho Humano, 30* (Mayo), 287–296. https://doi.org/http://dx.doi.org/10.5007/1980-0037.2019v21e55564

Spittaels, H., Verloigne, M., Gidlow, C., Gloanec, J., Titze, S., Foster, C., Oppert, J.-M., Rutter, H., Oja, P., Sjostrom, M., & De Bourdeaudhuij, I. (2010). Measuring physical activity-related environmental factors: reliability and predictive validity of the European environmental questionnaire ALPHA. *International Journal of Behavioral Nutrition and Physical Activity, 7*(1), 48. https://doi.org/10.1186/1479-5868-7-48

Stewart, O., Moudon, A. V., & Claybrooke, C. (2014). Multistate evaluation of safe routes to school programs. *American Journal of Health Promotion, 28*(3_suppl), S89–S96. https://doi.org/10.4278/ajhp.130430-QUAN-210

Uddin, R., Mandic, S., & Khan, A. (2019). Active commuting to and from school among 106,605 adolescents in 27 Asia-Pacific countries. *Journal of Transport & Health, 15*(August), 100637. https://doi.org/10.1016/j.jth.2019.100637

United Nations. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development Transforming our world: the 2030 Agenda for Sustainable Development. General Assembly 70 Session.* https://www.unfpa.org/resources/transforming-our-world-2030-agenda-sustainable-development

van der Ploeg, H. P., Merom, D., Corpuz, G., & Bauman, A. E. (2008). Trends in Australian children traveling to school 1971-2003: Burning petrol or carbohydrates? *Preventive Medicine, 46*(1), 60–62. https://doi.org/10.1016/j.ypmed.2007.06.002

Van Ristell, J., Quddus, M., Enoch, M., Wang, C., & Hardy, P. (2013). Quantifying the transport-related impacts of parental school choice in England. *Transportation, 40*(1), 69–90. https://doi.org/10.1007/s11116-012-9410-0

van Sluijs, E. M. F., Fearne, V. A., Mattocks, C., Riddoch, C., Griffin, S. J., & Ness, A. (2009). The contribution of active travel to children's physical activity levels: Cross-sectional results from the ALSPAC study. *Preventive Medicine, 48*(6), 519–524. https://doi.org/10.1016/j.ypmed.2009.03.002

Vanwolleghem, G., D'Haese, S., Dyck, D. Van, Bourdeaudhuij, I. De, & Cardon, G. (2014). Feasibility and effectiveness of drop-off spots to promote walking to school. *International Journal of Behavioral Nutrition and Physical Activity, 11*(1), 1–11. https://doi.org/10.1186/s12966-014-0136-6

Villa-González, E., Barranco-Ruiz, Y., Evenson, K. R., & Chillón, P. (2018). Systematic review of interventions for promoting active school transport. *Preventive Medicine, 111*(2017), 115–134. https://doi.org/10.1016/j.ypmed.2018.02.010

Villa-gonzález, E., Jesús, C., La, P. De, Joaquín, C., Rosa, A., & Ma, R. (2017). Desplazarse activamente : Una huella evolutiva (Issue March). *Habilidad Motriz, 48*, 2-4. ISSN: 1132-2462.

Villa-González, E., Rodríguez-López, C., Delgado, F. J. H., Tercedor, P., Ruiz, J. R., & Chillón, P. (2012). Factores personales y ambientales asociados con el desplazamiento activo al colegio de los escolares españoles. *Revista de Psicologia Del Deporte, 21*(2), 343–349.

Villa-González, E., Ruiz, J. R., & Chillón, P. (2015). Associations between active commuting to school and health-related physical fitness in spanish school-aged children: A cross-sectional study. *International Journal of Environmental Research and Public Health, 12*(9), 10362–10373. https://doi.org/10.3390/ijerph120910362

Villa-González, E., Ruiz, J. R., Ward, D. S., & Chillón, P. (2015). Effectiveness of an active commuting school-based intervention at 6-month follow-up. *The European Journal of Public Health, 26*(2), 272–276. https://doi.org/10.1093/eurpub/ckv208

Voss, C., Winters, M., Frazer, A., & McKay, H. (2015). School-travel by public transit: Rethinking active transportation. *Preventive Medicine Reports, 2,* 65–70. https://doi.org/10.1016/j.pmedr.2015.01.004

Wang, C. (1999). Photovoice: A participatory action research strategy applied to women's health. *Journal of Women's Health, 8*(2), 185–192. https://doi.org/10.1089/jwh.1999.8.185

Waygood, E. O. D., Friman, M., Olsson, L. E., & Taniguchi, A. (2017). Transport and child well-being: An integrative review. *Travel Behaviour and Society, 9*, 32–49. https://doi.org/10.1016/j.tbs.2017.04.005

Wendel-Vos, W., Droomers, M., Kremers, S., Brug, J., & van Lenthe, F. (2007). Potential environmental determinants of physical activity in adults: a systematic review. *Obesity Reviews, 8*(5), 425–440. https://doi.org/10.1111/j.1467-789X.2007.00370.x

Wong, B. Y.-M., Faulkner, G., Buliung, R., & Irving, H. (2011). Mode shifting in school travel mode: examining the prevalence and correlates of active school transport in Ontario, Canada. *BMC Public Health, 11*(1), 618–630. https://doi.org/10.1186/1471-2458-11-618

World Health Organization. (2018). *Global action plan on physical activity 2018–2030: more active people for a healthier world*. https://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf?ua=1

Xu, F, Ware, R. S., Leslie, E., Tse, L. A., Wang, Z., Li, J., & Wang, Y. (2015). Effectiveness of a randomized controlled lifestyle intervention to prevent obesity among Chinese primary school students: Click-obesity study. *PLoS ONE, 10*(10), e0141421. https://doi.org/10.1371/journal.pone.0141421

Yang, Yizhao, Schlossberg, M., Parker, R. G., Johnson, B., & Oregon, U. (2010). *Understanding school travel : how residential location choice and the built environment affect trips to school.* Oregon Transportation Research and Education Consortium. https://rosap.ntl.bts.gov/view/dot/18172

Yang, Yong, & Diez-Roux, A. V. (2013). Using an agent-based model to simulate children's active travel to school. *International Journal of Behavioral Nutrition and Physical Activity, 10*(1), 67. https://doi.org/10.1186/1479-5868-10-67

Zaragoza-Casterad, J., Sevil-Serrano, J., Bois, J. E., Generelo, E., Lhuisset, L., & Aibar-Solana, A. (2019). Centre for the Promotion of Physical Activity and Health (CAPAS-City): A pyrenean cross-cultural structure to lead the way in the design, implementation, and evaluation of multilevel physical activity interventions. *International Journal of Environmental Research and Public Health, 16*(19), 3631. https://doi.org/10.3390/ijerph16193631

Zaragoza, J., Corral, A., Estrada, S., Abós, Á., & Aibar, A. (2019). Active or passive commuter? Discrepancies in cut-off criteria among adolescents. *International Journal of Environmental Research and Public Health, 16*(20). https://doi.org/10.3390/ijerph16203796

Zaragoza, J., Corral, A., Ikeda, E., García-Bengoechea, E., & Aibar, A. (2020). Assessment of psychological, social cognitive and perceived environmental influences on children's active transport to school. *Journal of Transport and Health, 16*. https://doi.org/10.1016/j.jth.2020.100839

Fuentes legales:

Ley Orgánica 3/2020, de 29 de diciembre, por la que se modifica la Ley Orgánica 2/2006, de 3 de mayo, de Educación. https://www.boe.es/eli/es/lo/2020/12/29/3

Orden ECD/850/2016, de 29 de julio que modifica la Orden de 16 de junio de 2014, currículo de Educación Primaria. http://www.boa.aragon.es/cgi-bin/EBOA/BRSCGI?CMD=VEROBJ&MLKOB=921670621818&type=pdf

Orden SND/370/2020, de 25 de abril, sobre las condiciones en las que deben desarrollarse los desplazamientos por parte de la población infantil durante la situación de crisis sanitaria ocasionada por el COVID-19. https://www.boe.es/eli/es/o/2020/04/25/snd370/con

Real Decreto 157/2022, de 1 de marzo, por el que se establecen la ordenación y las enseñanzas mínimas de la Educación Primaria. https://www.boe.es/eli/es/rd/2022/03/01/157/con

# Anexos

# Anexo 1

La tesis se presenta como compendio de publicaciones. En la tabla 5 se recogen el factor de impacto y las áreas temáticas de los trabajos publicados, aceptados o en revisión.

**Tabla 5**

*Factor de impacto y áreas temáticas de las publicaciones de la tesis*

| Nombre de la revista | JIF (año) | Cuartil JIF | Categoría |
|---|---|---|---|
| Travel Behaviour and Society | 4.983 (2020) | Q2 | Transportation - SSCI |
| Journal of Environmental Research and Public Health<br>Special Issue Physical Activity and Health | 3.390 (2020) | Q1 | Public, environmental & occupational health - SSCI |
| Journal of Transport and Health | 2.796 (2020) | Q2 | Public, environmental & occupational health - SSCI |
| Retos: Revista de Educación Física, Deporte y Recreación | 0.26 (2019) | Q3 | Hospitality, leisure, sport & tourism - ESCI |

*Nota*. Fuente: Web Of Science, Journal Citation Reports. JIF: Journal Impact Factor. SSCI: Social Sciences Citation Index. ESCI: Emerging Sources Citation Index.

A continuación, se presentan las cartas de aceptación de los trabajos no publicados y las contribuciones de la doctoranda en los trabajos en coautoría (ver Tabla 6)

D. Francisco Ruiz Juan, con D.N.I. 26.456.815-F, en calidad de Presidente de la Federación de Asociaciones de Docentes de Educación Física y director de la revista "***Retos. Nuevas tendencias en Educación Física, Deporte y Recreación***" (ISSN: 1579-1726; Depósito Legal: M-10432-2002; I.S.S.N. – Edición Web 1988-2041):

**CERTIFICO**

Que el siguiente artículo ha sido aceptado para ser publicado en el número 46 de Retos. Nuevas tendencias en Educación Física, Deporte y Recreación (I.S.S.N. – Edición Web 1988-2041) https://recyt.fecyt.es/index.php/retos/index:
Applying the Intervention Mapping Protocol to promote Active Transport to School in primary school students: the ProATs intervention
Ana Corral-Abós, Javier Zaragoza, Alberto Aibar, Eduardo Ibor, José Antonio Julián
Dicha revista se encuentra incluida en los siguientes centros de documentación:

Web of Science de Thomson Reuters (Emerging Sources Citation Index), Scopus, Dialnet, DICE (Dissemination and Editorial Quality of Spanish Journals of Humanities and Social Sciences and Law), Directory of Open Access Journals (DOAJ), Directory of Research Journal Indexing (DRJI), Ebsco host, Academic Search Premier Collection, Sport Discus, e-revistas (Spanish and Latin American Scientific Electronic Journals database), Google Scholar (English and Spanish), IN-RECS (Impact Index of Spanish Social Science Journals), IRESIE (Higher Education and Educational Research Journals Index), Catálogo Latindex, LivRe!, Brazil's Nuclear Information Center, MIAR, Information Matrix for the Analysis of Journals,Network of University Libraries "Rebiun", Open Science Collector "Recolecta" (Spanish Foundation for Science and Technology), Portal of Health Sciences Journals "bvs" (Brazil), Portuguese Journals Website "Capes", ProQuest Ulrich's web, PSICODOC. Bibliographic Psychology Database, Redalyc (Network of Scientific Journals from Latin America and the Caribbean), RESH (Spanish Journals of Social Sciences and Humanities Information System), Sherpa/Romeo, United Kingdom, Sicapes (WebQualis), Brazilian Ministry of Education, Socol@r, Index of Open Educational Resources, China, Spanish National Research Council (CSIC) databases: ISOC, Social Sciences and Humanities, CINDOC, Spanish Union Catalogue of Periodicals "ARIADNA", Sport´docs database, from the National Institute of Sport and Physical Education of France, SUDOC (University Documentation System from Belgium), Union Catalogue "COPAC" from the United Kingdom, World Health Organization's "HINARI" journals, Google Académico, IRESIE, Fuente Academica, Colciencias/Publindex

Por la presente, expido el presente certificado para que surta los efectos oportunos, en San Javier a 24 de mayo de 2022.

**Fdo. Francisco Ruiz Juan**
Director de la revista
***Retos. Nuevas tendencias en Educación Física, Deporte y Recreación***

C/ Cabo Vidio, 27 - 30730 San Javier (Murcia) – Telf (+34) 968 19 36 95 – 650 45 43 17 – e-mail: feadef@gmail.com

**Tabla 6**

*Contribuciones de la doctoranda a los trabajos publicados en coautoría*

| **Contribución** | **Estudio 1** | **Estudio 2** | **Estudio 3** | **Estudio 4** | **Estudio 5** |
|---|---|---|---|---|---|
| Conceptualización | ⊗ | ✓ | ⊗ | ⊗ | ⊗ |
| Metodología | ⊗ | ✓ | ⊗ | ✓ | ⊗ |
| *Sofware* | ⊗ | ⊗ | ⊗ | ⊗ | ⊗ |
| Validación | ⊗ | ⊗ | ⊗ | ⊗ | ⊗ |
| Análisis formal | ✓ | ⊗ | ⊗ | ✓ | ⊗ |
| Investigación | ✓ | ✓ | ✓ | ✓ | ✓ |
| Recursos | ✓ | ✓ | ✓ | ✓ | ✓ |
| Conservación de los datos | ⊗ | ✓ | ✓ | ✓ | ✓ |
| Escribir – manuscrito original | ✓ | ✓ | ⊗ | ✓ | ✓ |
| Escribir – revisar y editar | ✓ | ✓ | ⊗ | ✓ | ✓ |
| Visualización | ⊗ | ⊗ | ⊗ | ⊗ | ⊗ |
| Supervisión | ⊗ | ⊗ | ⊗ | ⊗ | ⊗ |
| Administración del proyecto | ⊗ | ⊗ | ⊗ | ⊗ | ⊗ |
| Adquisición de fondos | ⊗ | ⊗ | ⊗ | ⊗ | ⊗ |

*Nota*. Las contribuciones de basan en la taxonomía CRediT (*Contributor Roles Taxonomy*) de Brand et al. (2015).

**Tabla 7**

*Resumen de intervenciones para promover el transporte activo al centro escolar*

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Kong et al., 2010) | Alburquerque, Nuevo México, EEUU. 22 estudiantes de 5-11 años. Duración: 10 semanas. | Los estudiantes que cumplían estándares de obesidad participaron en rutas diseñadas para andar que tenían puntos de encuentro. Estudiantes de la universidad acudían a las rutas para hablar sobre temas de salud. | Individual (comportamiento). Ambiente social y cultural (modelo). | Durante la intervención el 70% de los estudiantes caminó una media de 3 o más veces a la semana al colegio. |
| (Buliung et al., 2011) | 4 provincias de Canadá. 12 escuelas de primaria. 1489 padres de estudiantes de 4 - 14 años. Duración: 12 meses. | *School Travel Planning*. Facilitadores y personal escolar crean e implementan planes de acción para el transporte activo al centro escolar desde la promoción y la educación, con actividades y eventos. Cada escuela y su comité desarrollaban el programa, identificando las necesidades de cada contexto. En la parte educativa se desarrollaron en su mayoría estrategias de seguridad (p. ej., habilidad en bicicleta, beneficios del transporte activo), el aprendizaje espacial fue menos común (p. ej., identificación de rutas). También se llevaron a cabo actividades y eventos de concienciación (p. ej., el día de la bicicleta). Se mejoró el ambiente construido (p. ej., reparación de calzadas) y se realizó un refuerzo de infraestructuras (p. ej., aumento de aparcamiento de bicicletas). | Individual (conocimientos). Ambiente social y cultural (eventos). Ambiente físico (aumento de infraestructuras). | Aumento modesto en los porcentajes de frecuencia de desplazamientos activos. |
| (Duncan et al., 2011) | Auckland, Nueva Zelanda. 2 escuelas de primaria. 97 estudiantes de 9-11 años. Duración: 6 semanas. | Intervención multicomponente que busca mejorar los niveles de actividad física y la alimentación. Consiste en hacer deberes sobre los diferentes temas. Los deberes saludables eran política de la escuela. Andar era uno de los deberes de una de las semanas. | Individual (comportamiento). | No hubo cambios significativos en los desplazamientos activos en los estudiantes que recibieron la intervención. |

(Continúa tabla 7…)

(Continúa tabla 7…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Heinrich et al., 2011) | Hawai. 13 escuelas. Duración: 12 meses. | *Safe Routes to School* (SRTS). Recibieron financiación para el programa tras una evaluación de los comportamientos y del ambiente físico. La formación de un equipo de SRTS; la realización de un plan de acción SRTS; la aplicación de varias estrategias educativas, de fomento; asistencia técnica para la financiación adicional; y los premios de financiación SRTS. | Individual (conocimientos). Ambiente físico (infraestructuras bicicleta) Ambiente político (financiación) | No existe un análisis de los cambios en el ATS. Cada vez más escuelas participan en el programa. |
| (Hinckson et al., 2011; Hinckson & Badland, 2011) | Nueva Zelanda. 56 escuelas de primaria. 57.096 estudiantes de 5-10 años. Duración: 36 meses. | *School Travel Plan* (STP). Los componentes de la intervención son la ingeniería (p. ej., infraestructura para facilitar la bicicleta); la educación en circulación segura (p. ej., actividades curriculares); actividades de refuerzo (p. ej., refuerzo de multas de aparcamiento); educación pública (p. ej., *walking* bus); eventos (p. ej., día de andar); política (p. ej., no hay plazas de aparcamiento destinadas a dejar a los estudiantes). | Individual (conocimientos). Ambiente social y cultural (eventos). Ambiente físico (infraestructuras). Ambiente político (políticas de uso de aparcamiento escolar). | Aumento significativo del porcentaje de niños que se desplazan activamente al colegio. |
| (Mendoza et al., 2011) | Houston, Texas EEUU. 149 estudiantes de 9-10 años. Duración: 5 semanas. | El personal del estudio acompañó a los niños a la escuela hasta 5 días a la semana. Se establecieron en cada escuela de intervención de 1 a 3 rutas al colegio. Los niños y padres decidían que días participar. | Individual (comportamiento). | Aumento significativo de la frecuencia de desplazamiento en las escuelas experimentales respecto a las control. |
| (Børrestad et al., 2012) | Noruega. 1 escuela pública. 53 estudiantes de 10-13 años. Duración: 12 semanas. | Los niños fueron asignados al azar a un grupo de ciclistas o a un grupo de control. Se animó al grupo de ciclistas a ir y volver en bicicleta cada día a la escuela durante un periodo de 12 semanas. Se midió el $VO_2$máx, el peso y la altura. | Individual. (comportamiento). | El 65,9% del grupo de intervención empezó a ir en bicicleta, 48,5% del grupo control empezó a ir en bicicleta. |

(Continúa tabla 7…)

(Continúa tabla 7…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (McMinn et al., 2012) | Escocia, Reino Unido. 166 estudiantes de 8-9 años. Duración: 6 semanas. | *Travelling Green*. Incluye un manual para el profesor y paquetes para cada niño. El manual del profesor contiene actividades de introducción a la iniciativa y 13 planes de lecciones sobre temas como la seguridad vial, la importancia de un estilo de vida saludable y lecciones sobre el funcionamiento del cuerpo. El paquete del alumno contiene materiales que animan a los alumnos a fijarse objetivos para caminar y a registrar cómo se desplazan cada día hacia y desde la escuela. | Individual (conocimientos). | La intervención no tuvo un efecto en el transporte activo. |
| (Sayers et al., 2012) | Missouri, Columbia, EEUU. 77 estudiantes de 5-11 años. Duración: 7 días. | *Walking school bus*. Medición de los niveles de actividad física moderada vigorosa en los alumnos que participaban en el programa. | Individual (comportamiento). | No reporta. Aumento de actividad física moderada vigorosa en los que participan. |
| (Buckley et al., 2013) | Moscow, Idaho, EEUU. 475 estudiantes y sus padres [otoño] + 238 estudiantes y sus padres [primavera] de 5-11 años. Duración: 3 días [otoño] + 5 días [primavera]. | Eventos de rutas seguras. Realizado uno en otoño y otro en primavera. | Ambiente social y cultural (evento). | Aumento descriptivo de la frecuencia de desplazamientos durante ambos eventos. |

(Continúa tabla 7…)

(Continúa tabla 7…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Crawford & Garrard, 2013) | Victoria, Australia. 13 escuelas de primaria. 410 padres y 479 estudiantes de 9-12 años. Duración: 24 meses. | *Ride2School*. A nivel de programa (p. ej., participar el evento, mapear rutas seguras, seguimiento de las ratios de desplazamiento en clase) a nivel de comunidad escolar (p. ej., retos de kilómetros andados) y a nivel ambiental (p. ej., fondo de almacenamiento de bicicletas). Cada escuela implementa las actividades que considera. | Individual (conocimientos). Ambiente social y cultural (eventos y retos comunitarios). | Los padres reportaron una frecuencia mayor de los desplazamientos activos al colegio, mientras que los estudiantes reportaron una frecuencia menor después de la intervención. |
| (Henderson et al., 2013) | Atlanta, EEUU. 1 escuela de primaria. 658 estudiantes). Duración 24 meses. | *Safe Routes to School* (SRTS). Está compuesta por una parte educativa curricular (i.e. seguridad vial) y educación a los padres (beneficios del transporte activo, mapas con las rutas seguras); una parte de marketing (i.e., Día del transporte activo con publicidad en marquesinas, camisetas); una parte de apoyo comunitario (i.e., establecer lugares de aparcamiento para los que viven muy lejos del colegio, para que puedan caminar); y una parte de refuerzo. | Individual (conocimientos). Ambiente social y cultural (eventos). Ambiente físico (aparcamientos para coches a cierta distancia). | Aumento significativo de la prevalencia del transporte activo en la mañana. |
| (Bungum et al., 2014) | Henderson, Nevada, EEUU. 2 escuelas. 1336 estudiantes de 5-11 años. Duración: 4 días. | *Nevada Moves Day* (NMD). Diseño de un día del transporte activo al colegio para animar a los estudiantes y sus familias. Una escuela era grupo control y la otra experimental. Se promocionó durante 3 días en los anuncios matutinos habituales. Se envió un recordatorio a las familias, vía los estudiantes y vía mensaje telefónico del director. Se anunció en el tablón de la escuela durante la semana anterior al evento, y la profesora de educación física promovió repetidamente el evento en sus clases. Los alumnos que utilizaron transporte activo en el NMD también recibieron una pegatina de participación al llegar al campus. El mensaje de la pegatina rezaba: "¡He ido andando al colegio! Nevada *Moves Day*". | Ambiente social y cultural (apoyo social). | Aumento el número de desplazamientos activos al colegio el día del evento significativamente respecto a la escuela control. |

(Continúa tabla 7…)

(Continúa tabla 7…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Christiansen et al., 2014) | Región sur de Dinamarca. 14 escuelas, 1014 estudiantes de 11-13 años. Duración: 24 meses. | Cambio de organización y de estructura del ambiente escolar aumentando la parte no curricular de la AF (actividades en el patio, el transporte activo y un programa de fitness después del colegio). Se desarrollaron estrategias políticas (p. ej., animar a los padres a realizar desplazamientos activos, intentar trabajar con los municipios para aumentar la seguridad del ambiente); estrategias educativas (p. ej., entrenamiento de ciclismo seguro); y estrategias físicas (p. ej., mejora de la infraestructura ciclista). La intervención se llevó a cabo por un grupo interdisciplinar de profesores, directores escolares, asesores municipales y del grupo de investigación. Coordinación asumida por el director del proyecto de la región sur de Dinamarca. | Individual (habilidades). Ambiente social y cultural (Animar a las familias). Ambiente físico (infraestructura). Ambiente político (redes comunitarias de trabajo). | Aumento de la prevalencia del transporte activo en ambos grupos (experimental y control) sin diferencias significativas entre grupos. |
| (Ducheyne et al., 2014) | Flanders, Bélgica. 3 escuelas. 94 estudiantes de 9-10 años. Duración: 4 semanas. | Curso de entrenamiento ciclista. 4 semanas de intervención (1 sesión/semana). Habilidades con la bicicleta realizado por entrenadores externos (estudiantes de máster). 3 condiciones (solo niños, niños + padres y control). En la intervención con padres había deberes que tenían que ayudarles a hacer después de cada sesión. | Individual (competencia). Ambiente social y cultural (apoyo social de los padres). | No hubo diferencias significativas en el uso de la bicicleta. Las habilidades con la bicicleta mejoraron significativamente en el grupo experimental. |
| (Gutierrez et al., 2014) | Miami, EEUU. 692 padres de estudiantes de 5-17 años. Duración: 12 meses. | Campañas de concienciación (i.e., envío de mensajes automáticos al móvil de los componentes de la comunidad educativa de dónde se situaban los guardias en los cruces, anuncios de la administración, folletos sobre seguridad y mapeo de los guardias. Estas campañas duraron dos meses. | Ambiente social y cultural (campaña de concienciación). | El número de transportes activos no cambio. Aumentó el número de estudiantes que usaba las rutas seguras. |

(Continúa tabla 7…)

(Continúa tabla 7…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Mammen et al., 2014) | Canadá. 53 escuelas | *School Travel Planning*. Estrategias educativas (p. ej., mapeo de rutas); eventos y actividades (p. ej., competiciones de andar entre clases); planes de aumento de financiación (p. ej., infraestructura para guardas las bicicletas); y estrategias de aplicación de la ley (p. ej., presencia de guardias en los cruces) | Individual (conocimientos). Ambiente social y cultural (eventos). Ambiente físico (infraestructuras). Ambiente político (refuerzo de estrategias de seguridad vial). | No hubo un aumento significativo en la frecuencia de desplazamientos activos. |
| (McDonald et al., 2013, 2014) | 5 ciudades de EEUU. 2014: 65.000 estudiantes y 2013: 1582 estudiantes de 6-15 años. Duración: 5 años | *Safe Routes to School* (SRTS). Programa estatal que destina fondos para campañas de concienciación pública y de divulgación a la comunidad, educación vial, programas de seguridad para niños en bicicleta y peatones, y formación de voluntarios y gestores de SRTS. También inversiones en infraestructuras (p. ej., mejoras de las zonas peatonales, pacificación de vías, instalaciones de bicicletas en la vía pública). También se exigió a cada estado que financiara un coordinador a tiempo completo. | Individual (conocimientos). Ambiente social y cultural (divulgación). Ambiente físico (infraestructuras). Ambiente político (políticas de financiación para el programa). | Aumento de la frecuencia de transporte activo. |
| (Stewart et al., 2014) | 6 estados de EEUU. 53 escuelas de primaria estudiantes 5-18 años. Duración: 5 años | *Safe Routes to School* (SRTS). Programa estatal que destina fondos para campañas de concienciación pública y de divulgación a la comunidad, educación vial, programas de seguridad para niños en bicicleta y peatones, y formación de voluntarios y gestores de SRTS. También inversiones en infraestructuras (p. ej., mejoras de las zonas peatonales, pacificación de vías, instalaciones de bicicletas en la vía pública). También se exigió a cada estado que financiara un coordinador a tiempo completo. | Individual (conocimientos). Ambiente social y cultural (divulgación). Ambiente físico (infraestructuras). Ambiente político (políticas de financiación para el programa). | Aumento de los desplazamientos activos de forma significativa. |

(Continúa tabla 7…)

(Continúa tabla 7…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Vanwolleghem et al., 2014) | Flanders, Bélgica. 2 escuelas de primaria 58 estudiantes de 6-12 años. Duración: 1 semana. | *Drop-off spot*. Un profesor los acompañaba desde los puntos de encuentro al colegio. | Individual (comportamiento). Ambiente social y cultural (modelo). | Aumento significativo del número de viajes semanales activos. |
| (Hunter et al., 2015) | 2 ciudades de, Reino Unido y una de Canadá. 12 escuelas primarias y secundarias. 2068 estudiantes de 9-13 años. Duración: 4 semanas | *Beat the Street*. Participación en una competición internacional de andar a la escuela para conseguir puntos para ellos, su escuela y si país. | Ambiente social y cultural (evento). | Hubo una disminución gradual en la frecuencia del transporte activo a la escuela durante el periodo de 4 semanas. |
| (Østergaard et al., 2015) | Copenhague, Dinamarca. 25 escuelas. 2401 estudiantes de 9-10 años. Duración: 12 meses. | *Safe and Secure Cycling to school*. Programa multicomponente. Cambios en las infraestructuras cercanas a los centros escolares y la motivación de los centros escolares para promover el uso de la bicicleta en los desplazamientos. Dos tipos de iniciativas, unas por el ayuntamiento y otras por una asociación ciclista. Formación ciclista, políticas de seguridad del tráfico. | Individual (conocimiento). Ambiente físico (superficie de la carretera). Ambiente político (política de tráfico escolar). | No hubo diferencias significativas entre el grupo control y el experimental. |

(Continúa tabla 7…)

(Continúa tabla 7…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Sirard et al., 2015) | Minneapolis, EEUU. 25.000 estudiantes de 5-14 años. Duración: 8 meses. | Cambio de política de elección de escuela implementado en una zona urbana. | Ambiente político (políticas de elección de escuela). | No hubo cambios significativos en los estudiantes que se desplazaban activamente al colegio, ni por la mañana, ni por la tarde. |
| (Villa-González, Ruiz, Ward, et al., 2015) | Jaén, Granada, España. 206 niños de 8-11 años. Duración: 11 meses. | Tanto los profesores como el equipo de investigación aplicaron el programa de intervención en cada escuela. 6 actividades mensuales dentro del programa de intervención (cada actividad osciló entre 60 y 120 minutos cada mes) durante el horario escolar, además de sus clases regulares de Educación Física. Los padres participaron en una de las actividades. | Individual (actitudes). Ambiente social y cultural (participación de los padres). | Hubo un aumento significativo en la frecuencia de caminar a la escuela en el grupo de la intervención. |
| (Xu et al., 2015) | China. 8 escuelas de primaria, 1182 estudiantes de 8-9 años. Duración: 12 meses. | Actividades curriculares, apoyo al entorno escolar, participación de la familia y programas/eventos. | Individual (conocimientos). Ambiente social y cultural (eventos) | Los estudiantes de la intervención fueron más propensos de forma significativa a cambiar su desplazamiento pasivo por activo. |
| (Coombes & Jones, 2016) | Norwich, Reino Unido. 2 escuelas. 80 estudiantes de 8-10 años. Duración: 9 semanas. | *Beat the Street*. Instalación de 40 sensores en las calles. Competición para ver quién toca más sensores, entre niños y entre escuelas. La escuela que ganó al final de la intervención recibió dinero para comprar equipamiento deportivo. Las escuelas también competían contra otros grupos que participaban en *Beat the Street* (centros de trabajo locales), por premios semanales donados por locales. Se llevaron a cabo una serie de eventos promocionales para promover el interés en el programa y fomentar la participación. | Ambiente social y cultural (apoyo social). | No hubo diferencias significativas en el aumento de viajes activos al colegio entre el grupo control y el experimental. |

(Continúa tabla 7…)

(Continúa tabla 7…)

| Autores | Contexto | Descripción del programa | Nivel de actuación | Efectos en el transporte activo |
|---|---|---|---|---|
| (Goodman et al., 2016) | Londres, Reino Unido. 3336 estudiantes de 10-11 años. Duración: Media de 3 meses. | *Bikeability cycle training*. Entrenamiento ciclista. Proporcionar a los niños conocimientos prácticos y comprensión sobre cómo circular en bicicleta por las carreteras actuales. En dos niveles: (1) trabajando las habilidades con la bicicleta, (2) conocimiento de normas viales y de seguridad. | Individual (competencia). | Los niños que recibieron la intervención eran más propensos a ir en bicicleta al menos una vez a la semana. |
| (Hoelscher et al., 2016) | Houston, EEUU. 78 escuelas estudiantes de 9-10 años. Duración: 12 meses. | *Self Routes to School*. Incluían actividades de educación, fomento, aplicación y evaluación. Incluye escuelas que tiene proyecto con subvención pública (infraestructura de financiación), escuelas con proyectos sin infraestructura y escuelas control. | Individual (comportamiento). Ambiente político (plan estatal). | Los porcentajes de niños que se desplazan a la escuela de forma activa son significativamente mayores en las escuelas con proyectos |
| (Johnson et al., 2016) | Inglaterra. 3190 estudiantes de 5-9 años | Entrenamiento de habilidades de la bicicleta en la escuela. | Individual (habilidades). | Los estudiantes que recibieron programas de habilidades de la bicicleta eran más propensos a utilizarla para ir a la escuela. |

*Nota.* En el apartado de los niveles de aplicación, entre paréntesis se reporta un ejemplo de cada nivel, en algunas intervenciones podría haber varias estrategias por nivel.

# Anexo 3

Estimadas familias,

Nos ponemos en contacto con ustedes para informarles sobre el nuevo proyecto en el que va a participar nuestro centro. Es un proyecto europeo denominado "CAPAS-CITÉ / CAPAS-CIUDAD" liderado por la Universidad de Zaragoza, Ayuntamiento de Huesca, Ayuntamiento de Tarbes y Université de Pau et des Pays de l'Adour. Además cuenta con varios socios colaboradores como el Servicio provincial de Educación, Cultura y Deporte; Departamento Educación, Cultura y Deporte Gobierno Aragón; Servicio provincial de Sanidad; Ayuntamiento de Jaca y Ayuntamiento de Teruel.
Este proyecto nace para dar respuesta a un problema identificado en la población joven española- la inactividad física-, y por tanto pretende *"promocionar la actividad física en diferentes sectores poblacionales en la ciudad de Huesca".*

El proyecto se desarrollará en tres líneas de actuación:

- Programa de promoción de la actividad física: "Sigue la Huella" para adolescentes.
- Programa de promoción de la actividad física: "Pío se mueve" para poblaciones vulnerables.
- Programa de promoción de la actividad física: "Movilidad activa al centro escolar" para niños de primaria, familias, docentes y más agentes sociales de la ciudad.

En nuestro centro se va a desarrollar la línea de actuación **"Movilidad activa al centro escolar"**. Este trabajo **se suma a otras iniciativas que se están desarrollando en la ciudad** y pretende reforzar cualquier propuesta orientada al problema de fomentar el transporte activo. Concretamente pretendemos, con la participación de todos (niños, padres y profesores), realizar: a) una evaluación de la relación entre actividad física y capacidades cognitivas (capacidad atencional de inhibición y flexibilidad atencional) mediante el test de Flanker, donde participarán todos los alumnos que cursan 2º curso de Primaria, sus progenitores y el profesorado de estos cursos. Esta evaluación nos permitirá conocer la relación entre la actividad física y la supuesta mejora que produce en las capacidades atencionales, inhibición y flexibilidad hasta ahora no evaluada. La

investigación se está realizando de forma transcultural en colegios de Tarbes (Francia) y Huesca.

Toda la información que se genere durante el proyecto, se expondrá a todos los miembros de la comunidad educativa, y si es necesario, se darán a nivel particular, todas las explicaciones necesarias. Además los datos derivados de esta participación, se utilizarán de forma anónima y para fines exclusivamente investigadores.

*¿Cuál es la colaboración de su hijo/a en esta fase de evaluación diagnóstica?*

Realizar el test de Flanker en los periodos que determine la dirección del colegio, en presencia del profesorado del centro y del grupo de trabajo responsable del proyecto (Capas-ciudad). El test consiste en una sucesión de la misma imagen en diferentes colores y el niño/a ha de identificar mediante teclas en el ordenador la dirección (derecha o izquierda) de la imagen. Así mismo se pretende medir de forma objetiva, mediante un acelerómetro (similar a un reloj) que aporta el grupo de investigación, los niveles de actividad física de su hijo/a durante una semana de tiempo. Durante una reunión en el centro escolar y a través de la plataforma del mismo, se facilitará información concreta a los padres/tutores de las condiciones ideales de puesta y uso del acelerómetro.

*¿Cuál es la colaboración de los padres en esta fase de evaluación diagnóstica?*

Contestar a un cuestionario que le será entregado por su hijo/a, y devolverlo al colegio través de ellos.

Agradecemos de antemano su colaboración para que de forma conjunta podamos desarrollar este proyecto.

Atentamente

Fdo: _____

(Director/a pedagógica de Primaria del Colegio _____)

Antes de iniciar el proyecto necesitamos conocer si usted como padre/madre o tutor del menor **NO otorga el consentimiento para que su hijo/a participe**. Por ello os pedimos que cumplimentéis esta hoja y que vuestro hijo/a la entregue en el propio colegio (bien al profesor-a de Educación Física o al tutor/a).

…….

Yo…….(nombre y apellidos del padre/tutor), NO doy el consentimiento para que mi hijo/a…….……(nombre y apellidos del hijo/a), participe en el proyecto denominado **DESPLAZAMIENTO ACTIVO AL CENTRO ESCOLAR**, y se pueda utilizar los datos derivados de su participación, de forma confidencial y para fines exclusivamente investigadores.

Y para que así conste a los efectos oportunos, firmo el presente consentimiento en Huesca, en la

fecha, (día/mes/año):

Firma (padre/madre/tutor):

# Anexo 4

Proyecto Europeo Capas-Ciudad/ Capas-Cité

La Ciudad de las Niñas y los Niños de Huesca

**INFORME**

**Evaluación diagnóstica proyecto desplazamiento activo en la ciudad de Huesca**

[redacted]

**Guión**



**1. Introducción**

El desarrollo urbano moderno que ha potenciado la importancia del automóvil, supone en la actualidad uno de los principales problemas que padecen las ciudades: la movilidad. Una movilidad no sostenible genera impactos ambientales y sociales que tienen repercusión directa en la calidad de vida de la ciudadanía.

Huesca está inmersa en un nuevo modelo de ciudad, y desde el año 2004 se está desarrollando un Plan de Movilidad Urbana y Sostenible. Este Plan de Movilidad Urbana ha permitido definir las actuaciones necesarias para mejorar la calidad de vida de su población y convertirla en una ciudad más accesible, amable y segura, una ciudad donde el peatón sea el verdadero protagonista.

Ligado con este plan de movilidad, se ha estado desarrollando un proyecto realizado por el Proyecto Europeo denominado "CAPAS-CITÉ / CAPAS-CIUDAD" del que forma parte la Universidad de Zaragoza, Ayuntamiento de Huesca, Ayuntamiento de Tarbes y Université de Pau et des Pays de l'Adour y el Equipo interinstitucional de la Ciudad de las niñas y los niños liderado por la Facultad de Ciencias Humanas y de la Educación de Huesca y el Ayuntamiento de Huesca, que pretende favorecer el desplazamiento activo y autónomo al centro escolar de los estudiantes de Educación Primaria de Huesca. Durante el curso 2016-2017, los diferentes colegios de Educación Primaria de la ciudad de Huesca (niños-as y padres-madres) participaron en el proceso de evaluación diagnóstica de los patrones de desplazamiento activo y autónomo al centro escolar y de los factores de influencia.

Para realizar esta evaluación diagnóstica se utilizaron cuestionarios (niños y padres) que a través de diferentes preguntas, recogían información sobre patrones de desplazamiento (modo, frecuencia…) y sobre los factores que pueden influenciar este comportamiento. Esta evaluación diagnóstica se realizó en los estudiantes de 4º, 5º y 6º curso y en sus progenitores. Se contó con la participación de **11 centros escolares** de la ciudad de Huesca, con un total de **1336 escolares** (664 niños y 672 niñas) y **1835 familiares** (845 padres/tutores y 990 madres/tutoras).

En este informe queremos recoger los principales datos de esta evaluación diagnóstica del [redacted]

**2. Características de la muestra**

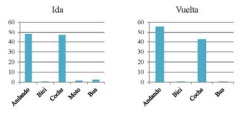
En el colegio Santa Rosa han participado en esta evaluación diagnóstica 120 estudiantes (62 niños y 58 niñas): 35 de 4º curso, 42 de 5º curso y 43 de 6º curso. La media de edad de todos los participantes es de 10,86 años. Según los datos reportados por los padres/tutores de los niños participantes, el peso medio de los estudiantes es de 38,7 kg y su talla de 145,8 cm. El índice de masa corporal (IMC) es de 18,21 por lo que se considera que los estudiantes tienen un peso "normal".

**3. Patrones de desplazamiento**

Hace referencia al medio de transporte utilizado para desplazarse del hogar al centro educativo, y viceversa. Este desplazamiento se realiza 2/4 veces al día (dependiendo si es jornada continua o no).

A continuación, se muestran unas gráficas (gráfica 1) que representan los medios de transporte utilizados por los niños del colegio para desplazarse al/desde el centro educativo a casa. En ellas podemos observar que **un porcentaje elevado utiliza medios pasivos de desplazamiento.** Para ir al colegio encontramos **un 48,3% de estudiantes que se desplazan caminando frente a un 46,7% que lo hace en coche.** A la vuelta del colegio **un 55,8% lo hace caminando frente a un 42,5% que lo hace en coche.**

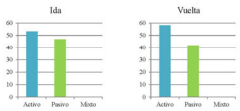
Gráfica 1. Modo de desplazamiento al colegio (%), ir y volver.




A continuación, se muestran las diferencias en el modo de desplazamiento **por género (por un lado niños/ir-volver al colegio y por otro niñas)**, distinguiendo tres modos: activo (andando o en bicicleta), pasivo (coche, moto o autobús) y mixto (una parte del desplazamiento de forma activa y otra de forma pasiva). Los resultados muestran una **mayor frecuencia de desplazamientos activos en los niños que en las niñas.**

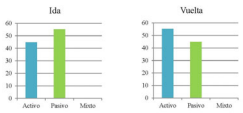
**El 46,8% de los niños utilizan medios de desplazamiento pasivos para ir al colegio y un 41,9% de los mismos utilizan también medios pasivos para volver del colegio.**

Gráfica 2. Modo de desplazamiento de los niños (%)




Del mismo modo, un alto porcentaje **de las niñas utiliza formas pasivas de desplazamiento** tanto para ir (55,2%) como para volver (44,8%).

Gráfica 3. Modo de desplazamiento de las niñas (%)




**4. Distancias**

En los datos que se aportan a continuación hay que tener en cuenta que se han eliminado aquellos sujetos que no viven en HUESCA CAPITAL.

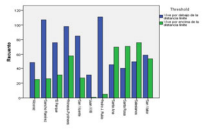
Estas son **las distancias límites** a partir de la cual es más probable que un niño se desplace de manera pasiva desde casa al colegio y viceversa en la ciudad de Huesca:

| |
|---|
| Total centros de la ciudad: 775 metros |
| Colegios públicos: 575 metros |
| Colegios concertados: 975 metros |
| Sujetos de 4º curso: 675 metros |
| Sujetos de 5º curso: 775 metros |
| Sujetos de 6º curso: 875 metros |

En relación al colegio Salesiano San Bernardo, la distancia media entre los diferentes domicilios donde viven los alumnos y el colegio es de **1016,89 metros**.

Considerando que la distancia límite a partir de la cual es más probable que un niño se desplace de manera pasiva desde casa al colegio y viceversa en la ciudad de Huesca, es de 775 metros, presentamos un gráfica donde se puede observar que en el colegio Salesianos un porcentaje alto de sujetos (75%) viven por encima de la distancia límite.

Gráfica 4. Sujetos que viven por debajo o encima de la distancia límite por cada colegio (%)




**5. Principales factores de influencia (barreras)**

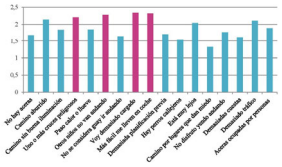
**5.1. Barreras percibidas por los estudiantes hacia el desplazamiento activo**

Entendemos las barreras hacia el desplazamiento activo como las dificultades o problemas que los niños encuentran para llevar a cabo este comportamiento. En este caso, en una escala del 1-5, las **barreras destacadas** por los estudiantes son:

1) **Voy demasiado cargado con cosas** (2,34)
2) **Hay uno o más cruces peligrosos** (2,32)
3) **Es más fácil que me lleven en coche** (2,32)
4) **Otros niños no van andando** (2,28)

Es importante distinguir de cara a la intervención, entre aquellas que son modificables y las que no. De las cuatro barreras más destacadas, diferenciamos dos de ellas que **son modificables desde el centro educativo** ("otros niños no van andando" y "voy demasiado cargado con cosas"). Sería interesante a la hora de intervenir, diseñar estrategias para que dejasen de ser una barrera para los niños, como por ejemplo con taquillas para dejar el material pesado en los centros, establecer rutas seguras desde todas las zonas donde viven para que puedan ir caminando, hacer quedadas en puntos de encuentro...

Gráfica 5. Barreras percibidas por los estudiantes



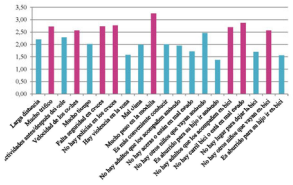

**5.2. Barreras percibidas por los padres hacia el desplazamiento activo**

En el caso de las familias, las barreras más destacadas son:

1) **Mucho peso en la mochila** (3,26)
2) **No hay carril bici o está en mal estado** (2,88)
3) **No hay policías en los cruces** (2,77)
4) **Falta de seguridad en los cruces** (2,73)
5) **Hay mucho tráfico** (2,72)
6) **No hay adultos que los acompañen en bici** (2,69)
7) **No hay otros niños que vayan en bici** (2,57)
8) **Velocidad de los coches** (2,56)

Destacamos como barreras modificables desde el centro educativo las siguientes: mucho peso en la mochila, no hay otros niños que vayan en bici y no hay adultos que los acompañen en bici.

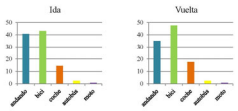
Gráfica 6. Barreras percibidas por las familias




**6. Actitudes hacia el desplazamiento activo de los estudiantes**

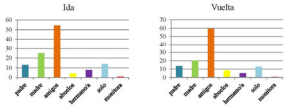
Otra de las variables evaluadas a través del cuestionario fue la intención de los estudiantes hacia el desplazamiento activo. Para ello, se preguntó respecto al modo y la compañía en el desplazamiento. La pregunta para el modo fue: "**Si pudieras elegir**, ¿cómo te gustaría ir al colegio?, ¿cómo te gustaría volver del colegio?". Se observa como **los medios activos son los más elegidos** por los estudiantes, mostrando a la ida un 40,7% que elegiría el desplazamiento caminando y un 43,2% la bici, seguido por el coche con un 14,4%. En el caso de la vuelta a casa un 35% lo haría caminando, un 47,5% en bici y un 17,5% en coche.

Grafica 7. Actitud hacia el modo de desplazamiento en los estudiantes (%)




Para conocer sus actitudes hacia la compañía durante el desplazamiento se preguntó: "¿Con quién te gustaría ir al colegio?, ¿con quién te gustaría volver del colegio?". Destacaron **los amigos** tanto a la ida (54,3%) como a la vuelta (59,3%), seguidos de sus madres igualmente a la ida (25%) y a la vuelta (20,3%).

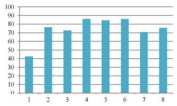
Gráfica 8. Actitud hacia la compañía en los estudiantes (%)




**7. Percepción del ambiente por parte de los estudiantes**

La percepción de ambiente se refiere a la accesibilidad a zonas públicas que ofrece el barrio y a la seguridad que éste transmite para poder llevar a cabo el desplazamiento activo. A continuación se muestran los resultados obtenidos en cada uno de los ítems.

Gráfica 9. Percepción del ambiente (%)




Siendo:

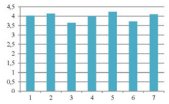
1) La mayoría de las viviendas son casas (42,5%)
2) Las tiendas están cerca y vamos andando (76,3%)
3) Las paradas de transporte público están cerca y se puede ir andando (72,5%)
4) Hay un parque cerca de casa al que se puede ir andando (85,8%)
5) Hay árboles en las calles (84,2%)
6) En mi casa tengo material deportivo pequeño como un balón, raquetas… (85,8%)
7) Caminar es seguro en relación al tráfico (70,8%)
8) Caminar es seguro debido al bajo nivel de delitos (75,6%)

Esta escala se puntúa de 0-1, **pudiendo obtener un máximo de 8** en la percepción del ambiente, entendiendo este máximo como el idóneo para que se pueda llevar a cabo el desplazamiento activo. Según las respuestas reportadas por los estudiantes, **el colegio Santa Rosa ha obtenido un 4,86** en la escala de percepción de ambiente de los hogares de los estudiantes.

**8. Conducta pro-ambiental**

Otro aspecto que se puede trabajar a través del desplazamiento activo es la educación ambiental y la conciencia ecológica. En esta evaluación diagnóstica se evaluó la conciencia ecológica de los niños con una escala del 1-5, obteniendo los siguientes resultados:

Gráfica 10. Conducta pro-ambiental de los estudiantes




Siendo:

**1)** Llevo a cabo actividades para ayudar a proteger el medio ambiente (4,02)
**2)** Para ahorrar agua, uso menos agua cuando me ducho (4,13)
**3)** En el colegio, hablo con los profesores y compañeros de lo importante que es hacer cosas para proteger el medio ambiente (como por ejemplo reciclar) (3,64)
**4)** En casa ayudo a separar y reciclar basura (4,00)
**5)** Para ahorrar energía, apago los aparatos electrónicos cuando no los estoy usando (4,23)
**6)** En el colegio, hablo con los profesores y compañeros de lo importante que es hacer cosas para proteger el medio ambiente (por ejemplo ir de forma activa al colegio como andando o en bici) (3,72)
**7)** Para cuidar el medio ambiente y evitar la contaminación, me desplazo andando o bicicleta siempre que puedo (4,10)

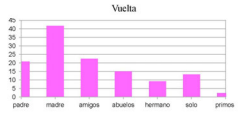
En este caso, todos los ítems se aproximan a una puntuación media de 4, lo que indica que los estudiantes están de acuerdo con las afirmaciones expuestas.

**9. Acompañamiento adulto del hogar a la escuela (ida y vuelta)**

En relación con los aspectos que más tienen que ver con el desplazamiento autónomo de niños y niñas, se evaluó, de modo independiente, con quién acuden y con quién vuelven de la escuela, distinguiéndose de este modo: a) adultos: padre, madre, abuelos; b) amigos y/o c) solos. Además se plantó una opción abierta para que respondiesen con qué otras personas acudian o volvían de la escuela (p.ej. hermanos, primos, tíos, vecinos, monitor, etc…). En este caso se destaca que la mayoría de niños/as realiza el desplazamiento hogar-escuela con su madre, siendo del 50% en la ida. El 26,3% realiza este desplazamiento con su padre. Sumando los porcentajes de niños y niñas que van al colegio solos, con amigos o con hermanos podemos concluir que un 41,6% van al colegio de forma autónoma (sin acompañamiento adulto). Para el regreso a casa, también, la mayoría de niños/as realiza el desplazamiento con su madre, un 47,3%. Sumando, para este caso, de nuevo, los que regresan solos, con amigos, o con hermanos, deducimos que un 47,3% hace el trayecto escuela- hogar sin acompañamiento adulto.

Gráfico 11. Acompañamiento/ **desplazamiento autónomo hogar-escuela** (%)


Gráfico 12. Acompañamiento / **desplazamiento autónomo** escuela-hogar (%)




**10. Actividades realizadas en solitario**

Además de conocer cómo es el desplazamiento autónomo y el tipo de acompañamiento de los niños en el trayecto hogar-escuela y viceversa, resultaba necesario valorar qué otras actividades realizan de manera autónoma. En este sentido, se les preguntó por diversas actividades en un formato de pregunta de esta tipo: *¿Cuántas veces realizas tal actividad, sin ir acompañado de un adulto?"*, siendo la actividades las siguientes: 1) ir a la escuela, 2) ver a los amigos y realizar actividades extraescolares, 3) ir a jugar a la calle, a espacios abiertos de la ciudad, al parque y por último, 4) *¿Tienes las llaves de tu casa?*, considerándose esta cuestión clave para conocer el grado de autonomía del niño, al disponer de las llaves en su entrada y salida del hogar, lo que le otorgaría un alto nivel de libertad y autonomía. Cada cuestión es respondida en una escala de respuesta de 4 puntos que oscila desde "Nunca", "Algunas veces", "Muchas veces" y "Siempre".

Como puede observarse en las gráficas la actividad en todas las actividades se muestra un bajo nivel de autonomía: en el desplazamiento al colegio: un 17,8% responde que lo hace siempre sin acompañamiento adulto, el 11,7% que dice que acude siempre

autonomamente a actividades extraescolares o ver amigos, y este es el mismo porcentaje para los que dicen ir siempre solo a jugar con amigos. Por contra el 37,8 % lleva siempre las llaves de casa.

Gráfico 13. Frecuencia con que acude solo/a a la escuela (%)


Gráfico 14. Frecuencia con que acude solo/a a ver a amigos, realizar actividades extraescolares (%)


Gráfico 15. Frecuencia con que acude solo/a a jugar a la calle, espacios abiertos de la ciudad (%)


Gráfico 16. ¿Tienes las llaves de casa? (%)


**11.-Percepción de la distancia entre el hogar y la escuela**

La distancia del hogar a la escuela resulta un parámetro importante para que las familias valoren el modo de desplazamiento hasta la escuela. En los datos recogidos de los cuestionarios de niños y niñas, resultaba de interés conocer cuál es la percepción del niño sobre la distancia que existe entre su hogar y la escuela, obteniendo de ellos una respuesta en formato dicotómico (lejos vs. cerca). En este caso hay casi el mismo porcentaje de niños que creen que la escuela está cerca, un 50% y los que creen que esta lejos, un 48,3%.

**12. Motivos de acompañamiento adulto a la escuela y otras actividades**

Otra de las cuestiones planteadas fue *"Cuando vas al colegio acompañado de un adulto es porque…"* y *"Cuando haces estas cosas acompañado de un adulto es porque…"* (estando la pregunta anterior relacionada con la frecuencia con que realizan diversas actividades solos). Para ambas preguntas, las opciones de respuesta fueron: *"Mis padres no se sienten capaces o preparados para dejarme ir solo/a"* ó *"Yo no quiero ir solo/a"*.

En relación a la escuela, de entre quienes ofrecieron una respuesta a esta pregunta, el 75% indicó que se debía a que sus padres no querían dejarlos ir solos, en tanto que el 25% afirmó no querer ir solo.

En relación a otras actividades, la mayoría de niños contestó que sus padres no querían dejarlos ir solos (69%) frente a un 31% que indicó no querer ir solo.

**13. Percepción sobre la dificultad de ir solo a la escuela**

En la medida en que determinadas experiencias se valoran como difíciles, la probabilidad de realizarlas disminuye. Por ello, se ha considerado relevante incluir en el cuestionario si los niños perciben como difícil acudir solos a la escuela y, en caso de indicar que sí, los motivos por los que les resulta difícil. En su mayoría, el 60% de los niños contestaron que NO les resultaría difícil ir solos a la escuela. En este sentido, la percepción de dificultad es baja, lo que podría facilitar la realización de la misma.

**14. Valoración (positiva-negativa) ir/volver a la escuela andando**

La evaluación positiva-negativa de ir/volver a la escuela andando resulta fundamental, pues nos informa de la atribución y el valor afectivo que otorgan a la actividad de desplazarse andando para acudir a la escuela/hogar. Para ello, se les planteó un listado con diversas valoraciones positivas, en concreto: muy interesante, agradable, divertido, bueno, útil y seguro frente a sus valoraciones negativas: nada interesante, desagradable, aburrido, malo, inútil y peligroso respectivamente. Las opciones de respuesta oscilaron desde 1 hasta 5, considerándose el valor 3 igual a "no lo sé". En relación a cada uno de los aspectos planteados se obtuvo que la mayoría de encuestados ofreció las siguientes respuestas de modo más común: el 25,2% consideró la experiencia como "bastante interesante", el 51,5% como "agradable", el 31,1% como "un poco divertido", el 61,8% como algo "bueno", el 61,2% como algo "útil" y finalmente, el 33% consideró la actividad como algo "seguro".

**15. Deseo ir solo a la escuela**

Finalmente, se considera valioso conocer el deseo del propio niño sobre poder acudir sólo a la escuela. Se destaca que la mayoría de niños/as, en concreto el 61,11% desearía acudir solo a la escuela.

# Anexo 5

Cuestionarios adaptados para la investigación de la tesis doctoral:

## Teoría de la conducta planificada

**Actitudes** (α de Cronbach= 0,97)

Para ti ir/volver andando al colegio puede ser algo (INTERÉS)
1- Nada interesante 2- Poco interesante 3- No lo sé 4- Bastante interesante 5- Muy interesante

Para ti ir/volver andando al colegio puede ser algo (AGRADABLE)
1- Muy desagradable 2- Un poco desagradable 3- No lo sé 4- Un poco agradable 5- Agradable

Para ti ir/volver andando al colegio puede ser algo (ABURRIDO)
1- Aburrido 2- Un poco aburrido 3- No lo sé 4- Un poco divertido 5- Muy divertido

Para ti ir/volver andando al colegio puede ser algo (MALO)
1- Malo 2- Un poco malo 3- No lo sé 4- Un poco bueno 5- Muy bueno

Para ti ir/volver andando al colegio puede ser algo (INÚTIL)
1- Inútil 2- Un poco inútil 3- No lo sé 4- Un poco útil 5- Útil

Para ti ir/volver andando al colegio puede ser algo (PELIGROSO)
1- Peligroso 2- Un poco peligroso 3- No lo sé 4- Un poco seguro 5- Seguro

**Norma subjetiva** (ítems 5, 6, 7; α de Cronbach=0,90),
**Percepción de control** (ítem 1, 2, 3; α de Cronbach=0,92),
**Intención** (ítem 4)

Señala si estás de acuerdo o no con estas frases…

1. Podría ir a la escuela andando todos los días si quisiera
2. Tengo el tiempo para ir a la escuela andando todos los días si quisiera
3. Vivo en un lugar que me permite ir caminando a la escuela todos los días si quisiera
4. Yo quiero ir andando al colegio todos los días
5. Yo a menudo voy andando al colegio con mis padres
6. Yo a menudo voy andando al colegio con mis amigos o compañeros de clase
7. Alguno de mis padres va normalmente andando a su trabajo

Respuesta: Escala Likert
1- Totalmente desacuerdo 2- En desacuerdo 3- No lo sé 4- De acuerdo 5- Totalmente de acuerdo

**Percepción del ambiente construido**

(α de Cronbach=0.90)

Piensa como es tu barrio…

1. Densidad residencial. La mayoría de las viviendas son casas
2. Acceso a servicios. Las tiendas están cerca y vamos andando
3. Conectividad. Las paradas de transporte público están cerca y se puede ir andando
4. Estética del barrio. Hay un parque cerca de casa al que se puede ir andando
5. Estética del barrio. Hay árboles en las calles
6. *Caminar es peligroso debido al tráfico
7. *Caminar es peligroso debido al nivel de delitos
8. Acceso a instalaciones deportivas y materiales. En mi casa tengo material deportivo pequeño como un balón, raquetas...

* Ítems invertidos
Respuesta: Escala Likert
1- Totalmente desacuerdo 2- En desacuerdo 3- De acuerdo 4- Totalmente de acuerdo

**Actitudes padres, madres, tutores**

(α de Cronbach=0.74)

Señala si estás de acuerdo o no con estas frases…

1. *Es muy conveniente llevar a mi hijo/a en coche al colegio
2. Yo normalmente estoy dispuesto a acompañar a mi hijo andando al colegio
3. Es interesante que mi hijo/a vaya solo o con amigos andando al colegio
4. *Es peligros que mi hijo/a vaya solo o con amigos andando al colegio
5. *Considero que no sirve para nada (es inútil) que mi hijo/a vaya solo o con amigos andando al colegio
6. *Es irresponsable que los padres permitan a sus hijos ir andando solos al colegio sin acompañamiento de adultos
7. *Creo que lo más responsable es que los padres lleven a sus hijos en coche al colegio
8. *Creo que lo más responsable es que los padres o un adulto acompañen a los hijos andando al colegio
9. Creo que es importante que mi hijo desarrolle habilidades para ir andando solo al colegio
10. Estoy seguro de que mi hijo tiene la habilidad para poder caminar solo al colegio sin ningún adulto

* Ítems invertidos
Respuesta: Escala Likert
1- Totalmente desacuerdo 2- En desacuerdo 3- No lo sé 4- De acuerdo 5- Totalmente de acuerdo

# Anexo 6

GOBIERNO DE ARAGON
Departamento de Sanidad

**Informe Dictamen Favorable**
**Proyecto Investigación Biomédica**
C.P. - C.I. PI17/0018
15 de febrero de 2017

Dña. María González Hinjos, Secretaria del CEIC Aragón (CEICA)

**CERTIFICA**

**1º.** Que el CEIC Aragón (CEICA) en su reunión del día 15/02/2017, Acta Nº 03/2017 ha evaluado la propuesta del investigador referida al estudio:

**Título: El desplazamiento activo al colegio y factores que lo influencian: evaluación diagnóstica, diseño, implementación y análisis del efecto de un programa de intervención en escolares de Educación Primaria de la ciudad de Huesca**

**Investigador Principal: Javier Zaragoza Casterad, Universidad de Zaragoza**

**Versión protocolo: enero/2017**
**Versión documento de información a los participantes (padres e hijos): febrero 2017**

**2º.** Considera que

- El proyecto se plantea siguiendo los requisitos de la Ley 14/2007, de 3 de julio, de Investigación Biomédica y su realización es pertinente.
- Se cumplen los requisitos necesarios de idoneidad del protocolo en relación con los objetivos del estudio y están justificados los riesgos y molestias previsibles para el sujeto.
- Es adecuada la utilización de los datos y los documentos para la obtención del consentimiento informado.
- El alcance de las compensaciones económicas previstas no interfiere con el respeto a los postulados éticos.
- La capacidad de los Investigadores y los medios disponibles son apropiados para llevar a cabo el estudio.

**3º.** Por lo que este CEIC emite **DICTAMEN FAVORABLE a la realización del proyecto**.

Lo que firmo en Zaragoza, a 15 de febrero de 2017

María González Hinjos
Secretaria del CEIC Aragón (CEICA)



Tel. 976 71 48 57 Fax. 976 71 55 54 Correo electrónico mgonzalezh.ceic@aragon.es

# Anexo 7

CAPAS cité - ciudad

Grupo de Investigación de Referencia EFYPAF - Educación Física y Promoción de la Actividad Física Universidad Zaragoza

Interreg POCTEFA

## HACIA UNA MOVILIDAD ACTIVA Y SOSTENIBLE EN LA CIUDAD DE HUESCA

CAPAS-Ciudad es un proyecto europeo orientado a mejorar la calidad de vida a través de la actividad física. Este proyecto se desarrolla en las ciudades de Huesca y Tarbes, en torno a 3 líneas de actuación: "desplazamiento activo al centro escolar"; "promoción de la actividad física en población adolescente"; "promoción de la actividad física en poblaciones desfavorecidas". A continuación se presenta alguno de los resultados de la línea de actuación "desplazamiento activo al centro escolar".

### PARTICIPANTES

11 escuelas de Huesca

1129 niños y niñas de 4º, 5º y 6º de primaria

### FORMAS DE DESPLAZAMIENTO AL CENTRO ESCOLAR

¿Cómo se desplazan los niños a la escuela?

- 69 % Niños y niñas que van caminando al colegio
- 1 % Niños y niñas que van en bicicleta al colegio
- 30 % Niños y niñas que van en coche al colegio

¿Cómo quieren desplazarse los niños a la escuela?

- 45% Caminar
- 40% Bicicleta
- 15% Coche

### BARRERAS FAMILIARES HACIA EL DESPLAZAMIENTO ACTIVO

- «Otros niños no van andando». Barrera social
- «Van demasiado cargados con cosas». Barrera de planificación
- «Falta de seguridad en los cruces». Barrera de seguridad
- «No hay carriles bici o están en mal estado». Barrera ambiental (infraestructura)

### FACTORES DE INFLUENCIA PARA LOS NIÑOS

**Intención**

Los niños que tienen una mayor intención de realizar estos desplazamientos de forma activa tienen muchas más posibilidades de ir andando o en bicicleta al colegio.

**Autonomía**

A mayor autonomía, más intención de caminar o ir en bicicleta al colegio.

**Tener la situación bajo control y sentirse competente**

Aquellos niños que sienten que tienen suficientes habilidades y conocimientos perciben que tienen la situación bajo control, lo que aumenta sus intenciones de desplazamiento activo.

**Elementos del ambiente**

Una ruta más segura, con zonas más verdes, con menos cruces y menos densidad de viviendas ayuda a los niños a sentirse más competentes y tener mayor seguridad para desplazarse activamente.

### IMPORTANCIA DE LA DISTANCIA DESDE LA VIVIENDA EN EL DESPLAZAMIENTO AL COLEGIO


A una menor distancia del domicilio a la escuela, más probabilidad de desplazarse caminando.

### EFECTOS AMBIENTALES DEL DESPLAZAMIENTO EN COCHE A LA ESCUELA

ESCUELAS PÚBLICAS: 15 % De los viajes al colegio son en coche — 577 metros Distancia media del viaje

ESCUELAS CONCERTADAS: 40 % De los viajes al colegio son en coche — 979 metros Distancia media del viaje

PRODUCCIÓN DE CO2 ANUAL: 25.809 KG DE CO2 → SE NECESITA PLANTAR 218 ÁRBOLES PARA CONTRARRESTARLO = PRÁCTICAMENTE LA ZONA DE LAS PAJARITAS DEL PARQUE MIGUEL SERVET

### CONSIDERACIONES

- Fomentar el desplazamiento activo al centro escolar, puede contribuir a configurar un modelo de ciudad más sostenible, activa y saludable.
- Actuar sobre la mejora de las infraestructuras (carriles bici), incidir sobre los aspectos de la seguridad, mejorar las habilidades y competencias del alumnado, pueden ser algunas de las claves sobre las que diseñar estrategias de intervención en la ciudad.
- Para ello, es necesario crear sinergias entre los responsables políticos y educativos que permitan actuaciones eficaces a diferentes niveles: individual, interpersonal, familiar y comunitario.

Socios de CAPAS-CIUDAD

Proyecto cofinanciado por el FEDER

Tarbes · Ayuntamiento de Huesca · Universidad Zaragoza · Université de Pau et des Pays de l'Adour

INVESTIGADORES LÍNEA DE DESPLAZAMIENTO ACTIVO
JAVIER ZARAGOZA CASTERAD, ALBERTO AIBAR SOLANA, ANA CORRAL ABÓS, JOSÉ ANTONIO JULIÁN CLEMENTE, EDUARDO IBOR BENALTE.

# Anexo 8



## ¿Qué es la actividad física?

La Organización Mundial de la Salud propone las siguientes actividades como "actividades físicas" para niños y jóvenes de entre 5-17 años


¿Dónde y con quién?

En familia
En escuela
En la comunidad

**¿Qué entendemos por actividad sedentaria? ¿Cuáles son las diferentes intensidades de la actividad física?**

| | |
|---|---|
|  | Las actividades **sedentarias** son aquellas en las que consumimos muy poca energía para llevarlas a cabo, en niños y jóvenes estas actividades suelen ser todas aquellas que se realizan tumbado o sentado. |
|  | **Ligeras** (actividades que tienen unas intensidades bajas, como caminar despacio) |
|  | **Moderadas** (actividades como trotar, ir en bicicleta suave, nadar a un ritmo suave…) |
|  | **Vigorosas** (actividades muy intensas como los sprints, jugar un partido de algún deporte, bailar, juegos intensos –de persecución– en el recreo o en clase de educación física…). |
| Estos son los tipos de intensidades de la actividad física según el esfuerzo físico que realizamos para llevar a cabo cada una de ellas. | |

Si quiere saber más sobre el papel de las familias en la promoción de hábitos saludables, puede consultar la guía realizada por CAPAS-Ciudad: El papel de las familias en la promoción de hábitos saludables.

Alumna: [redacted] [redacted]a). Año 2019.

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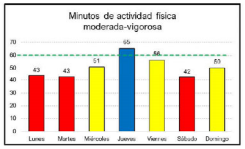
## ¿Cómo de activos somos?

Las recomendaciones mínimas de actividad física propuestas por la Organización Mundial de la Salud son 60 minutos diarios de actividad física moderada vigorosa.

**6 días** no cumplimos estas recomendaciones.




**¿Cómo se distribuyen nuestras diferentes intensidades de actividad a lo largo de a la semana?**

Lo ideal es disminuir los tiempos sedentarios con actividades ligeras o moderadas, como pueden ser caminar, subir escaleras, hacer pausas activas, levantarnos cada 50 minutos de la silla...

Lo ideal es incorporar **6 pausas activas de 10 minutos al día**.

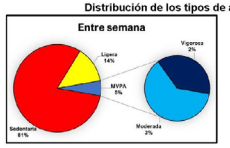
Las recomendaciones de horas de sueño de la Organización Mundial de la Salud para niños hasta los 14 años son entre 9-10 diarias.

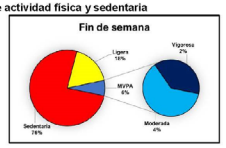
**Entre semana** no cumplimos estas recomendaciones.

**Minutos de actividad física y actividad sedentaria diaria y horas de sueño**

| | Sedentaria | Ligera | Moderada | Vigorosa | Horas sueño |
|---|---|---|---|---|---|
| **Lunes** | 795 | 102 | 27 | 16 | 7:30:00 |
| **Martes** | 759 | 102 | 27 | 16 | 7:20:00 |
| **Miércoles** | 771 | 118 | 30 | 21 | 7:00:00 |
| **Jueves** | 693 | 181 | 43 | 23 | 6:20:00 |
| **Viernes** | 759 | 125 | 34 | 22 | 7:10:00 |
| **Sábado** | 648 | 130 | 24 | 18 | 9:30:00 |
| **Domingo** | 458 | 121 | 32 | 18 | 9:40:00 |

**Distribución de los tipos de actividad física y sedentaria**




Alu[redacted] [redacted]ca). Año 2019.

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