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Tesis Doctoral

ACTIVIDAD FÍSICA Y ABSENTISMO LABORAL DEBIDO A ENFERMEDAD

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ACTIVIDAD FÍSICA Y ABSENTISMO LABORAL DEBIDO A ENFERMEDAD

PHYSICAL ACTIVITY AND SICKNESS ABSENCE

RUBÉN LÓPEZ BUENO

Departamento de Fisiatría y Enfermería

Universidad de Zaragoza

Actividad física y absentismo laboral debido a enfermedad

Physical activity and sickness absence

RUBÉN LÓPEZ BUENO

A mi director, José Antonio

A mi familia y amigos

En agradecimiento a toda vuestra ayuda y comprensión

La derrota tiene algo positivo: nunca es definitiva.

En cambio, la victoria tiene algo negativo: jamás es definitiva.

José Saramago

Prof. Dr. Jose Antonio Casajús Mallén
Catedrático de Universidad
Departamento: Fisiatría y Enfermería. Área de Educación Física
Facultad de Ciencias de la Salud

JOSÉ ANTONIO CASAJÚS MALLÉN, CATEDRÁTICO POR LA UNIVERSIDAD DE ZARAGOZA, CERTIFICA:

Que el trabajo recogido en la presente Memoria de Tesis Doctoral, titulada "Actividad física y absentismo laboral debido a enfermedad", presentada por el doctorando D. RUBÉN LÓPEZ BUENO al superior juicio del Tribunal que designe la Universidad de Zaragoza, ha sido realizada bajo mi dirección durante los años 2015 a 2020. Se trata de un trabajo de investigación original e inédito, que obtiene conclusiones innovadoras y de gran aplicabilidad a futuras líneas de investigación y consideramos que reúne todos los requisitos legales. Por ello, autorizo su presentación y defensa para optar el doctorando al grado de Doctor con mención Internacional. Igualmente, indicar que esta memoria de tesis resulta de la expresión de la capacidad técnica e interpretativa de su autor en condiciones tan aventajadas que le hacen merecedor de dicho título, siempre y cuando así lo considere el citado Tribunal.

Para que así conste a los efectos oportunos, firmo la presente en Zaragoza, a 11 de Junio de 2020.

Fdo.: Dr. D. José Antonio Casajús Mallén

PhD. Emil Sundstrup
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That the work included in the present Thesis report entitled “Physical Activity and Sickness Absence”, presented by the doctorate Rubén López Bueno, meets international standards regarding Doctoral Theses. This is an original research study with important conclusions and applicability to future lines of research. Equally, it is worth noting that this report is a result of the technical capacity of the author in such advantage conditions that makes him worthy of a Doctor degree, providing that the Thesis Tribunal considers it.

And as evidence thereof, I hereby issue this certificate in Copenhagen on April 2nd 2020.

Signature.: PhD. Emil Sundstrup

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JONAS VINSTRUP, ASSISTANT RESEARCHER AT THE DEPARTMENT OF HEALTH, SCIENCE AND TECHNOLOGY, AALBORG UNIVERSITY

That the work included in the present Thesis report entitled “Physical Activity and Sickness Absence”, presented by the doctorate Rubén López Bueno, meets international standards regarding Doctoral Theses. This is an original research study with important conclusions and applicability to future lines of research. Equally, it is worth noting that this report is a result of the technical capacity of the author in such advantage conditions that makes him worthy of a Doctor degree, providing that the Thesis Tribunal considers it.

And as evidence thereof, I hereby issue this certificate in Copenhagen on March 12th 2020.

Signature.: PhD. Jonas Vinstrup

Listado de publicaciones [List of publications]

La presente Tesis Doctoral se ha realizado a modo de compendio de artículos científicos publicados, aceptados para publicación o sometidos a revisión. Los artículos incluidos son los siguientes:

I. **López Bueno R**, Casajús Mallén JA, Garatachea Vallejo N. Physical activity as a tool to reduce disease-related work absenteeism in sedentary employees: A systematic review. **Rev Esp Salud Publica**. 2018; 92(October).

II. **López-Bueno R**, Smith L, Andersen LL, López-Sánchez GF, Casajús JA. Association between physical activity and sickness absenteeism in university workers. **Occup Med (Lond).** 2019. doi: 10.1093/occmed/kqz158. [Epub ahead of print]

III. **López-Bueno R**, Andersen LL, Smith L, López-Sánchez GF, Mompel J, Casedas L, Casajús JA. Physical activity and perceived stress at work in university workers: a cross-sectional study. **J Sports Med Phys Fitness**. 2019. doi: 10.23736/S0022-4707.19.10259-9. [Epub ahead of print]

IV. **López-Bueno R**, Sundstrup E, Vinstrup J, Casajús JA, Andersen LL. High leisure-time physical activity reduces the risk of long-term sickness absence. **Scand J Med Sci Sports.** 2020. doi: 10.1111/sms.13629. [Epub ahead of print]

V. **López-Bueno R**, Calatayud J, López-Sánchez GF, Smith L, Andersen LL, Casajús JA. Higher leisure-time physical activity is associated with lower sickness absence: cross-sectional analysis among the general workforce. **J Sports Med Phys Fitness**. 2020, 60(6), 919–925. doi: 10.23736/S0022-4707.20.10434-1

VI. **López-Bueno R**, Clausen T, Calatayud J, Casajús JA, Andersen LL. Vigorous and moderate leisure physical activity reduces the risk of long-term sickness absence among 4699 healthy eldercare workers. **J Sports Sci**. *Submitted.*

VII. **López-Bueno R**, Bláfoss, R, Calatayud J, López-Sánchez GF, Smith L, Andersen LL, Casajús JA. Higher leisure-time physical activity is associated with lower chronic disease among the Spanish workforce. **Prev Chronic Dis.** *Accepted.*

VIII. **López-Bueno R**, López-Sánchez G, Smith L, Sundstrup E, Andersen LL, Casajús JA. Higher leisure-time physical activity is associated with lower activity limitation among the Spanish working population. **Science & Sport.** *Submitted.*

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Content

Proyecto de investigación

La presente Tesis Doctoral y los artículos que forman parte de ella se incluyen en el siguiente proyecto de investigación: *"Physical activity influence in absenteeism of Zaragoza University employees".*

Dicho proyecto de investigación ha sido posible gracias a la colaboración con la Unidad de Prevención de Riesgos Laborales de la Universidad de Zaragoza y el Centro Nacional de Investigación del Entorno Laboral de Dinamarca. Las encuestas y los registros utilizados fueron financiados por las siguientes instituciones:

"Encuesta de revisiones médicas a los trabajadores de la Universidad de Zaragoza"

- Servicio de Vigilancia de la Salud de la Universidad de Zaragoza

"**Danish Work Environment Cohort Study (DWECS)"**

- Ministerio de Empleo del Gobierno de Dinamarca

"Danish Register for Evaluation of Marginalization (DREAM)"

- Ministerio de Empleo del Gobierno de Dinamarca

"Encuesta Nacional de Salud (ENSE)"

- Ministerio de Salud, Consumo y Bienestar Social del Gobierno de España

"European Health Interview Survey (EHIS)"

- Ministerio de Salud, Consumo y Bienestar Social del Gobierno de España

Investigador principal: **José A. Casajús Mallén.**

Research Project

The present Thesis and the linked articles are included in the following research project: "Physical activity influence in absenteeism of Zaragoza University employees".

The research project has been possible due to the collaboration with the Occupational Risk Division of the University of Zaragoza, and the National Centre for the Working Environment of Denmark. The surveys and the registers used were funded by the following institutions:

"University of Zaragoza worker´s medical survey"

- Health Vigilance Service of the University of Zaragoza

"Danish Work Environment Cohort Study (DWECS)"

- Danish Ministry of Employment

"Danish Register for Evaluation of Marginalization (DREAM)"

- Danish Ministry of Employment

"National Health Survey"

- Spanish Ministry of Health, Consumerism, and Social Wellness

"**European Health Interview Survey (EHIS)"**

- Spanish Ministry of Health, Consumerism, and Social Wellness

Principal investigator: **José A. Casajús Mallén.**

Resumen general

El absentismo laboral debido a enfermedad es un fenómeno multicausal influido por las características del entorno laboral, el puesto de trabajo y el estilo de vida. Su elevado coste es soportado por empresas e instituciones públicas en base a la legislación vigente, y representa una parte importante del presupuesto para muchos países. Sin embargo, no se trata únicamente de una cuestión económica, sino también de una cuestión de salud pública; el absentismo laboral por enfermedad de larga duración ha sido asociado tanto a un mayor riesgo de experimentar pensión por incapacidad permanente, como a un mayor riesgo de mortalidad. Entre sus causas más relevantes se ha señalado a diferentes condiciones y enfermedades crónicas, en ocasiones, específicas de determinadas profesiones y sectores laborales. Así, el dolor de espalda (i.e. zona lumbar y zona cervical), los trastornos mentales (i.e. ansiedad y depresión), y diferentes enfermedades cardiovasculares han sido observadas entre las condiciones más prevalentes en trabajadores de diferentes poblaciones que experimentan absentismo laboral por enfermedad de larga duración.

Por otro lado, niveles moderados y altos de actividad física, en especial cuando se realizan en el tiempo libre o con motivo de desplazamiento al centro de trabajo, han sido asociados a menores niveles de, por un lado, absentismo laboral por enfermedad y, por otro, algunas de las enfermedades crónicas más extendidas en poblaciones generales y específicas de trabajadores. Además, esta asociación inversa se ha observado más pronunciada con niveles mayores de actividad física en el tiempo libre.

El objetivo de estos estudios fue el de ampliar el conocimiento acerca de estas relaciones entre actividad física y absentismo laboral por enfermedad, haciendo especial énfasis en su observación con diferentes muestras de trabajadores españoles, trabajadores daneses, poblaciones de trabajadores específicas y condiciones o enfermedades crónicas asociadas a estas situaciones.

Los estudios llevados a cabo son de carácter observacional, y utilizaron datos de muestras de poblaciones de trabajadores españoles y daneses. Los artículos II y III analizaron dos muestras de trabajadores universitarios (n=1025 y n=757). Los artículos IV y VI realizaron el seguimiento de una muestra tanto general (n=10427) como específica de trabajadores daneses (n=4699). Los artículos V, VII y VIII investigaron muestras generales de trabajadores españoles (n=9512 y n=9885).

Herramientas como el Cuestionario Internacional de Actividad Física (IPAQ) fueron usadas para estimar los niveles de actividad física, mientras que el absentismo laboral por enfermedad fue evaluado mediante pregunta incluida en cuestionarios o a través del registro danés para la evaluación de la marginalidad (DREAM). Los análisis fueron ajustados por diferentes variables de control señaladas por la literatura y recogidas en los cuestionarios.

Los resultados de la presente Tesis Doctoral mostraron una asociación inversa entre actividad física y absentismo laboral por enfermedad en trabajadores españoles. Dicha asociación se observó más pronunciada con mayores niveles de actividad física y en determinados subgrupos de trabajadores. En la misma línea, también se observó una asociación inversa entre actividad física y determinadas condiciones (dolor de espalda crónico, depresión, ansiedad, hipertensión, diabetes, estrés laboral y limitación de la actividad cotidiana). Por otro lado, la actividad física en el tiempo libre redujo el riesgo de absentismo laboral de larga duración en trabajadores daneses.

En conclusión, los resultados sugieren que niveles altos de actividad física se asocian con menor prevalencia y riesgo de absentismo laboral por enfermedad. Estrategias basadas en la promoción de la actividad física en el tiempo libre podrían resultar beneficiosas para la reducción del absentismo laboral por enfermedad.

Tabla 1. Síntesis del estado de la cuestión y los resultados que añade la Tesis Doctoral

Artículo	Estado de la cuestión	Lo que añade esta Tesis
I	Se han realizado diferentes intervenciones y se ha observado la exposición a la actividad física y su relación con el absentismo laboral por enfermedad. La evidencia existente es moderada y poco concluyente. La heterogeneidad del diseño de los estudios es muy alta, lo que dificulta su comparación.	Examina la relación entre las dos variables objeto de estudio en poblaciones de trabajadores con niveles bajos de actividad física en su puesto de trabajo. La revisión sugiere una asociación inversa entre actividad física, particularmente la actividad física vigorosa, y absentismo laboral por enfermedad.
II	La relación entre actividad física y absentismo laboral es poco conocida en determinados ámbitos laborales, especialmente en países del sur de Europa.	Investiga la relación entre actividad física y absentismo laboral en el ámbito universitario. Los resultados sugieren una asociación inversa entre las dos variables. Alcanzar los niveles mínimos de actividad física semanal se asocia con una reducción media de tres días de absentismo anual por trabajador.
III	La evidencia de que el estrés laboral se asocia a mayor prevalencia de enfermedades crónicas por enfermedad es alta, aunque menos se conoce de su relación con el absentismo laboral por enfermedad. Los costes derivados del absentismo laboral debido a depresión o ansiedad son elevados en los países desarrollados.	Los resultados sugieren una asociación entre mayores niveles de actividad física y menores niveles de estrés laboral percibido por empleados universitarios. La promoción de la actividad física podría resultar beneficiosa para mejorar la percepción de estrés laboral en esta población de trabajadores.
IV	El absentismo de larga duración constituye uno de los mayores gastos de la seguridad social en los países europeos. Este tipo de absentismo se ha identificado como un predictor fiable de pensión por incapacidad permanente, y ha sido asociado a mayores niveles de mortalidad. No existe consenso en la evidencia de asociación entre actividad física y absentismo laboral de larga duración.	La práctica de actividad física en el tiempo libre reduce el riesgo de absentismo laboral de larga duración por enfermedad en una población general de trabajadores daneses. Esta reducción del riesgo resultó particularmente significativa en mujeres menores de cuarenta y cinco años.
V	Aunque la relación entre actividad física y absentismo laboral por enfermedad ha sido examinada en diferentes estudios, se conoce poco acerca de dicha relación en trabajadores españoles. Las características propias de la legislación laboral en cada país podrían afectar a dicha relación.	Los resultados sugieren una asociación inversa entre la actividad física en el tiempo libre y absentismo laboral por enfermedad en una población general de trabajadores españoles. Dicha asociación se mostró especialmente significativa en mujeres entre cuarenta y cuatro y cincuenta y un años de edad.
VI	El sector sanitario es uno de los de mayor riesgo de experimentar absentismo laboral de larga duración por enfermedad. En concreto, los profesionales al cuidado de personas mayores han sido identificados como los más expuestos a esfuerzos físicos por encima de sus posibilidades y a mayores niveles de estrés psicológico en el desempeño de su trabajo.	La actividad física moderada y vigorosa realizada en el tiempo libre redujo el riesgo de absentismo laboral de larga duración por enfermedad en cuidadores de personas mayores. Dicha reducción fue mayor con la exposición a actividad física vigorosa.
VII	Las enfermedades crónicas representan la mayor causa de absentismo laboral de larga duración en diferentes poblaciones de trabajadores. En concreto, el dolor crónico de espalda (i.e. zona lumbar y cervical), las enfermedades cardiovasculares y los trastornos mentales se identifican como los mayores causantes del absentismo laboral por enfermedad de poblaciones generales y específicas de trabajadores.	Menores niveles de actividad física en el tiempo libre se asociaron con mayores niveles de enfermedad crónica en una población general de trabajadores españoles. Después de ajustar por todas las variables de control, la asociación entre actividad física en el tiempo libre y enfermedad crónica permaneció significativa en el subgrupo de hombres de diecisiete a cuarenta y cuatro años de edad.
VIII	La limitación de las actividades de la vida cotidiana es un fenómeno poco estudiado pero relevante desde el punto de vista de la calidad de vida y la salud pública. Algunas investigaciones han sugerido su posible asociación directa con el absentismo laboral por enfermedad y las pensiones por incapacidad permanente.	Los resultados sugieren que cumplir con los niveles mínimos recomendados de actividad física se asocia a menores limitaciones de la actividad cotidiana en una población general de trabajadores españoles.

General abstract

Sickness absence is a multicausal phenomenon influenced by the working environment, job role and lifestyle. Its high cost is supported by companies and public institutions in accordance with the current legislation and represents a substantial part of the budget for many countries. Nevertheless, this is not only an economic issue but also a public health issue; long-term sickness absence has been associated to experience disability pension, as well as mortality risk. Both chronic conditions and diseases have been pointed at among its main relevant causes, occasionally, linked to specific occupational classes. Thus, back pain (i.e. low back pain and neck pain), mental disorders (i.e. anxiety and depression) and different cardiovascular diseases have been observed among the most prevalent in workers experiencing long-term sickness absence.

On the other hand, moderate and high levels of physical activity, particularly when they are performed during leisure or when commuting to work, have been associated with lower sickness absence, as well as lower of the most common chronic diseases among both general and specific populations of workers. In addition, this inverse association has been observed to be more pronounced with higher leisure-time physical activity.

The aim of these studies was to widen knowledge about the physical activity and sickness absence relationship, focusing on its observation among different samples of Spanish and Danish workers, specific population of workers, as well as chronic conditions and diseases associated with these situations.

Observational studies examining samples of both Spanish and Danish workers were carried out. Manuscripts II and III analysed two samples of university workers (n=1025 and n=757). Manuscripts IV and VI followed up a general (n=10427) as well as a specific sample of Danish workers (n=4699). Manuscripts V, VII and VIII investigated samples of general populations of Spanish workers (n=9512 y n=9885).

Tools such as International Physical Activity Questionnaire (IPAQ) were used to estimate physical activity levels, while sickness absence was assessed through either a question included in the questionnaires or the Danish Registry for Evaluation of Marginalization (DREAM). Analyses were adjusted for different control variables appointed by literature and collected in the questionnaires.

Results of the present Thesis showed an inverse association between physical activity and sickness absence in Spanish workers. Such association was observed stronger with higher levels of physical activity and certain subgroups of workers. Similarly, an inverse association

between physical activity and certain conditions (i.e. chronic back pain, depression, anxiety, hypertension, diabetes, work-related stress, and usual activity limitations). Moreover, leisure-time physical activity reduced the risk of long-term sickness among Danish workers.

In conclusion, the results suggest that higher levels of physical activity associates with lower prevalence and risk of sickness absence. Strategies based on promoting physical activity during leisure might be beneficial for reducing sickness absence.

Table 1. Summary of the state of the art and what this Thesis adds.

Manuscript	What is known about this topic	What this Thesis adds
I	Different interventions have been carried out and physical activity expositions and its relationship with sickness absence has been obseved. The evidence is moderate and inconclusive. The heterogeneity of the study designs is high, which difficults comparisons.	Examines the relationship between the two study variables in worker populations with low levels of occupational physical activity. The review suggests an inverse association between physical activity, particularly that vigorous, and sickness absence.
II	The relationship between physical activity and sickness absence is little known in specific job roles, particularly in South European countries.	Investigates the relationship between physical activity and sickness absence in the university sector. The results suggest an inverse association between the two variables. To reach recommended weekly minimum levels regarding physical activity associates with a mean reduction of three annual days of sickness absence per worker.
III	There is high level of evidence that work-related stress associates with a higher prevalence of chronic diseases but less is known about its relation to sickness absence. The derived costs of sickness absence due to depression or anxiety are high in developed countries.	The results suggest an association between higher levels of physical activity and lower levels of self-perceived work-related stress in university employees. Physical activity strategies might be beneficial for improving perception of work-related stress in this population of workers.
IV	Long-term sickness absence represents one of the highest social security costs among European countries. Thys type of sickness absence has been identified as a reliable predictor for disability pension, and has been associated with higher levels of mortality. There is no consensus in the evidence of association between physical activity and long-term sickness absence.	To perform physical activity during leisure reduces risk of long-term sickness absence among a general population of Danish workers. This reduction was significantly higher in women aged forty-five or less.
V	Although the relationship between physical activity and sickness absence has been examined in different studies, little is known about it among Spanish population of workers. Specific characteristics of the labour legislation in each country might affect that relationship.	The results suggest an inverse association between physical activity during leisure and sickness absence in a general population of Spanish workers. Such association was particularly significant among women aged between forty-four and fifty-one.
VI	Sanitary sector is among those with highest risk of experiencing long-term sickness absence. Particularly, professionals taking care of elderly people have been identified as the most exposed to physical efforts above their possibilities and to a higher level of work-related psychological stress.	Moderate and vigorous physical activity performed during leisure reduced the risk of long-term sickness absence in eldercare workers. Such reduction was higher with exposure to vigorous physical activity.
VII	Chronic diseases represent the highest cause for long-term sickness absence in different populations or workers. Particularly, chronic back pain (i.e. low back and neck pain), cardiovascular diseases and mental conditions are identified as the most relevant causes behind sickness absence among both general and specific populations of workers.	Lower levels of physical activity during leisure associated with higher levels of chronic disease in a general population of Spanish workers. After adjusting for all the control variables, the association between leisure-time physical activity and chronic disease remained significant in men aged between seventeen to forty-four subgroup.
VIII	Usual activity limitations is a little known phenomenon but relevant from the point of view of the quality of life and public health. Several studies have suggested a potential direct association of usual activity limitations with sickness absence and disability pension.	The results suggest that to reach the recommended minimum levels regarding physical activity associates with lower usual activity limitations in a general population of Spanish workers.

Listado de abreviaturas

AF	Actividad física
ALE	Absentismo laboral por enfermedad
UE	Unión Europea
OMS	Organización Mundial de la Salud
OCDE	Organización para la Cooperación y el Desarrollo Económicos
INSS	Instituto Nacional de la Seguridad Social
PIB	Producto Interior Bruto
AVAD	Años de Vida Ajustados por Discapacidad
CIE	Clasificación Internacional de Enfermedades
EU-OSHA	Agencia Europea para la Seguridad en el Trabajo
CEICA	Comité Ético de la Investigación de la Comunidad de Aragón
IMC	Índice de Masa Corporal
CNO	Clasificación Nacional de Ocupaciones

List of abbreviations

GPS	Global Positioning System
MET	Metabolic Equivalent of Task
ACSM	American College of Sports Medicine
EUROFUND	European Foundation for the Improvement of Living and Working
PA	Physical activity
SA	Sickness absence
DWECS	Danish Work Environment Cohort Study
DREAM	Danish Register for Evaluation of Marginalisation
EHIS	European Health Interview Survey
SOSU	Social- og sundhedsuddannelse
EIM	Exercise is Medicine
PAVS	Physical Activity Vital Sign
IPAQ	International Physical Activity Questionnaire
SPSS	Statistical Package for the Social Sciences
SAS	Statistical Analysis System
WHO	World Health Organization

1. Introducción

La presente Tesis Doctoral tiene como fin analizar la asociación entre la exposición a la actividad física (AF) general y en el tiempo libre y el absentismo laboral por motivos de enfermedad (ALE) en diferentes tipos de poblaciones. A lo largo de los distintos apartados que conforman esta introducción, se abordarán diferentes cuestiones relativas a la conceptualización, clasificación y estado de la cuestión de las dos variables mencionadas.

1.1. La actividad física como factor de prevención de enfermedades crónicas

El contexto actual de envejecimiento de la población activa, con una tendencia al aumento de la edad de jubilación en el conjunto de los países de la Unión Europea (UE) (1), y una disminución de los niveles de condición física (2), pone de relieve la necesidad de desarrollar programas preventivos para el desarrollo de las enfermedades crónicas en poblaciones de trabajadores, más aún cuando la prevalencia de inactividad física continúa alta y sin perspectivas de reducción sustancial a corto plazo (3). El proceso de envejecimiento *per se* ya ha sido identificado como factor de riesgo para el desarrollo de las principales enfermedades crónicas (4), muchas de las cuales representan la causa principal del absentismo laboral y sus costes económicos asociados (5). Por otro lado, la AF ha demostrado ser una herramienta eficaz para disminuir el riesgo mortalidad y de desarrollo de enfermedades crónicas con diversos tipos de poblaciones, incluidas las de trabajadores de diferentes sectores profesionales (6–9).

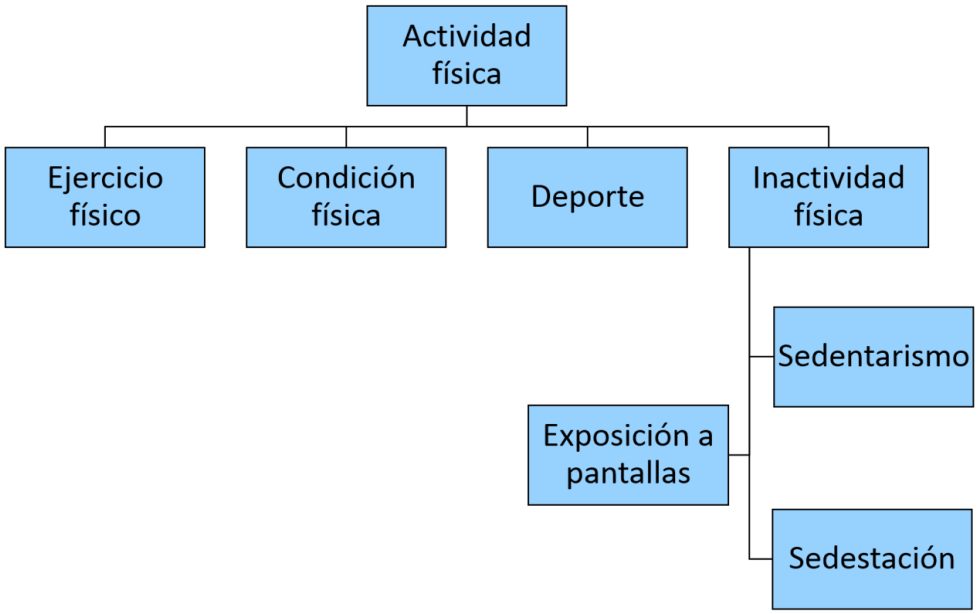
1.1.1 Conceptualización de la actividad física

La Organización Mundial de la Salud (OMS) considera la AF como el gasto de energía producido en el movimiento a través de la contracción de los músculos esqueléticos (10). Desde el punto de vista metabólico, requiere un gasto de energía superior al de estar en reposo que, dependiendo de sus características (i.e. duración, velocidad , resistencia a vencer y frecuencia) será cubierto de manera combinada a través de diferentes vías de producción de energía (i.e. aeróbica, anaeróbica aláctica y anaeróbica láctica) (11).

Aunque AF, ejercicio y deporte son usados frecuentemente como si fueran sinónimos, la conceptualización de dichos términos presenta claras diferencias. Mientras la AF se centra en el movimiento producido por la contracción de los músculos esqueléticos que deriva en un aumento del consumo calórico, el ejercicio es una subcategoría de AF basada en la repetición de patrones de movimiento planificados con el objetivo de desarrollar o mantener uno o más

componentes de la condición física; ésta sería la habilidad de llevar a cabo las tareas cotidianas con vigor, sin fatiga excesiva y con energía suficiente para disfrutar del tiempo libre y responder a las emergencias imprevistas (12). Por último, el deporte se diferencia de los términos anteriores por su carácter orientado a la competición y su práctica y promoción llevada a cabo de manera institucionalizada a través de federaciones, clubes y asociaciones deportivas (13).

Figura 1. Actividad física y terminología asociada. Fuente: elaboración propia.



En la actualidad, la inactividad física está considerada como uno de los principales factores de riesgo de mortalidad a nivel mundial (10). Además, la práctica regular de AF ha sido señalada por diferentes organismos internacionales como factor de prevención en el desarrollo de las principales enfermedades crónicas no transmisibles (12). La evidencia de esta relación entre inactividad física y enfermedades crónicas como ciertos tipos de cáncer, enfermedades cardiovasculares, dolencias musculoesqueléticas y pobre salud mental es muy alta, habiéndose observado en distintos tipos de poblaciones analizadas en estudios de diferente naturaleza (7,14). En la misma línea, el sedentarismo, o el tiempo prolongado sin llevar a cabo AF por encima del estado de reposo, también ha sido asociado al desarrollo de enfermedades crónicas (15). Además, esta relación entre AF y enfermedades crónicas, también ha mostrado asociaciones dosis-respuesta, de tal modo que, a mayor nivel de AF, menor mortalidad por causa de enfermedades cardiovasculares (16).

El desarrollo de nuevas tecnologías para el control del movimiento humano ha permitido, por un lado, generalizar las observaciones relativas a la AF al disponer una mayor accesibilidad a instrumentos de medición debido a una mayor asequibilidad de los mismos, así como, por otro lado, obtener instrumentos de mayor precisión. De esta manera, la AF ha sido evaluada mediante el uso de diferentes herramientas de diferente precisión, desde cuestionarios internacionalmente validados hasta el método del agua doblemente marcada, considerado por algunos estudios como el método de referencia o *gold standard*; en un escalón intermedio se han situado métodos de valoración directos e indirectos tales como los sensores de movimiento, la acelerometría, la calorimetría, el análisis de gases, el posicionamiento, el *global positioning system* (GPS), o el desarrollo de aplicaciones para dispositivos móviles, entre otros (11,17,18).

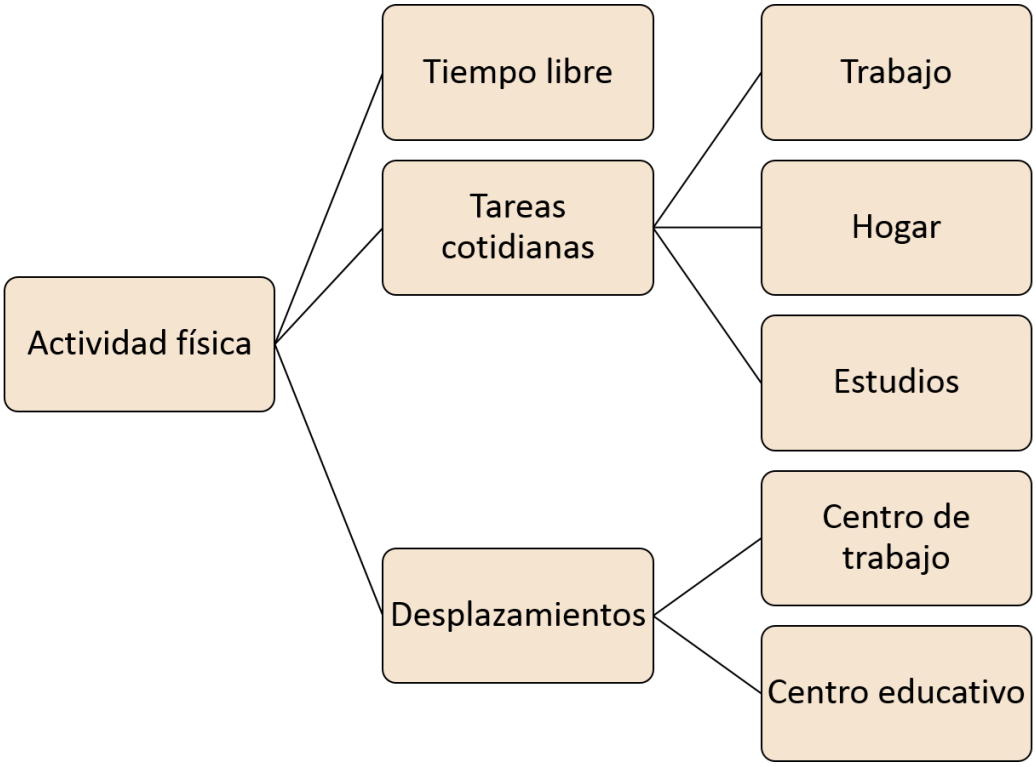
1.1.2 Tipos de actividad física

Uno de los criterios más usados a la hora de clasificar la AF ha estado basado en el rango de intensidad. Dicho rango de intensidad ha estado vinculado normalmente al tipo de herramienta que ha realizado la medición de la intensidad de la AF. De este modo, la intensidad de la AF ha sido clasificada, entre otros, en función del porcentaje de la frecuencia cardiaca de reserva, el consumo máximo de oxígeno o el índice metabólico MET (Metabolic Equivalent of Task); este último ha resultado de especial utilidad por haber facilitado la comparación de diferentes tipos de actividades en relación con su consumo de energía (11). Este hecho se ha debido a la estandarización de la intensidad del esfuerzo físico y la elaboración de tablas con diferentes tipos de actividades asociadas a su número estimado de METs. De esta manera, ha sido posible agrupar actividades según su intensidad gracias a los MET estimados en las mismas. Así, se ha podido distinguir entre actividades ligeras o muy ligeras (<3.0 METs), moderadas (3.0.-5.9 METs) y vigorosas (≥6.0 METs) tomando como referencia un MET, definido como la cantidad de oxígeno consumido en estado de reposo, equivalente a 3.5 mililitros de oxígeno por kilogramo de peso corporal por minuto; estos intervalos de intensidad del esfuerzo físico han sido utilizados como referencias en diferentes estudios y cuestionarios al objeto de estimar los niveles de AF de diferentes poblaciones (19,20).

Otra clasificación útil al efecto de valorar la AF, es la relacionada con el contexto en el cual ésta se lleva a cabo. De esta manera es posible encontrar estudios que utilizan la AF en el tiempo libre como exposición o intervención, y lo mismo ocurre con aquellos que observan o utilizan la AF en la actividad principal (i.e. en el lugar de trabajo, el centro de estudio o las tareas cotidianas en el hogar), o la AF en el desplazamiento desde el lugar de residencia habitual hasta

el trabajo o el centro de estudios (21–23). Por último, y siguiendo esta misma línea, es posible valorar la AF realizada en su conjunto, tomando en cuenta todas las situaciones mencionadas de desarrollo de AF a lo largo de varios días (24).

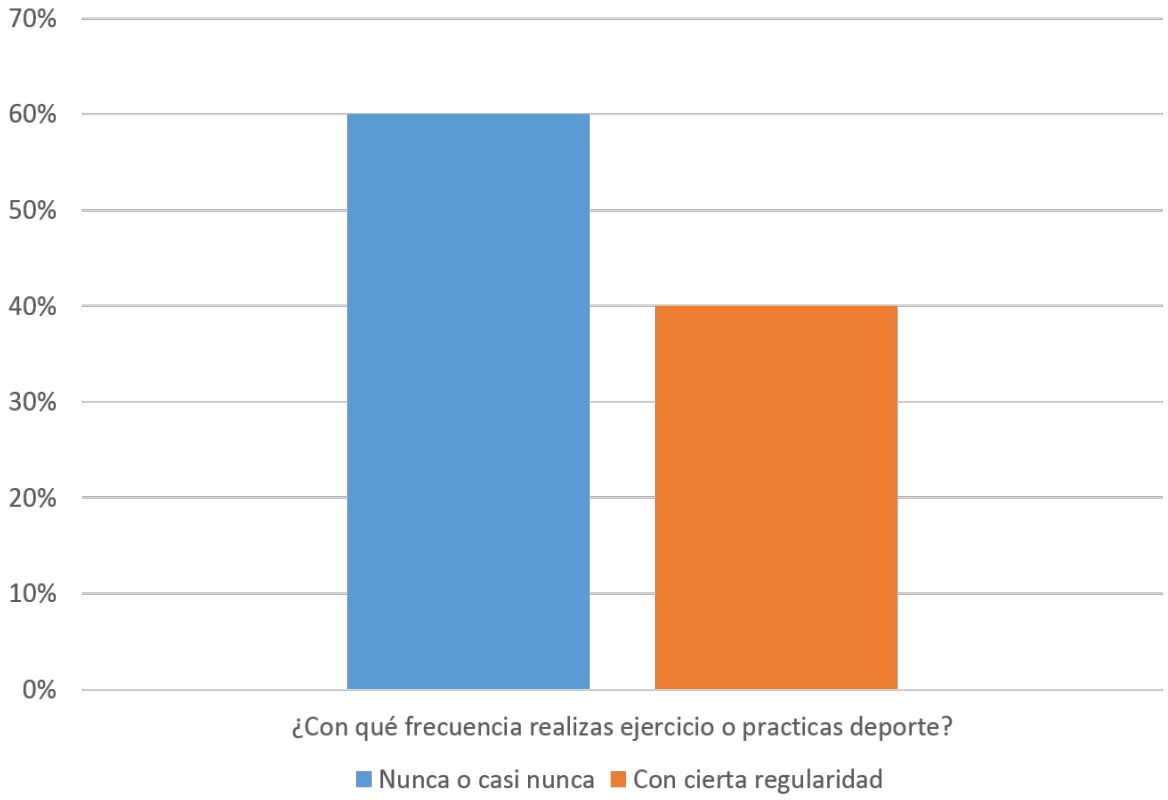
Figura 2. Tipos de actividad física en función del momento en el que se produce. Fuente: elaboración propia.



1.1.3 La evolución de los niveles de actividad y la condición física

El desarrollo de la tecnología ha afectado sustancialmente a los hábitos relacionados con la AF tanto en poblaciones pertenecientes a países desarrollados como en países en vías de desarrollo. La prevalencia de niveles bajos de AF permanece alta entre países de la UE, entre los cuales España ocupa un lugar destacado (25). Además, se ha sugerido que los niveles de condición física han disminuido en las últimas décadas, de tal manera que la capacidad aeróbica, uno de sus principales componentes, podría haber disminuido en torno a un 8% a lo largo de los últimos treinta años (2).

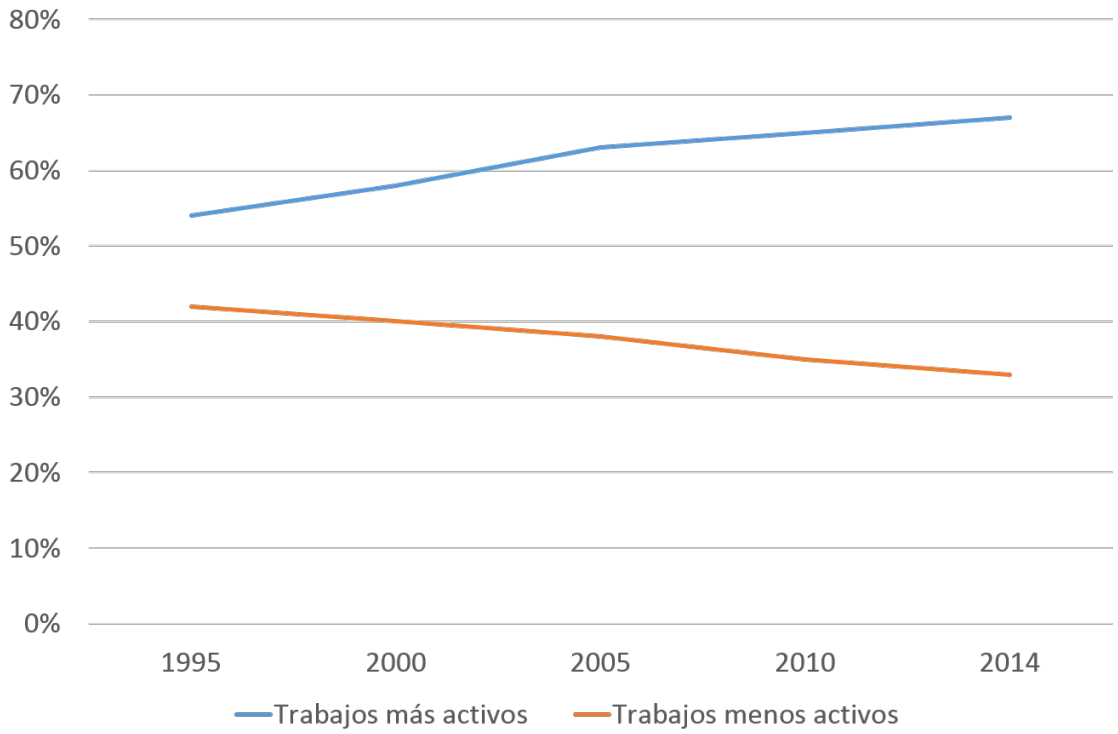
Figura 3. Niveles de actividad física en la Unión Europea. Fuente: adaptado de *Special Eurobarometer 472 Report Sport and physical activity, European Comission, 2018.*



Guthold et al. (3) han identificado una tendencia estable de la prevalencia de la inactividad física (i.e. no alcanzar los niveles de actividad física recomendados por la OMS) a nivel mundial, que muestra un distanciamiento de los objetivos de reducción de un 10% para este factor de riesgo en el año 2025.

En lo que se refiere al desempeño laboral, la naturaleza de los trabajos ha ido cambiando paulatinamente, de tal manera que, el trabajo de carácter administrativo, más propio del sector servicios, ha ido ganando peso en detrimento de los trabajos manuales; esta tendencia se ha observado especialmente marcada en los países desarrollados, en los cuales se ha podido identificar una tendencia creciente de trabajos de carácter más sedentario, al mismo tiempo que una tendencia decreciente de los trabajos caracterizados por el desempeño físico (26).

Figura 4. Evolución de los tipos de trabajo según nivel de actividad física en la Unión Europea. Fuente: adaptado de *The economic cost of physical inactivity in Europe, Centre for Economics and Business Research, 2015*.



De igual manera, el fenómeno de la deslocalización del trabajo, con un distanciamiento progresivo y generalizado de los lugares de residencia con respecto a los centros de trabajo podría haber favorecido tanto el uso del transporte público como el del transporte privado en los desplazamientos. En este contexto, diferentes iniciativas han promocionado el denominado desplazamiento activo, a pie o en bicicleta, para los desplazamientos al centro de trabajo (27).

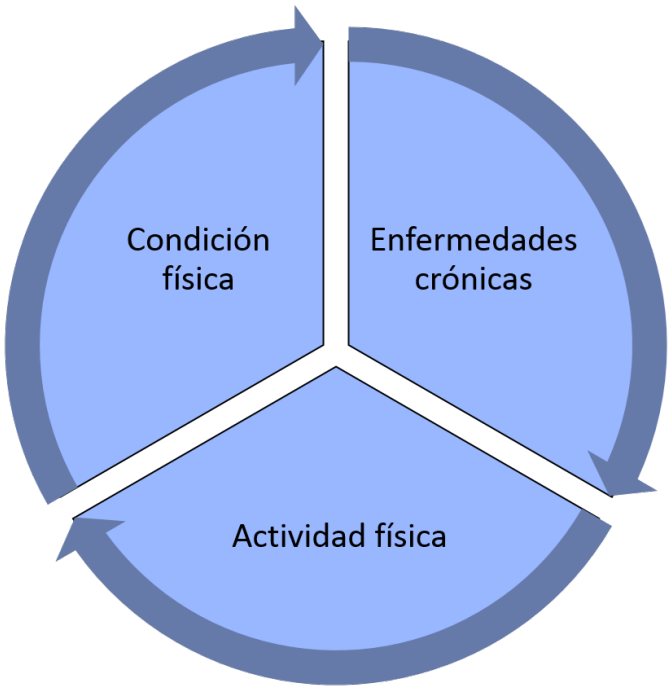
Como consecuencia de los mencionados cambios en los estilos de vida en relación con la AF, diferentes instituciones de ámbito internacional han emitido informes con pautas sobre los niveles mínimos de actividad física recomendados para prevenir la aparición de diferentes tipos de enfermedades crónicas. Así, la OMS, ha fijado estos límites para adultos en 150 minutos semanales de actividad física moderada o, en su ausencia, 75 minutos semanales de actividad vigorosa, con la posibilidad de combinar los tiempos para ambas actividades (10). Otras organizaciones de referencia como el Colegio Americano de Medicina del Deporte (ACSM) han establecido niveles similares, si bien han remarcado la necesidad de realizar dos días de entrenamiento de fuerza a la semana (12). Conviene destacar que se trata de niveles mínimos, puesto que diferentes estudios han identificado asociaciones dosis-respuesta en el sentido de

que a mayores niveles de AF menor mortalidad (6). A pesar de estas recomendaciones, niveles más bajos de AF han sido asociados con una disminución en la aparición de factores de riesgo de enfermedades cardiovasculares (28).

1.2 Beneficios de la práctica regular de actividad física en la salud

Es posible considerar la AF como una herramienta de prevención y/o tratamiento de un amplio rango de enfermedades de tipo crónico de diferente casuística (29). En este apartado se abordan algunas de las principales enfermedades y dolencias crónicas más prevalentes en poblaciones generales de trabajadores y los beneficios que la AF proporciona para cada uno de ellos.

Figura 5. Relación entre actividad física y enfermedades crónicas. Fuente: elaboración propia.



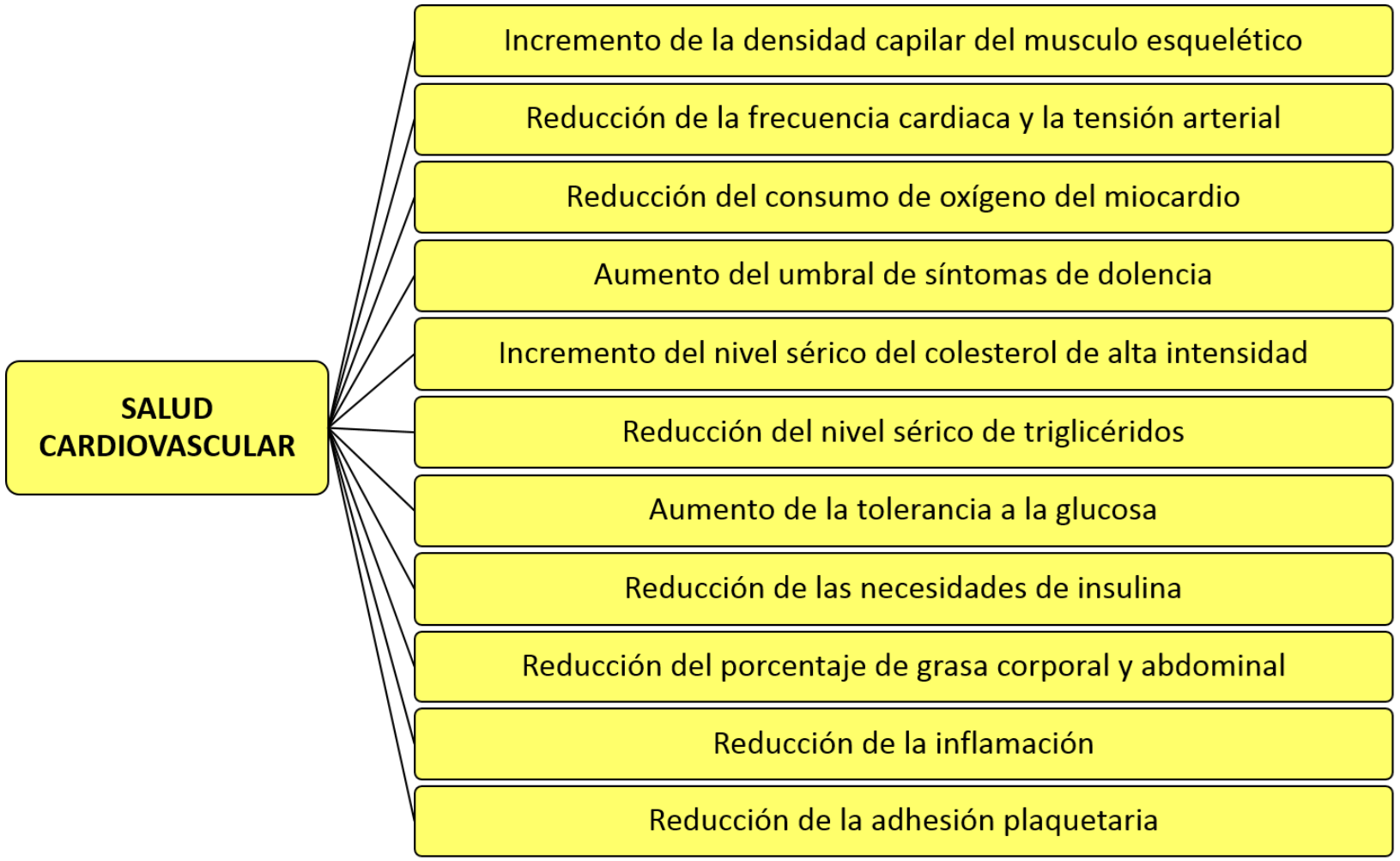
1.2.1 Salud cardiovascular

La práctica regular de AF constituye un importante factor de prevención para el desarrollo de las principales enfermedades cardiovasculares. Entre los efectos más significativos de la AF en relación con la función cardiovascular se ha identificado la mejora de la densidad capilar en el músculo esquelético, reducción de la frecuencia cardiaca y de la tensión arterial a diferentes tipos de intensidades de esfuerzo submáximas, reducción del consumo de oxígeno del miocardio y aumento del umbral de aparición de síntomas de dolencia o enfermedad como la angina de pecho, entre otros (12). Igualmente, se han observado efectos beneficiosos en un conjunto de factores de riesgo asociados al desarrollo de patologías cardiovasculares: reducción de la tensión arterial sistólica y diastólica en reposo, incremento de los niveles séricos del colesterol de alta densidad, reducción del nivel sérico de triglicéridos, reducción del porcentaje total de grasa corporal así como intra-abdominal, aumento de la tolerancia a la glucosa, reducción de las necesidades de insulina, reducción de la adhesión plaquetaria y, por último, reducción de la inflamación (12).

Por otro lado, es significativo el hecho de que el sedentarismo ha sido asociado con enfermedades cardiovasculares, diabetes y mortalidad por todo tipo de causas (30), si bien sus efectos nocivos podrían atenuarse a través de niveles altos de AF de carácter moderado y/o intenso (31).

La AF realizada con motivo del desplazamiento al trabajo también se ha asociado con una menor prevalencia de factores de riesgo de enfermedad cardiovascular, independientemente de la cantidad de AF realizada durante el tiempo libre (22).

Figura 6. Beneficios de la actividad física en la salud cardiovascular. Fuente: adaptado de *ACSM´s Guidelines for Exercise Testing and Prescription, 2018*.



1.2.2 Salud musculoesquelética

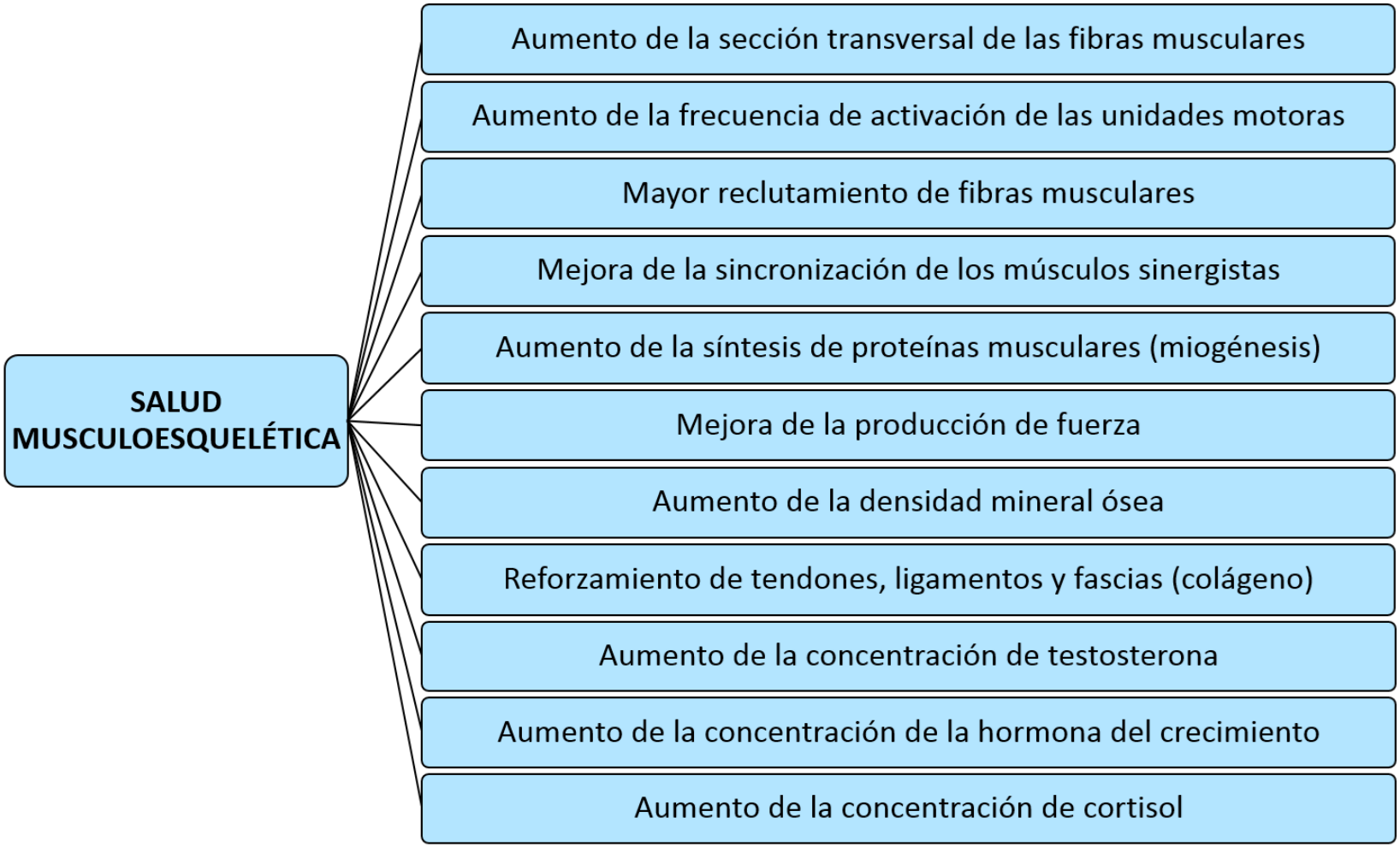
Los niveles de fuerza muscular aumentan como respuesta a la AF y, en particular, como adaptación al entrenamiento resistido. El área transversal de las fibras musculares aumenta y mejoran las funciones neuromusculares a través del aumento de la frecuencia de activación de las unidades motoras, un mayor reclutamiento de fibras musculares y una mejora de la sincronización de la actividad sinérgica de los músculos implicados (32). Se ha observado que este tipo de actividades basadas en entrenamientos contra resistencia favorecen la síntesis de proteínas musculares o miogénesis y mejoran la producción de fuerza en sujetos diagnosticados con sarcopenia (33).

A través del ejercicio físico es posible proporcionar estímulos de carácter osteogénico para aumentar la densidad mineral ósea en zonas específicas del organismo (34,35). De la misma manera, es posible reforzar estructuras anatómicas tales como tendones, ligamentos y fascias a través de la síntesis de colágeno como respuesta a la actividad física (32).

El ejercicio físico resistido produce una respuesta aguda de las hormonas con funciones anabolizantes en el organismo. En particular, se han observado aumentos en la concentración tanto de la testosterona como de la hormona del crecimiento y el cortisol hasta media hora después de la actividad, lo que favorecería el crecimiento de masa muscular (32). Un solo componente de la condición física como es la fuerza muscular ha sido identificado como predictor de mortalidad por todo tipo de causas, incluso con poblaciones previamente saludables (36).

Las dolencias de tipo musculoesquelético representan uno de los mayores problemas en el ámbito laboral, siendo una de las principales causas de ausencia del trabajo por motivos de salud. Por este motivo, numerosos estudios han analizado los posibles beneficios de la actividad física sobre el dolor lumbar y cervical, entre otros, en diferentes poblaciones de trabajadores; dichos estudios han observado mejoras significativas en la percepción del dolor tras la implementación de diferentes programas de entrenamiento de la fuerza con intensidades de esfuerzo predominantemente altas (37).

Figura 7. Beneficios de la actividad física en la salud musculoesquelética. Fuente: adaptado de *Essentials of Strength Training and Conditioning, 2016.*



1.2.3 Salud mental

A diferencia de la prevención y tratamiento de enfermedades cardiovasculares o dolencias musculoesqueléticas, donde diversos procesos fisiológicos que explican las razones por las cuales la AF tiene efectos beneficiosos están bien definidos, la fisiología relacionada con los beneficios que produce la AF en la salud mental es menos conocida (38). Los trastornos mentales más comunes han sido señalados por la OMS, y comprenden los trastornos depresivos y los trastornos de ansiedad; los primeros incluyen el trastorno depresivo mayor o episodio depresivo, y el trastorno depresivo persistente o distimia, mientras que los segundos incluyen el trastorno generalizado de ansiedad y otros como el trastorno obsesivo compulsivo, el trastorno de estrés post-traumático, trastorno de ansiedad social y un amplio espectro de fobias y pánicos (39).

La práctica de AF ha sido asociada con mejores niveles de salud mental en la literatura (40). Indicadores de salud mental tales como la tendencia a pensamientos suicidas han sido asociados a niveles más bajos de fuerza de prensión en hombres adultos pertenecientes a un amplio rango de edades (41). En adultos de nacionalidad española, se han detectado asociaciones dosis-respuesta de diferentes niveles de AF y sus correspondientes prevalencias de depresión y ansiedad, de manera que a mayores niveles de AF menor prevalencia de depresión y ansiedad y viceversa (42).

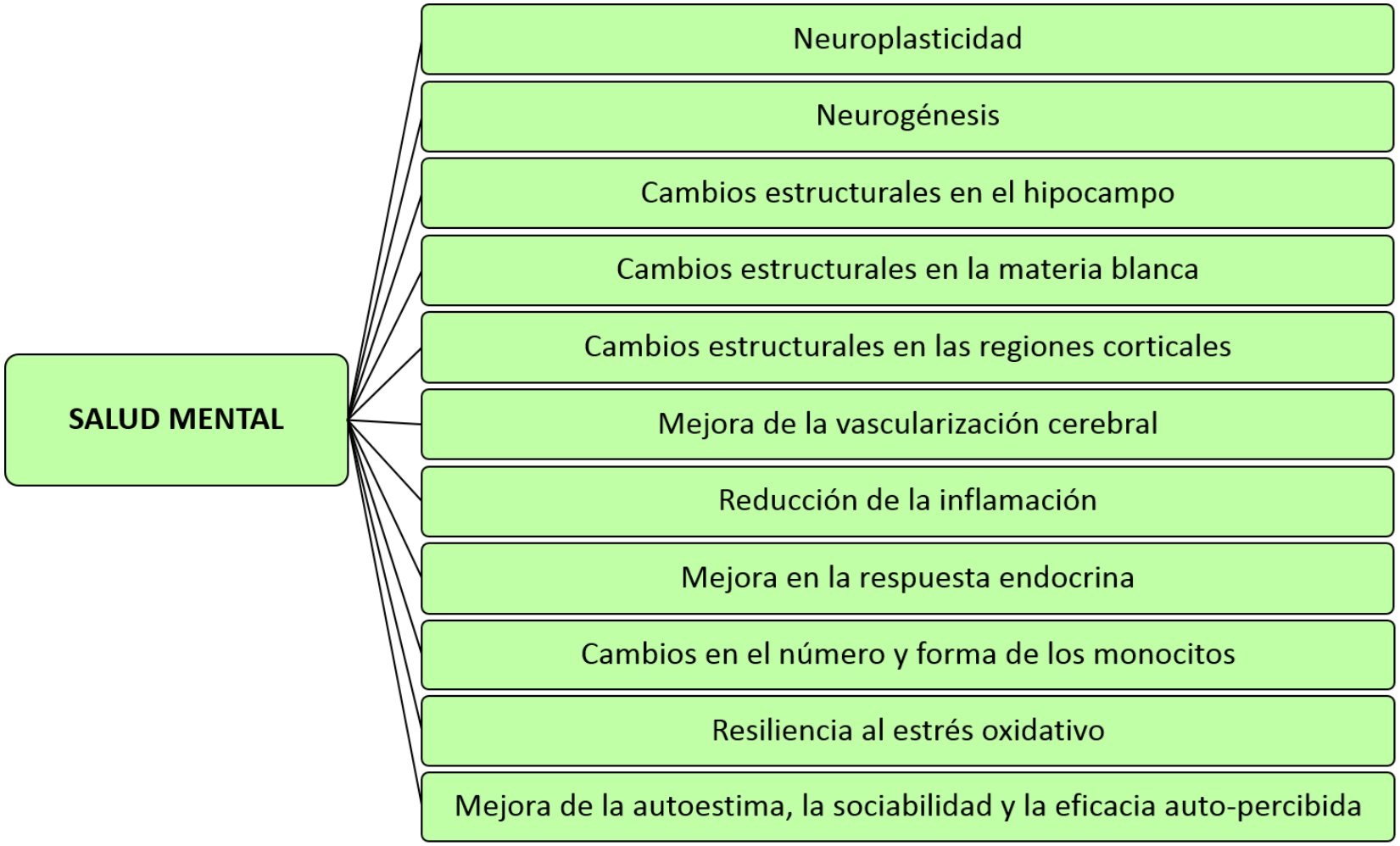
La depresión es una de las enfermedades mentales más extendidas, y una de las principales causas de años vividos con discapacidad en el mundo (43). Según estimaciones de la OMS, 322 millones de personas estaban viviendo con depresión en el año 2017, siendo las mujeres, las personas ancianas y los jóvenes las poblaciones más vulnerables (39). Por otro lado, la prevalencia de trastornos de ansiedad en el mundo ha sido estimada en 264 millones de personas, entre las cuales hay un porcentaje mayor de mujeres y de adultos jóvenes (39).

Según Kandola et al. (44) los beneficios antidepresivos de la AF provienen de diferentes vías; por un lado, de mecanismos biológicos tales como la neuroplasticidad, la cual resulta estimulada mediante la liberación de neurotrofinas, la neurogénesis, los cambios estructurales en el hipocampo, las regiones corticales y la materia blanca, y una mejora de la vascularización cerebral. Por otro lado, se ha observado una reducción de la inflamación a través de una reducción de los marcadores que favorecen la inflamación, un aumento de los marcadores y el tejido adiposo que reducen la inflamación y cambios en el número y la forma de los monocitos. Además, se produce una mejora en la respuesta endocrina, gracias a una mayor regulación del eje hipotalámico-hipofisario-adrenal, responsable de gestionar la respuesta al estrés, cambios

en la actividad del cortisol y, por último, un aumento de la resiliencia al estrés oxidativo. Según estos mismos autores, los efectos que la AF tiene sobre los síntomas depresivos también se relacionarían con mecanismos psicológicos y sociales tales como la mejora de la autoestima, la sociabilidad y la eficacia auto-percibida (44).

En los últimos años, diferentes líneas de investigación están desarrollando estudios en este ámbito, con un énfasis de los efectos de ejercicio físico específico en la salud mental. En concreto, la práctica de ejercicio interválico de alta intensidad (HIIT) ha mostrado mayores mejoras en sujetos con depresión en comparación con el entrenamiento de ejercicio continuo de intensidad moderada (45).

Figura 8. Beneficios de la actividad física en la depresión. Fuente: adaptado de *Physical activity and depression: Towards understanding the antidepressant mechanisms of physical activity, 2019.*



1.3 El absentismo laboral debido a enfermedad

El presente apartado tiene como finalidad aclarar y delimitar la diferente terminología relacionada con la variable dependiente principal objeto de estudio. Igualmente pretende informar acerca del estado de la cuestión en relación a los estudios previos que han abordado este tema desde diferentes perspectivas tales como la económica o la social. Por último, se presenta la evidencia relacionada con las asociaciones y los efectos observados de la AF sobre el absentismo laboral.

1.3.1 Conceptualización de absentismo laboral

El absentismo laboral es un fenómeno complejo, cuya definición depende en buena medida de la legislación laboral vigente en cada país y, en ocasiones, de los acuerdos propios alcanzados entre empresas y/o administraciones y trabajadores. Por este motivo, realizar estimaciones de cifras con relación a prevalencias y costes no siempre resulta sencillo. Es por ello que, para evitar confusiones, conviene aclarar los diferentes conceptos asociados al término absentismo laboral.

En primer lugar, conviene esclarecer el hecho de que, para que exista ALE, el sujeto tiene que estar previamente en situación laboral activa en un centro de trabajo, y no estar disfrutando de otro tipo de situaciones tales como excedencias o permisos. El motivo de ausencia al centro de trabajo debe ser la enfermedad y, en este sentido, no se contempla el disfrute de días festivos o ausencias para realizar otro tipo de tareas como revisiones médicas rutinarias, exámenes oficiales, tutorías con los profesores de los hijos en los centros educativos u otros menesteres. Según el VIII informe Adecco (46), el absentismo laboral registrado en España durante el año 2018 se debió a causas de diferente índole como incapacidad temporal (72%), permisos (e.g. maternidad) (19%), razones técnicas o económicas (1%), compensación de horas extras (1%) u otras causas (i.e. representación sindical, formación decidida por la empresa y ausencias injustificadas) (7%). De esta manera, en España, el concepto de ALE, está ligado al de incapacidad temporal del trabajador con motivo de dolencia y/o enfermedad.

La Fundación Europea para la Mejora de las Condiciones de Vida y de Trabajo (EUROFUND) definió el absentismo laboral como “incapacidad temporal, prolongada o permanente para trabajar como resultado de una enfermedad o dolencia” (47), delimitando su duración a las primeras 52 semanas, que es el periodo establecido por la mayoría de países de la Organización para la Cooperación y Desarrollo Económicos (OCDE) a partir del cual evaluar la incapacidad permanente del trabajador (48). Desde esta perspectiva, el absentismo laboral

estaría íntimamente relacionado con el de incapacidad temporal, y tendría un límite temporal a partir del cual pasaría a considerarse incapacidad permanente. En España existe la particularidad de que, una vez transcurridos los primeros doce meses, existe la posibilidad de un período prorrogable de seis meses, cuando se estima que el trabajador puede incorporarse a su puesto de trabajo. Dicha incapacidad temporal podrá venir originada como consecuencia de enfermedad común, enfermedad profesional o accidente y se gestiona a través del Instituto Nacional de la Seguridad Social (INSS); cuando la incapacidad temporal se prolonga durante más de doce o dieciocho meses, según el caso, puede derivar en una incapacidad permanente con pensión. Dicha pensión de incapacidad permanente podrá clasificarse como parcial, total, absoluta o gran invalidez, que implica la asistencia de un cuidador para las tareas más esenciales (49).

El ALE ha sido identificado como un factor de riesgo para las pensiones de incapacidad permanente (50), y un predictor para la mortalidad de los trabajadores (51). La media de los costes directos e indirectos estimada entre los países de la UE asciende a un 2,5% de media del producto interior bruto (PIB) (52).

Conviene diferenciar nítidamente el concepto de absentismo laboral de otros presentes en la literatura aneja, como el de limitaciones en la actividad cotidiana, el cual puede o no implicar restricciones parciales o totales de las actividades laborales (53). Un indicador común al objeto de estandarizar la medida de la incapacidad temporal es el de Años de Vida Ajustados por Discapacidad (AVAD), el cual ha servido como referencia para valorar las consecuencias de las enfermedades crónicas y comparar la carga de enfermedad entre diferentes regiones y países; dicha medida es interpretada como el número de años perdidos como consecuencia de enfermedad, discapacidad o muerte anticipada (43). El AVAD no debería confundirse con el ALE puesto que ambos se refieren a cuestiones diferentes, aunque puedan guardar cierta relación.

El tiempo de retorno al trabajo (i.e. tiempo transcurrido desde el inicio de la incapacidad temporal hasta el momento de la vuelta al trabajo) ha resultado objeto de estudio en diferentes investigaciones; su interés radica en el hecho de que una reducción de los tiempos de incapacidad conlleva ahorros en los costes derivados del pago del salario del trabajador, entre otros (54,55).

Otro término recurrente en los estudios con objetivo de valorar la productividad laboral es el presentismo (56). Instituciones como EUROFUND la definen como la práctica de ir a trabajar durante el curso de una enfermedad, con el consiguiente riesgo de una disminución del rendimiento en el trabajo (52). Se trata de un fenómeno de especial interés, cuyos costes se

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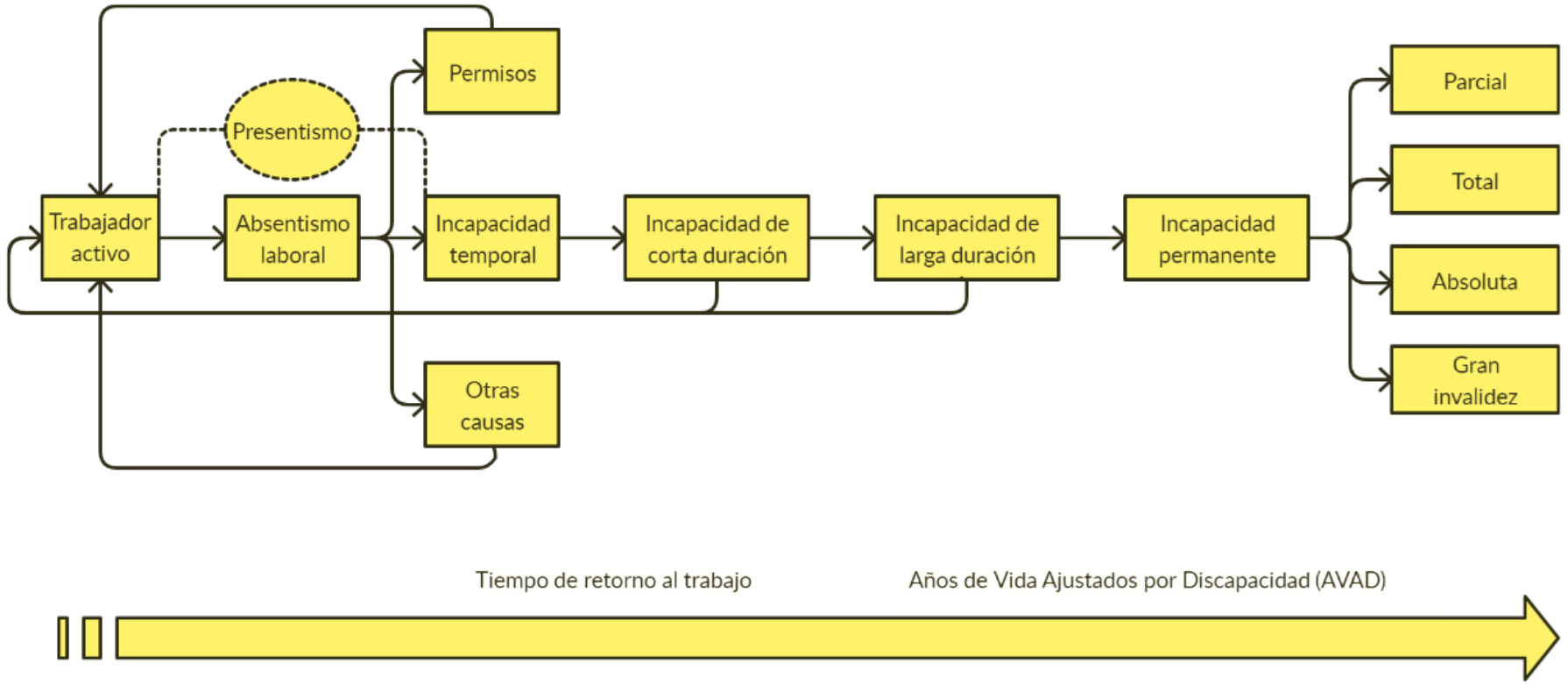
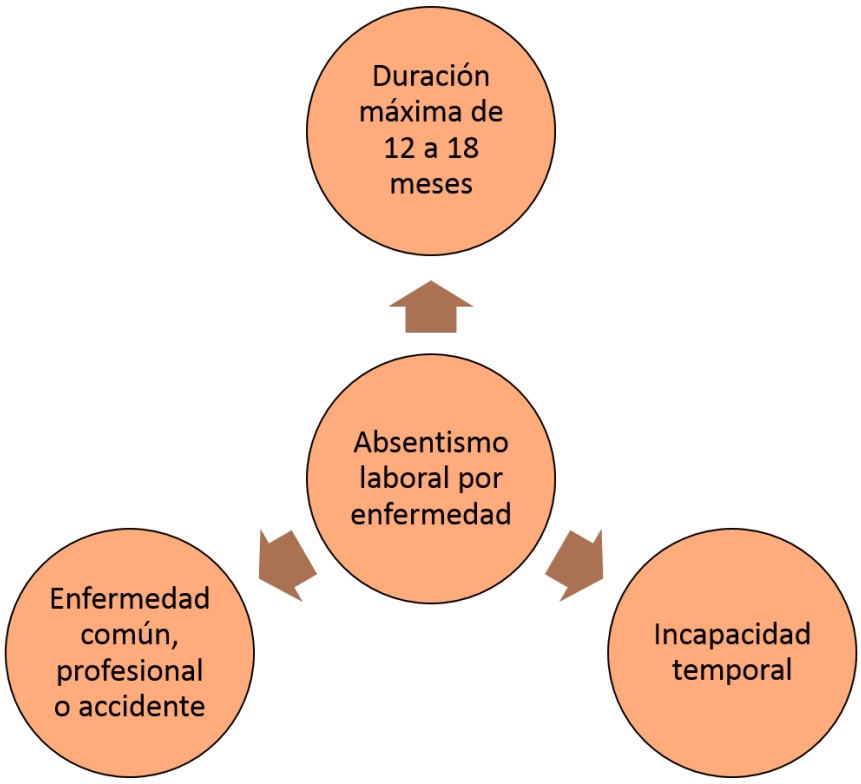
Figura 9. Absentismo laboral por enfermedad y relación con otros términos. Fuente: elaboración propia.



1.3.2 Tipos de absentismo laboral

Es posible identificar diferentes tipos de absentismo en función de criterios tales como la duración de la ausencia o el tipo de enfermedad que provoca la ausencia al puesto de trabajo. La revisión exhaustiva sobre absentismo laboral en diversas publicaciones académicas especializadas, presenta el criterio de la duración del periodo de ausencia como medición predominante de la variable ALE. Sin embargo, las unidades de medida temporal suelen diferir entre estudios, así el absentismo laboral debido a enfermedad ha sido valorado en días mensuales, anuales e, incluso, plurianuales (59–61). En cualquier caso, una de las unidades de medida más comunes del absentismo es la de días anuales. De esta manera, es posible distinguir entre ALE de corta duración y de larga duración, aunque, de nuevo, los puntos de corte para delimitar dichas categorías difieren entre los estudios consultados. Las investigaciones en las que el ALE es tratado como variable cuantitativa medida en horas o días facilitan el análisis comparado entre estudios, aunque las diferencias existentes entre las legislaciones laborales de cada país (i.e. duración de las jornadas laborales) necesitarían de una homogeneización previa. Éste es uno de los motivos por los cuáles existe tanta dificultad para la realización de metaanálisis teniendo al absentismo laboral como variable principal de estudio (62).

Figura 10. Características del absentismo laboral por enfermedad. Fuente: elaboración propia.



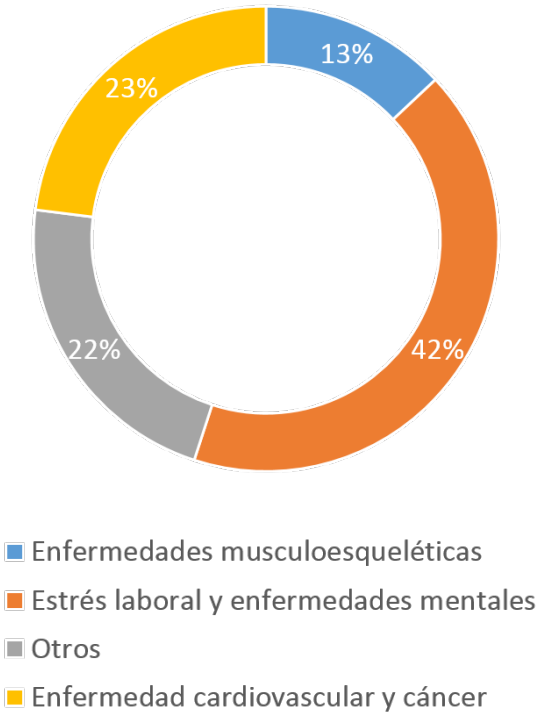
La literatura distingue un ALE de corta duración, comprendido en un rango que varía entre uno y catorce días consecutivos (59,63), y, por otro lado, un absentismo de larga duración que suele estar determinado por un tiempo mayor de dos semanas consecutivas (63,64), llegando a establecer algunos autores este punto de corte del absentismo laboral de larga duración en seis o más semanas consecutivas (65). Esta distinción resulta relevante en muchos casos puesto que, dependiendo de la duración de la ausencia y, en ocasiones, la causa que la ha motivado, será el empleador el que asuma una parte o la totalidad de los costes del trabajador (i.e. salario y cotizaciones) o la seguridad social (52). En España, el mayor número de ausencias al trabajo por incapacidad temporal debida a contingencias comunes son de corta duración, siendo los intervalos más comunes los de 1 a 3 días (12%) y 4 a 15 días (10%) (46).

En cuanto al origen de la causa que ha generado la incapacidad temporal, España tiene como referencia el Manual de Tiempos Óptimos de Incapacidad Temporal, editado por el INSS, y el cual ofrece el listado por tablas de un amplio rango de diagnósticos, agrupados por categorías, asociados a un código de Clasificación Internacional de Enfermedades (CIE), así como a un tiempo estándar de días de recuperación (66). La causa principal de incapacidad temporal a lo largo del año son las contingencias comunes (i.e. accidentes, enfermedades o dolencias no relacionadas con el trabajo), siendo la franja comprendida entre los 16 a los 24 años quien más la experimenta (46%), seguida de la franja de edad de 25 a 34 años (36%), mientras que menos de un 5% de los trabajadores españoles experimentó un episodio de incapacidad temporal durante el transcurso de 2018 (46).

La prevalencia de incapacidad temporal por contingencia común se ha observado más alta en mujeres que en hombres para toda la serie temporal comprendida entre los años 2009 y 2018; en concreto, en el año 2018, un 37% de mujeres experimentaron algún proceso de incapacidad temporal frente a un 26% de hombres (46). Valores más altos de ALE en mujeres han sido también observados en otros países europeos (67).

En general, la mayor parte de las investigaciones del ámbito de ciencias de la salud que ponen el foco en el ALE, están centradas en las enfermedades crónicas más prevalentes en poblaciones específicas de trabajadores (e.g. profesionales sanitarios, trabajadores de cadenas de montaje o administrativos) pertenecientes a determinadas regiones o países (68–72). El dolor crónico lumbar y cervical y los trastornos depresivos y de ansiedad representan cuatro de las condiciones más asociadas a incapacidad temporal en el ámbito laboral (73). Por este motivo, un número alto de investigaciones han puesto el foco en las enfermedades musculoesqueléticas y mentales en el entorno laboral (70,74–77).

Figura 11. Causas del absentismo laboral de larga duración por enfermedad en el Reino Unido (trabajadores manuales y no manuales). Fuente: adaptado de *Absence Management - Annual Survey Report*, *CIPD*, 2016.



1.3.3 Costes del absentismo laboral debido a enfermedad

Tomando la legislación laboral española como referencia, es posible distinguir dos tipos de incapacidad temporal; aquella causada por contingencias comunes (i.e. causas ajenas al desempeño laboral) o aquella causada por contingencias profesionales (i.e. derivadas del trabajo) (49). En el caso de esta última, el coste del salario del trabajador durante el periodo de inactividad corre íntegramente a cuenta del empleador, mientras que, si la causa de la incapacidad son contingencias comunes, los tres primeros días no se abonan al trabajador, del cuarto al quinceavo día la cuantía del salario correspondiente por incapacidad temporal lo abona el empleador, y, a partir del dieciseisavo día en adelante, será el INSS la que se haga cargo de sufragar dicho coste. En el caso de los trabajadores por cuenta propia, el coste del salario correspondiente a incapacidad temporal por contingencia común, será sufragado por el INSS a partir del cuarto día. Los convenios en vigor en cada sector, compañía o administración pueden modificar algunos aspectos de la norma siempre que estas sean para mejorar las condiciones del trabajador (49).

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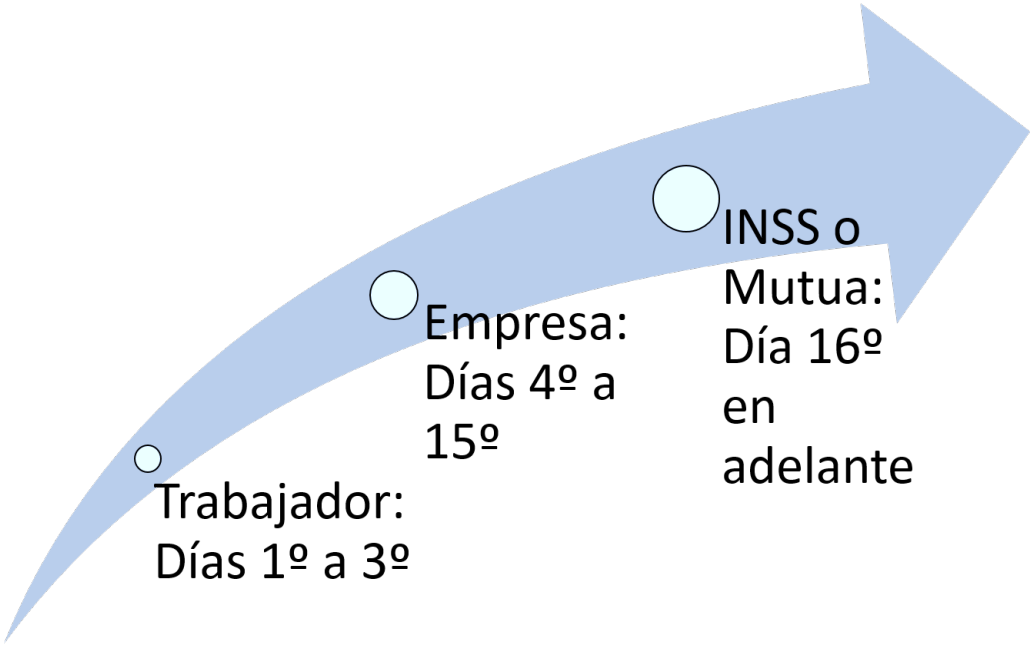

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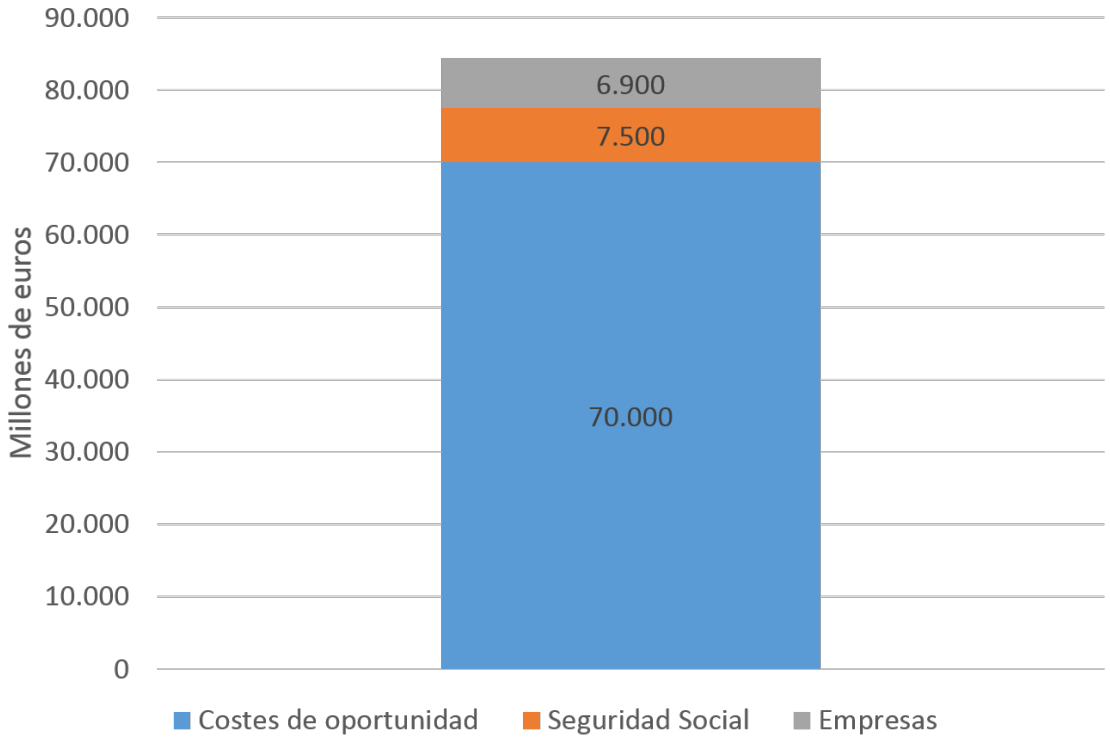
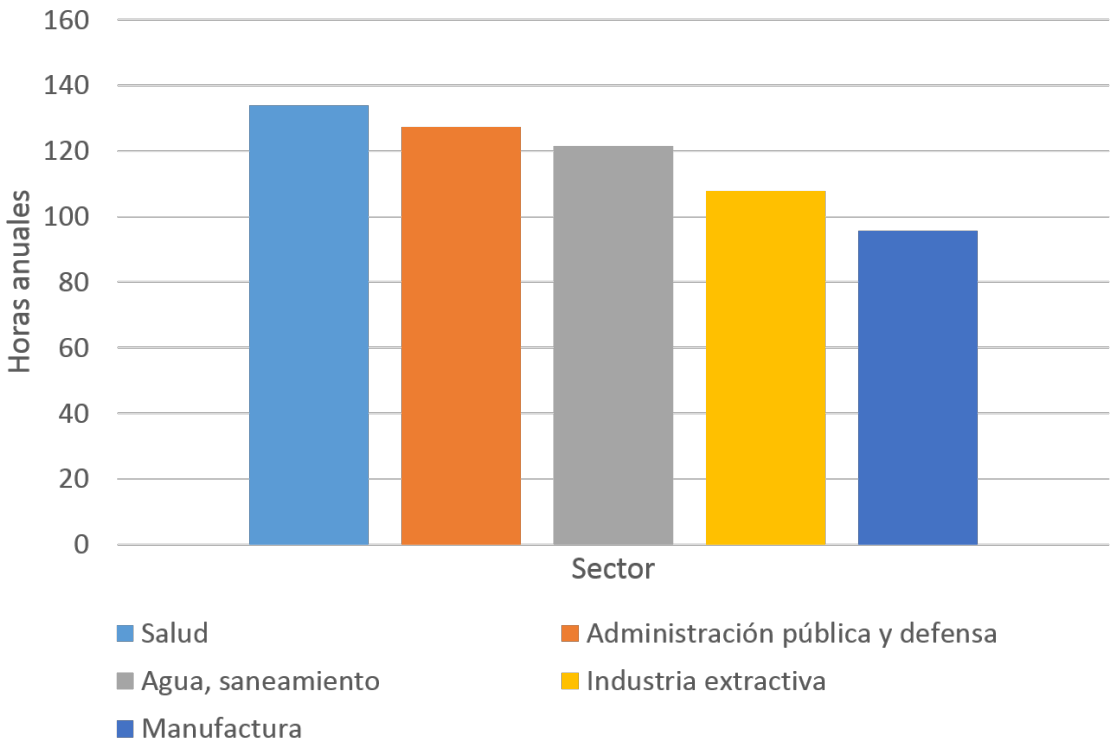
Figura 13. Costes del absentismo laboral por contingencias comunes en España en millones de euros. Fuente: adaptado de VIII Informe Adecco sobre absentismo, 2019.



El porcentaje de horas no trabajadas, en tendencia ascendente desde el año 2014, se ha estimado en poco más del 5% para el conjunto del estado español, mientras que la media del resto de países de la Unión Europea oscila entre el 3% y el 6% (52). En países como Japón se ha estimado el coste de los gastos médicos y farmacéuticos asociados al ALE en 520 dólares por persona y año, siendo los trastornos mentales y musculoesqueléticos los que más contribuyen a dicha cantidad (57). En la misma línea, el consumo de frutas y verduras y la práctica de AF han sido asociados de manera conjunta a menores costes directos de absentismo laboral de corta duración en trabajadores finlandeses, con un ahorro estimado de 620 euros por empleado en el transcurso de un periodo de cinco años (78).

El ámbito de los profesionales de la salud es el que alcanza un mayor número de horas de absentismo anual por trabajador en España (144 horas) (46), algo similar a lo que ocurre en otros países europeos donde también son profesionales sanitarios los que presentan las cifras más altas de ALE (79). Sin embargo, no se trata meramente de una cuestión económica, puesto que diferentes estudios han encontrado el ALE un predictor fiable de la mortalidad y del estado de salud (51,80,81).

Figura 14. Sectores con más horas anuales de incapacidad temporal por contingencias comunes en España. Fuente: adaptado de VIII Informe Adecco sobre absentismo, 2019.



1.4 Efectos de la actividad física sobre el absentismo laboral debido a enfermedad

El presente trabajo pretende poner el foco en aquellas enfermedades y condiciones crónicas como el dolor lumbar y cervical, la hipertensión, la depresión o la ansiedad, entre otras, señaladas por la literatura como las más prevalentes entre diferentes poblaciones de trabajadores (82,83). Además, las enfermedades crónicas constituyen un factor determinante para el ALE (84) y representan la principal causa de mortalidad en España (85).

Los efectos beneficiosos de la AF sobre la prevención y el tratamiento de la mayoría de las enfermedades crónicas son bien conocidos (29). En general, la exposición a mayores niveles de AF global ha sido asociada a menores niveles de ALE tanto de corta como de baja duración (59,86), y las intervenciones con programas de ejercicio orientados, de manera específica, al tratamiento de determinadas condiciones crónicas, han resultado efectivos (37,69). Se han sugerido asociaciones dosis-respuesta al producirse mayores reducciones de ALE con AF de intensidad vigorosa que con intensidad moderada (63). Sin embargo, algunos estudios han obtenido resultados poco concluyentes, especialmente cuando las valoraciones de los

programas de AF en el entorno laboral se realizaban desde el punto de vista del coste-efectividad económico (87).

El trabajo de Holterman et al. (88) ha abierto nuevas vías de investigación en el ámbito de la salud laboral en relación con la AF, identificando diferencias en su relación con el ALE en la denominada paradoja de la salud; dicho estudio observó mayores niveles de AF en el tiempo libre asociados a menores niveles de ALE. Por el contrario, se observaron mayores niveles de AF ocupacional (i.e. con motivo del desempeño del trabajo) asociados a mayores niveles de ALE. Esta distinción de la AF (i.e. si esta se realiza durante el tiempo libre o con motivo del trabajo) en su relación con el ALE ha sido corroborada en diversos estudios, algunos de los cuales han identificado los niveles altos de AF en el trabajo como un factor de riesgo importante para la mortalidad prematura en hombres o para padecer fibrilación atrial (89–91). En la misma línea, el esfuerzo físico percibido por trabajadores sanitarios, la mayoría de ellos mujeres, ha sido asociado a un incremento del riesgo de ALE de larga duración con motivo de enfermedad; es por ello que se han efectuado recomendaciones de ajustar la carga física de trabajo a las posibilidades individuales (92), aunque, de nuevo, altos niveles de AF en el tiempo libre han mostrado reducciones en el riesgo de ALE de larga duración en poblaciones consideradas de alto riesgo de ALE (93).

Con el fin de reducir el tiempo que los empleados pasan sentados, tanto en el trabajo como fuera del trabajo, se han llevado a cabo numerosas intervenciones; cambios físicos en el lugar de trabajo, cambios en las políticas de la empresa, provisión de información y acompañamiento del empleado, escritorios de altura regulable (i.e. posición sentado o posición en bipedestación), escritorios con tapiz rodante, pausas activas programadas, mensajes por ordenador, escaleras saludables o reuniones caminando, todos ellos con resultados poco concluyentes en cuanto al sedentarismo y el ALE debido a, entre otros aspectos, el tipo de diseño utilizado y el uso herramientas de medición poco fiables (94,95). Por el contrario, el diseño de lugares de trabajo que faciliten la movilidad del empleado sí que ha obtenido reducciones en el sedentarismo con empleados de oficina, sin pérdida de productividad, aunque sin efectos reportados sobre el ALE (96,97).

1.4.1 Los efectos de la actividad física sobre el absentismo laboral debido a enfermedad cardiovascular

La evidencia de que la práctica de AF reduce el riesgo de mortalidad debido a enfermedades cardiovasculares está bien documentada (16). Los niveles altos de AF moderada e intensa han mostrado modificar la asociación entre sedentarismo y mortalidad debida a enfermedades cardiovasculares y cáncer (31). Por ello, cabría esperar que la AF realizada durante el tiempo libre de los trabajadores contribuyera a reducir este riesgo, más aún cuando dicha asociación ha sido previamente observada en la literatura (91). La práctica de AF en el tiempo libre ha demostrado reducir los riesgos de sufrir enfermedad cardiovascular con poblaciones de sujetos en el último periodo de su vida laboral y sus primeros años de jubilación (98).

Fernández-Navarro et al. (42) observaron una asociación dosis-respuesta inversa de la AF en el tiempo libre (i.e. categorizada en cuatro niveles) con los niveles de prevalencia de hipercolesterolemia e hipertensión en una población representativa de sujetos de nacionalidad española, de tal manera que, aquellos practicantes que alcanzaron 150 minutos semanales de AF, se asociaron a menores niveles de prevalencia de las dos condiciones mencionadas. En la misma línea, se han observado reducciones significativas en el riesgo de ALE asociadas a mejoras en el perfil cardiovascular de una muestra amplia de trabajadores españoles (99).

1.4.2 Los efectos de la actividad física sobre el absentismo laboral debido a enfermedad musculoesquelética

Los trastornos musculoesqueléticos constituyen la primera causa del ALE en Europa (100). Tanto la AF en el tiempo libre como los programas de ejercicio físico, dirigidos a condiciones específicas de diversas poblaciones de trabajadores, han mostrado mejorías en la gestión del dolor muscular crónico y la reducción de los tiempos de retorno al trabajo (69,101,102).

El dolor experimentado en zonas como las manos, las muñecas o la zona lumbar constituyen el principal factor de riesgo de ALE de larga duración entre colectivos de trabajadores pertenecientes a sectores muy diversos tales como la construcción, el sector industrial, el sector servicios o el sector académico, entre otros (103). En menor medida, el dolor de espalda y de cuello también han sido observados factores de riesgo del ALE de larga duración entre colectivos más restringidos de trabajadores, con tareas más propias de trabajo administrativo, mientras que el dolor de rodillas no ha sido sugerido factor de riesgo (103).

En general, los niveles bajos de AF en el tiempo libre han sido asociados con niveles más altos de ALE musculoesquelética (9), aunque los programas de ejercicio físico específicos han demostrado mitigar el dolor experimentado en zonas concretas; en una revisión de estudios con metaanálisis sobre intervenciones con programas de ejercicio físico en el entorno laboral, se observaron reducciones significativas del dolor generalizado, el dolor de espalda y el dolor de cuello, pero no se encontró evidencia concluyente de su efectividad para reducir su dolor en otras zonas como los brazos, los codos, las muñecas, las manos, los dedos y la zona lumbar (104). En concreto, el entrenamiento de fuerza de alta intensidad ha sido relacionado con reducciones del dolor y de los síntomas derivados de diferentes trastornos musculoesqueléticos (70).

1.4.3 Los efectos de la actividad física sobre el absentismo laboral debido a enfermedad mental

Según la Agencia Europea para la Seguridad en el Trabajo (EU-OSHA), el número de trabajadores que experimentan estrés laboral, ansiedad, depresión o trastornos psicosociales representa un coste económico importante y una amenaza para la salud de los ambientes de trabajo; el coste anual de los trastornos mentales ha sido estimado en 240.000 millones de ,entre gastos directos e indirectos, en los países que forman parte de la UE, y una parte sustancial de esa cifra se corresponde con trastornos derivados del estrés laboral (105).

Niveles altos de estrés laboral han sido identificados como factor de riesgo del ALE de larga duración (106), y han sido asociados a una mayor prevalencia de enfermedades cardiovasculares tales como accidentes cerebrovasculares, cardiopatías isquémicas, enfermedades coronarias o fibrilaciones atriales (107–110). Algunos estudios han señalado un mayor riesgo de padecer enfermedad cardiovascular asociada a estrés laboral en hombres (110).

El estrés laboral es un fenómeno muy complejo, en el cual intervienen multitud de factores tales como características personales, las condiciones de trabajo y la cultura y la estructura de la organización, entre otros (105). Aun con todo, las intervenciones para mejorar la gestión del estrés laboral basadas en programas de AF han obtenido buenos resultados, especialmente cuando han sido promocionados desde las propias organizaciones, y han observado reducciones importantes en el ALE (111).

En general, la práctica de AF se ha asociado con una mejor salud mental (40). Sin embargo, se ha sugerido moderada evidencia de la efectividad de las intervenciones con AF, normalmente multicomponente (i.e. asociadas a la modificación de diferentes hábitos), dirigidas a mejorar la salud mental de los trabajadores y, entre otras consecuencias, el ALE derivado (112).

Por otro lado, una gestión inadecuada de los esfuerzos físicos y mentales en el trabajo podría aumentar el sedentarismo, el absentismo laboral y reducir la práctica de la AF en el tiempo libre (89,113–115).

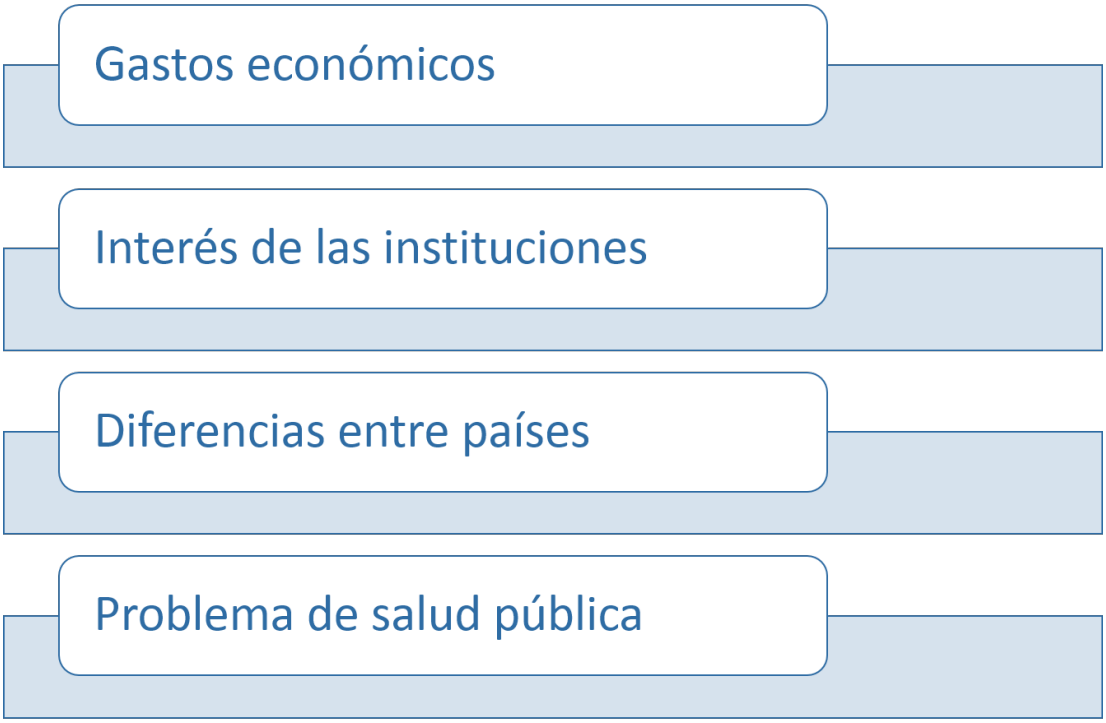
1.5. Motivos para el estudio de la relación de la actividad física y el absentismo laboral debido a enfermedad

El gasto derivado del ALE es alto, y existe interés por parte de las instituciones en abordar este problema de salud pública (116). A diferencia de otros países del norte de Europa, los estudios llevados a cabo en este ámbito con población española son pocos. Además, las diferencias en los estilos de vida, la cultura organizacional y la legislación laboral con respecto a aquellos países son evidentes y, potencialmente, influyentes en la relación entre las dos variables objeto de estudio (25,52,117).

Dado que existen diferencias en las características del trabajo y en los estilos de vida de trabajadores pertenecientes a sectores laborales distintos (118–121), parece necesario investigar acerca del tipo y cantidad de AF más adecuada para cada población. Por ejemplo, es posible que el ejercicio físico más recomendable para obreros de la construcción no sea el mismo que para trabajadores que desempeñan su labor en una oficina.

La evidencia existente al respecto de este tema proviene, en su mayoría, de estudios observacionales, y la estimación de variables implicadas se ha realizado a través de instrumentos heterogéneos, lo que dificulta su comparación, y, en buena medida, subjetivos y no validados (122). Este hecho ha contribuido a reafirmar la decisión de algunas empresas de no implementar programas de AF con sus trabajadores (123).

Figura 15. Motivos para investigar la relación entre actividad física y absentismo laboral por enfermedad. Fuente: elaboración propia.



2. Hipótesis

Una mayor exposición a AF está relacionada con menores niveles de ALE.

2. Hypotheses

Higher exposition to PA is related to lower SA.

3. Objetivos

Los objetivos generales de esta Tesis doctoral son los de, por un lado, valorar la relación entre AF y ALE en diferentes poblaciones de trabajadores y, por otro, examinar la asociación de la AF sobre la salud de los trabajadores.

Los objetivos específicos de los ocho artículos que conforman la presente Tesis Doctoral son:

Artículo I. Resumir el estado actual de la relación entre la AF y el ALE en la literatura.

Artículo II. Valorar la asociación entre AF y ALE en una población de trabajadores universitarios españoles.

Artículo III. Examinar la relación entre AF y estrés laboral en una población de trabajadores universitarios españoles.

Artículo IV. Investigar el riesgo de ALE en función del nivel de AF en una población general de trabajadores daneses.

Artículo V. Examinar la asociación entre AF en el tiempo libre y ALE en una población general de trabajadores españoles.

Artículo VI. Valorar el riesgo de ALE en función del nivel de AF en una población danesa de cuidadores de ancianos.

Artículo VII. Investigar la asociación entre AF en el tiempo libre y un conjunto de las enfermedades crónicas más comunes en trabajadores en una población general de trabajadores españoles.

Artículo VIII. Examinar la asociación entre AF en el tiempo libre y limitaciones de la actividad cotidiana en una población general de trabajadores españoles.

3. Aims

The general aims of this Thesis are, on the one hand, to assess the relationship between PA and SA among different populations of workers and, on the other hand, to examine the association of PA with the health of the workers.

The specific aims of the eight manuscripts which comprises the present Thesis are:

Manuscript I. To summarise the state of the art regarding the relationship between PA and SA in the literature

Manuscript II. To assess the association between PA and SA among a Spanish population of university workers.

Manuscript III. To examine the relationship between PA and work-related stress in a Spanish population of university workers.

Manuscript IV. To investigate the risk of SA regarding the level of leisure-time PA in a general population of Danish workers.

Manuscript V. To examine the association between PA during leisure and SA in a general population of Spanish workers.

Manuscript VI. To assess the risk of SA regarding the level of leisure-time PA in a population of Danish eldercare workers.

Manuscript VII. To investigate the association between leisure-time PA and a set of the most common chronic diseases among the workforce in a general population of Spanish workers.

Manuscript VIII. To examine the association between leisure-time PA and usual activity limitations among a general population of Spanish workers.

4. Material y métodos

En este apartado se describe la metodología general utilizada en el proyecto de investigación *Physical activity influence in absenteeism of Zaragoza university employees*, al cual está vinculado la presente Tesis Doctoral. La metodología específica puede leerse en el apartado correspondiente en cada uno de los artículos.

4.1 Comité de ética

Los estudios que componen la presente Tesis Doctoral se efectuaron siguiendo las indicaciones de la Declaración de Helsinki de 1975 (revisada en la 64º Asamblea General en Fortaleza, Brasil, en 2013) de Principios Éticos para las Investigaciones Médicas en Seres Humanos.

El proyecto de investigación vinculado a esta Tesis Doctoral se desarrolló de acuerdo con la legislación española (Ley 14/2007, de 3 de julio, de Investigación Biomédica) y danesa (Danish Code for Research Integrity, December 2014) vigentes, y fue evaluado por el Comité de Ética de la Investigación de la Comunidad Autónoma de Aragón (CEICA) en reunión celebrada el día 14 de febrero de 2018, Acta Nº 3/2018, con dictamen favorable y código de identificación (PI18/027) (Anexo I).

A pesar de que la legislación española y danesa no obligan a someter los estudios basados en encuestas y registros a comités éticos de investigación, los participantes de los estudios fueron informados de sus derechos y del fin de las encuestas y decidieron participar en las mismas de manera voluntaria. Los datos de todos los estudios fueron anonimizados y se trataron bajo la más estricta confidencialidad, de acuerdo con la ley vigente al respecto (Ley Orgánica 3/2018, de 5 de diciembre, de Protección de Datos Personales y garantía de los derechos digitales).

Antes del comienzo del proyecto fueron celebradas diferentes reuniones para informar del mismo a las partes implicadas y solicitar su colaboración (Gerencia, Prevención de Riesgos Laborales, Servicios de Vigilancia de la Salud y Servicios de Prevención de la Mutua de Accidentes de Zaragoza), a la cual se prestaron de manera desinteresada.

4.2 Diseño del proyecto

El diseño de este proyecto está basado en estudios de naturaleza observacional, los cuales incluyen un periodo de recogida de datos que comprendió las fechas de enero de 2017 a diciembre de 2018 inclusive, en diferentes centros médicos del Servicio de Prevención de la Mutua de Accidentes de Zaragoza. Por otro lado, se han extraído datos de bases de datos públicas derivadas de la Encuesta Nacional de Salud en España (ENSE) a través de la página web del Ministerio de Sanidad, Consumo y Bienestar Social, de la base de datos del *Danish Work Environment Cohort Study* (DWECS) y del registro *Danish Register for Evaluation of Marginalization* (DREAM) en sus diferentes ediciones, con la autorización del Ministerio de Empleo de Dinamarca.

4.3 Muestras

El criterio de inclusión principal para las muestras de los diferentes estudios que componen esta Tesis Doctoral fue el de ser trabajador, si bien cada estudio tiene sus propias especificidades, como puede ser la del país donde se trabaja (e.g. España o Dinamarca) o el colectivo de trabajadores concreto al que se pertenece (e.g. trabajadores universitarios o cuidadores de personas mayores). Como algunos de los criterios de exclusión más relevantes para determinados estudios, cabe destacar el de no ser considerado previamente sano (i.e. haber padecido alguna de las condiciones enumeradas en el apartado de método del estudio), como sucede en el caso de los cuidadores de personas ancianas, o no pertenecer a sectores laborales caracterizados por esfuerzos físicos exigentes, como en el caso de la revisión sistemática. En total, más de cincuenta mil participantes han formado parte de alguna de las muestras examinadas en los estudios que forman parte de este proyecto. Los participantes con valores perdidos en alguna de las variables objeto de estudio fueron excluidos de los análisis.

El artículo I es una revisión sistemática, en la cual se incluyen muestras de trabajadores de diferentes sectores laborales, provenientes tanto de ensayos clínicos como de estudios observacionales.

Los artículos II y III son estudios observacionales con diseño transversal que analizan una muestra de trabajadores universitarios distinta cada uno (n=1025 y n=757).

El artículo IV es un estudio observacional con diseño longitudinal de tipo cohorte prospectivo, en el cual se efectúa el seguimiento de una muestra general de trabajadores daneses (n=10427).

El artículo V es un estudio observacional con diseño transversal que investiga una muestra general de trabajadores españoles (n=9512).

El artículo VI es un estudio observacional con diseño longitudinal de tipo cohorte prospectivo, en el cual se realiza el seguimiento de una muestra específica de cuidadores de personas ancianas (i.e. mujeres sanas) (n=4699).

Los artículos VII y VIII son estudios observacionales de tipo transversal que examinan una muestra general de trabajadores españoles (n=9885).

4.4 Herramientas de valoración

Las herramientas de valoración de las variables implicadas en los diferentes artículos que componen esta Tesis Doctoral son cuestionarios. Por razones administrativas y de confidencialidad, la recogida de datos no siempre pudo realizarse de la manera deseada (e.g. la edad de los trabajadores universitarios tuvo que recogerse categorizada para garantizar el anonimato de los participantes). Además, una parte de los datos se recogió a través de preguntas previamente no validadas (e.g. estrés laboral), aunque con un historial previo de uso en ediciones anteriores o, como en el caso de los estudios llevados a cabo con trabajadores daneses, bases de datos y registros de instituciones públicas, considerados de alta fiabilidad. Dada la naturaleza subjetiva de los datos, todos los artículos incluyen un comentario al respecto en la sección o párrafo relativo a las limitaciones del estudio. La tabla I resume cuáles fueron los cuestionarios y/o preguntas de valoración utilizados para cada uno de los artículos.

Tabla 2. Valoraciones realizadas en los artículos de la presente Tesis Doctoral.

Valoración	Método	Origen	Informante	Validación	Artículos
Absentismo laboral debido a enfermedad	Pregunta con respuesta numérica (días/año)	Cuestionario de revisión médica	Trabajador	No	II, III
	Pregunta dicotómica sobre absentismo anual (sí/no)	European Health Interview Survey (EHIS)	Trabajador	No	V
	Registro de la compensación económica vinculada al absentismo (6 semanas consecutivas)	Danish Register for Evaluation of Marginalization (DREAM)	Ministerio de Empleo de Dinamarca	Sí, estudios previos	IV, VI
Actividad física general	Physical Activity Vital Sign (PAVS) (minutos/semana)	Cuestionario de revisión médica	Trabajador	Sí, estudios previos	II, III
Actividad física en el tiempo libre	International Physical Activity Questionnaire (IPAQ) (METs)	Cuestionario de revision médica	Trabajador	Sí, estudios previos	II, VII, VIII
	Pregunta categórica con 3 opciones (baja, moderada, alta)	Danish Work Environment Cohort Study (DWECS)	Trabajador	No	IV
	Pregunta categórica con 4 opciones (nada, baja, media, alta)	Social- og sundhedsuddannelse (SOSU) questionnaire	Trabajador	No	VI
	Pregunta categórica con 4 opciones (sedentaria, ligera, moderada, vigorosa)	European Health Interview Survey (EHIS)	Trabajador	No	V
Estrés laboral	Pregunta con respuesta numérica ordinal (1-10)	Cuestionario de revisión médica	Trabajador	No	III
Enfermedades crónicas	Pregunta dicotómica (sí/no)	Encuesta Nacional de Salud en España (ENSE)	Trabajador	No	VII
Limitaciones de la actividad cotidiana	Pregunta dicotómica (sí/no)	Encuesta Nacional de Salud en España (ENSE)	Trabajador	No	VIII

4.4.1 Valoración de la actividad física

En esta Tesis Doctoral, la AF ha sido evaluada, dependiendo del diseño del estudio, como exposición o como factor de riesgo. Su valoración se ha realizado de manera subjetiva, mediante preguntas y/o cuestionarios completados por diferentes muestras de trabajadores.

Es posible distinguir entre aquellas preguntas y cuestionarios utilizados que estaban previamente validados y aquellos que no lo estaban. Entre los primeros se ubica la pregunta referida a la versión corta de *Physical Activity Vital Sign* (PAVS) (124), incluida en los cuestionarios de las revisiones médicas. La herramienta PAVS está vinculada al desarrollo de la iniciativa *Exercise is Medicine* (EIM) del ACSM, y su uso se ha extendido entre las revisiones médicas rutinarias de ciertas compañías médicas norteamericanas (125). En este mismo conjunto de herramientas validadas se incluye el *International Physical Activity Questionnaire* (IPAQ), cuyo uso está ampliamente extendido en el ámbito de la investigación (20). Una de las diferencias entre ambas herramientas radica en el hecho de que la primera valora la actividad física en global, sin discriminar en qué momento se ha realizado, y el IPAQ tiene como fin valorar la actividad física llevada a cabo en el transcurso del tiempo libre.

La finalidad de la herramienta PAVS es estimar los minutos de AF en una semana típica. Consiste en dos preguntas acerca de, por un lado, el número de días en los que el sujeto realiza actividad física de manera habitual y, por otro lado, el número habitual de minutos que transcurren realizando actividad física en dichos días. De esta manera, los sujetos pueden seleccionar entre 0,1,2,3,4,5,6 o 7 días en la primera pregunta y 10,20,30,40,50,60,90 o 150 o más minutos en la segunda pregunta (Anexo III). La versión corta de PAVS no discrimina entre AF moderada y vigorosa, y ha sido comparada con acelerometría, mostrando valores moderados de concordancia entre trabajadores administrativos (Cohen´s κ=0.46, P<0.001) (126). Puesto que no existía una versión española de PAVS, se realizó la traducción del inglés al español de la versión original corta de la herramienta. El cuestionario PAVS ha mostrado correlación inversa con el índice de masa corporal (IMC) (124).

Por otro lado, la versión corta del cuestionario IPAQ en español estima la frecuencia de AF durante el tiempo libre en días por semana y horas y minutos por día; discrimina según su nivel de intensidad (moderada y vigorosa), el tiempo que se empleó caminando (días, horas y minutos), así como el tiempo sentado (horas y minutos por día). Todas las preguntas están referidas a la actividad llevada a cabo durante los últimos siete días (Anexo III). Según las instrucciones del cuestionario IPAQ, la estimación final de la actividad física en el tiempo libre se realiza en MET a través de la suma de todos los apartados mencionados (i.e. actividad física

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de pagos con motivo de la situación de incapacidad temporal del trabajador alcanzaba las tres o las seis semanas consecutivas, según el estudio, se consideraba un registro válido de ALE. La duración del ALE de larga duración se estableció en función de la legislación vigente en el momento del seguimiento (i.e. el número de semanas a partir de las cuales el gobierno danés se hacía cargo del pago del trabajador en situación de incapacidad temporal).

4.4.3 Otros datos

Además de las ya mencionadas, otras variables de interés fueron recogidas en los estudios que componen esta Tesis Doctoral. En la mayoría de los casos se utilizaron como variables de control, dada la posibilidad de que actuaran, según la literatura consultada, como factores de confusión.

4.4.3.1 Estrés laboral

El estrés laboral fue utilizado como variable dependiente en uno de los estudios realizados con una muestra de trabajadores universitarios. Se estimó con una pregunta con escala graduada de 1 a 10 puntos, representando 1 la opción de "poco estrés" y 10 la opción de "mucho estrés". Aunque dicha pregunta no fue validada, fue incluida en todas las ediciones anteriores de los cuestionarios de las revisiones médicas a petición expresa de los servicios médicos. Estudios previos han mostrado validez de contenido, criterio y constructo en la valoración del estrés laboral con este tipo de preguntas (132).

4.4.3.2 Enfermedades crónicas

Dependiendo del estudio, las enfermedades crónicas fueron consideradas como variable dependiente o como variable de control. En el primer caso, la información fue extraída de la base de datos correspondiente a la edición 2017 de ENSE, que se registró tras realizar la siguiente pregunta a los participantes: "¿Ha padecido dolor crónico (lumbar) en los últimos doce meses? (133). Los participantes que contestaron "sí" fueron considerados como afectados por dicha enfermedad o condición crónica en el citado periodo. El mismo procedimiento fue usado para valorar la prevalencia del resto de enfermedades y condiciones crónicas seleccionadas (i.e. dolor cervical crónico, hipertensión, diabetes, depresión y ansiedad) por encontrarse entre las más comunes en poblaciones generales de trabajadores (82,84,103). La respuesta afirmativa a una o más de estas preguntas fue la condición de inclusión en el grupo de trabajadores con enfermedades crónicas.

Cuando las enfermedades crónicas fueron tratadas como variable de control fueron valoradas a través de esta misma pregunta u otra de similares características. Ambas preguntas han sido utilizadas para valorar la prevalencia de enfermedades crónicas en estudios previos (65,85).

4.4.3.3 Limitaciones en la actividad cotidiana

Las limitaciones de la actividad cotidiana, variable dependiente de uno de los estudios, fue estimada a través de pregunta incluida en el cuestionario ENSE en el apartado relativo a restricciones de la actividad: "Durante las últimas dos semanas, ¿ha tenido que reducir o limitar sus actividades habituales al menos la mitad de un día, por alguno o varios dolores o síntomas?" (133). Los participantes que contestaron afirmativamente a esta pregunta fueron agrupados en la categoría de trabajadores que habían experimentado dichas limitaciones.

4.4.3.4 Ambiente laboral

El ambiente laboral ha sido asociado al ALE (i.e peor ambiente de trabajo se asoció con mayor ALE) (134), por lo que fue considerado variable de control en los estudios llevados a cabo con muestras de trabajadores daneses. Su medición se realizó a través del *Copenhagen Psicosocial Questionnaire* (135), una herramienta validada de probada fiabilidad para medir el ambiente de trabajo (136).

4.4.3.5 Índice de Masa Corporal

El Índice de Masa Corporal (IMC) se obtuvo de manera indirecta a través de la información que los trabajadores proporcionaron sobre su peso y su talla en los cuestionarios. Esta variable de control fue estimada debido a las asociaciones entre sobrepeso y absentismo laboral con motivo de enfermedad detectadas en la literatura, a las que también hubo que sumar la observación de asociaciones dosis-respuesta entre niveles de actividad física e IMC (9,137). Así, la variable IMC derivó de las variables peso y talla (i.e. kilogramos de peso divididos por la altura en metros cuadrados) y los participantes fueron agrupados en categorías de acuerdo con la clasificación de la OMS: IMC ≥30 kg/m^2 (obeso), sobrepeso (25-29.9 kg/m^2), normal (18.5-25 kg/m^2) y bajo peso (<18.5 kg/m^2) (138).

4.4.3.6 Formación académica

El número de años de permanencia en el sistema educativo ha sido asociado a mayores niveles de ALE (i.e. menor número de años estudiando se asoció a mayor ALE) y a niveles de AF

(i.e. mayor nivel académico se asoció a mayor nivel de AF en el tiempo libre) (84,139). Por ello se utilizó como variable de control en los estudios llevados a cabo con muestras generales de trabajadores españoles y daneses, así como cuidadores daneses de personas ancianas. Los datos sobre formación académica fueron estimados a través de las preguntas que completaron los trabajadores españoles referidas a su nivel educativo (i.e. nivel más alto de estudios completados) y los cuidadores de ancianos daneses (i.e. diferente categoría profesional) en sus respectivos cuestionarios.

4.4.3.7 Consumo de tabaco

Los estilos de vida constituyen un factor de riesgo para el ALE, y el consumo de tabaco ha sido sugerido como uno de los más perjudiciales (9,140). Además, el hábito de fumar también ha sido asociado a inactividad física (141), por lo que fue controlado en la asociación entre AF y ALE. Su estimación se realizó a través de preguntas relativas al consumo de tabaco incluidas en los cuestionarios.

4.4.3.8 Tipo de trabajo

Otra de las variables controladas en los estudios fue la del tipo de trabajo desempeñado por el participante. Diferentes tipos de trabajo han sido asociados a diferentes niveles de ALE y a diferentes niveles de AF, por lo que el control de esta variable fue considerado relevante (142,143). Los cuestionarios de la edición 2017 del ENSE incluían una pregunta de opción múltiple para señalar el tipo de trabajo que estaba desempeñando el trabajador en el momento de realización de la encuesta; las ciento sesenta y ocho opciones ofrecidas estaban basadas en la Clasificación Nacional de Ocupaciones (CNO), la cual agrupa todos los trabajos en torno a seis grandes categorías basadas, entre otros criterios, en el nivel de cualificación y de especialización (144). En el caso de los trabajadores daneses, la agrupación del tipo de trabajo se realizó en base a su propia clasificación nacional, de la cual se vieron representadas ochenta y seis categorías diferentes (e.g. reponedores de almacén, administrativos, directivos y autónomos, entre otras categorías).

4.5 Análisis estadísticos

En este apartado se resumen las principales pruebas estadísticas efectuadas en los estudios que componen esta Tesis Doctoral. Un mayor detalle de las mismas puede ser encontrado en el apartado correspondiente de metodología de cada uno de los estudios.

Los análisis estadísticos fueron realizados a través de los paquetes informáticos *Statistical Package for Social Sciences* (SPSS) versión 22.0 para Windows (SPSS Inc., Chicago, IL, USA) y *Statystical Analysis Software* (SAS) en su versión 9.4 para Windows (SAS Institute, Cary, North Carolina, USA). El procedimiento habitual fue el de, en primer lugar, realizar un análisis descriptivo de las variables para, a continuación, efectuar un estudio de la normalidad en las variables continuas a través del test de *Kolmogorov-Smirnov*. Si la distribución de la variable resultaba normal, se iniciaba el análisis de la asociación entre la variable independiente (e.g. actividad física) y la dependiente (e.g. absentismo laboral debido a enfermedad), ajustada por potenciales factores de confusión (e.g. tipo de trabajo).

Cuando la variable dependiente era numérica (i.e. días anuales de absentismo laboral debido a enfermedad) y la independiente nominal, se utilizó una prueba de regresión lineal múltiple ajustada por posibles variables de confusión. Este procedimiento se realizó con el fin de examinar la asociación entre las dos variables estudiadas. En los casos en los que las dos variables principales eran nominales, el análisis de la asociación se efectuó mediante regresión logística múltiple ajustada por factores de confusión. Ambas pruebas de regresión fueron empleadas en los estudios de diseño transversal.

En los estudios basados en un diseño de cohorte prospectivo, se analizó el riesgo de absentismo laboral de larga duración debido a enfermedad en función de los niveles de actividad física. Para ello, se utilizó una regresión de Cox ajustada por posibles factores de confusión.

El tamaño de la muestra fue estimado a través del paquete informático *EpiDat,* versión 4.2 para Windows (Consejería de Sanidad, Xunta de Galicia, Galicia, España) para un nivel de confianza bilateral del 95%, una proporción esperada del 20%. El resultado obtenido fue de un tamaño de muestra de 618 participantes para los estudios transversales llevados a cabo con las muestras de trabajadores universitarios y de 1537 participantes para los estudios llevados a cabo con muestras provenientes de la población general de trabajadores españoles. En el primer caso, el nivel de precisión absoluta fue establecido en el 3% y, en el segundo caso, se fijó en el 2%.

Para los estudios de cohortes llevados a cabo con trabajadores daneses, el cálculo del tamaño de la muestra se estimó para un nivel de confianza del 95%, un 80% de potencia estadística, un riesgo en expuestos del 9% (i.e. menores niveles de actividad física) y un riesgo relativo de 1,5. El resultado obtenido para dichas condiciones fue de 2418 participantes (i.e. 50% para cada uno de los dos grupos).

El nivel de significación estadístico fijado para todos los estudios fue de $p<.05$.

5. Resultados y discusión

El objetivo principal de esta Tesis Doctoral era examinar la relación entre AF y ALE. Los resultados de los estudios realizados sugieren una asociación entre mayores niveles de AF, especialmente la que se realiza en el tiempo libre, y menores niveles de ALE. En la misma línea, los resultados de los estudios transversales sugieren asociación inversa entre mayores niveles de actividad física y menor prevalencia de estrés laboral, limitación de actividades cotidianas y ciertas enfermedades y condiciones crónicas en diferentes muestras de trabajadores. El tipo de diseño utilizado en estos estudios no permite confirmar la existencia de una relación causal entre las variables objeto de estudio.

Un mayor grado de evidencia de esta asociación entre AF durante el tiempo libre y ALE, fue detectado a través de los estudios de cohortes llevados a cabo con trabajadores daneses, donde mayores niveles de actividad física en el tiempo libre redujeron el riesgo de absentismo laboral de larga duración debido a enfermedad. Dicha reducción del riesgo se observó particularmente significativa entre determinados subgrupos de trabajadores.

Los resultados y la discusión de esta Tesis Doctoral se presentan como artículos científicos, con el mismo formato en el que se han sometido, aceptado o publicado en las diferentes publicaciones académicas.

5. Results and discussion

The main aim of this Thesis was to examine the relationship between physical activity and sickness absence. The results of the conducted studies suggest an association between higher levels of PA, especially which performed during leisure, and lower levels of SA. In a similar vein, the results of the cross-sectional studies suggest an inverse association between higher levels of PA and lower prevalence of work-related stress, usual activity limitations, and several chronic diseases and conditions among different samples of workers.

A higher level of evidence of the association between PA during leisure and SA was identified through the cohort studies carried out with Danish workers, in which higher levels of PA during leisure reduced the risk of long-term SA. That risk reduction was observed as particularly significant among certain subgroups of workers.

Results and discussion of the present Thesis are shown as scientific papers, in accordance with the journal formats in which they were submitted, accepted or published.

ARTÍCULO I

SYSTEMATIC REVIEW

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PHYSICAL ACTIVITY AS A TOOL TO REDUCE DISEASE-RELATED WORK ABSENTEEISM IN SEDENTARY EMPLOYEES: A SYSTEMATIC REVIEW

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The authors declare that there was no conflict of interests.

ABSTRACT

Background: Physical Activity (PA) programs have been suggested to lower absenteeism due to illness in sedentary employees. This review examines available scientific literature in order to study PA effects in workplace absenteeism, considering the program design.

Methods: A search through 4 databases (Medline, Sportdiscus, Web of Science and Embase), from inception to December 2017, was conducted to identify control intervention and observational studies about PA and absenteeism published in either English or Spanish language using PRISMA procedures.

Results: A total of 10 published studies between 1981 and 2017 met the inclusion criteria. Evidence from the review suggests that PA is effective in reducing illness-related absence. Likelihood of being off from the workplace reported with sedentary workers reach more probabilities when compared with exercisers.

Conclusions: General PA is considered paramount in order to lower employees' absenteeism, which could be more related to vigorous training. However, there is a lack of rigorous and more specific studies about the issue. More focused on the PA effect on absenteeism, adjusted by intervention variables, research would be desirable.

Key words: Physical activity, Absenteeism, Sick leave, Days off from work, Employees.

RESUMEN

La actividad física como herramienta para reducir el absentismo laboral debido a enfermedad en trabajadores sedentarios: una revisión sistemática

Fundamentos: Se ha sugerido que los programas de actividad física (AF) podrían reducir el absentismo laboral por motivos de enfermedad en trabajadores sedentarios. Esta revisión examina la evidencia científica disponible para estudiar los efectos de la AF sobre el absentismo laboral teniendo en consideración el diseño del programa de AF.

Métodos: Se realizó una búsqueda bibliográfica en 4 bases de datos (Medline, Sportdiscus, Web of Science y Embase) de ensayos clínicos y estudios observacionales publicados sobre AF y absentismo laboral, en inglés y en español, desde el inicio de indización hasta diciembre de 2017, utilizando la metodología PRISMA.

Resultados: Un total de 10 estudios publicados cumplieron con los criterios de elegibilidad establecidos. Las evidencias encontradas en la revisión sugieren que la AF es efectiva como medida para reducir el absentismo laboral por motivos de enfermedad. En general, los estudios observan mayores probabilidades de ausentarse del trabajo en trabajadores sedentarios que en los físicamente activos.

Conclusiones: La AF en general parece disminuir el absentismo laboral. En concreto, la AF vigorosa podría obtener mejores resultados que la realizada a intensidad moderada, aunque faltan estudios de intervención más rigurosos y específicos, con un mayor control sobre las variables de intervención.

Palabras clave: Actividad física, Absentismo laboral, Trabajadores, Absentismo debido a enfermedad.

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INTRODUCTION

The World Health Organization ranks physical inactivity as the fourth mortality risk factor worldwide[1]; a new way of life that is being set inside and outside the workplace[2]. The development of the society, and particularly the labor model in the developed countries, presents a clear trend to reduce physical activity (PA)-related caloric expenditure, which favors the occurrence of diseases related to sedentary lifestyle[3,4] and it has been associated with increased mortality[5]. Therefore, physical inactivity represents a relevant risk factor for public health, having been associated to the major non-communicable diseases such as cardiovascular diseases, type 2 diabetes[6] and 13 types of cancer[7]. Much time lying or sitting, with little caloric expenditure has been linked with obesity, type 2 diabetes, cardiovascular diseases and premature mortality, especially when inactivity is not broken with active pauses[8,9]. Hence, PA promotion, where labor workday takes too much physical inactivity, is paramount for the health of the workers and the sickness absence for the companies.

Several specific studies focused on the results of PA interventions at the workplace have shown that sickness absenteeism is often reduced[10,11,12]. However, other studies do not have confirmed those results[13,14,15] or show moderate evidence[16]. Therefore, a more detailed analysis of sickness absenteeism and its relationship with PA is required. Besides, it also seems necessary to discriminate studies with workers who perform sedentary tasks most of the time from those who do not, and to take into account whether PA is done inside or outside the workplace.

Although there is evidence of the positive effects of PA over health and work performance[4,17,18,19,20], a recent report from the National Occupational Safety Institute states that in Spain, unlike other European countries, PA promotion in the workplace is still novel as only 6% of people doing PA do it at the workplace. This fact could be due to several causes, including a lack of information about the return of investment or figures on productivity or sickness absence related to PA promotion strategies[21].

As regards economic impact cost of physical inactivity with employees, the figures of the Adecco report on absenteeism[22], concerning 2014 data on Spain, show first direct days off payment cost of 4,768 million euros to the national health system and 4,503 million euros to the companies.

Also, sedentary lifestyle cost across European Union is estimated in more than annually 80 billion euros adding both direct and indirect cost derived from medical care, medicines, functional limitations, disability and loss of independence, as well as the loss of working hours and low productivity[3].

This study aimed to review the available scientific evidence to analyze the effects of PA over workplace sickness absenteeism, taking into account the PA promotion design.

MATERIAL AND METHODS

A systematic review using PRISMA[23] procedures was conducted, and the whole review process was registered and submitted in PROSPERO systematic reviews database (Ref. Num: CRD42017072073).

Search strategy. The bibliographic search was defined using PICOS strategy (population, intervention, comparator, results and environment). Relevant studies about PA workplace effects over sickness absenteeism (time off from work due to illness) in sedentary workers in comparison to those being active were identified. An independent search through

two authors was carried out in 4 databases; Medline (PubMed), Web of Science, Embase y SportDiscus, including both English and Spanish study up to December 2017.

In order to set the search strategy for the four databases, the terms to search were identified into three categories (table 1). The first group of search terms was related to the PA independent variable (used terms: "physical activity", "physical exercise", "fitness", "sedentary", "sedentarism"). The second group of search terms was related to the sickness absenteeism dependent variable (used terms: "absenteeism", "medical leave", "sick leave", o "sickness absence"). The last search term group was the one related to population (used terms: "worksite", "workplace", "employee"). The final search strategy combined terms from the table 1 relating population with PA and absenteeism with the following limits: field: "title/abstract", language: "English/Spanish", type of article: "clinical trial/observational study". The range of search was extended to the related articles and the bibliography of the recovered articles.

Eligibility criteria:

– Inclusion criteria. Original studies which accomplished the following inclusion criteria were chosen:

i) Subjects of 18 years old or more (working legal age without parental permission in Spain) with sedentary occupational activity.

ii) Including any way of PA assessment as independent variable.

iii) Including company or self-reported sickness absence results in days.

iv) Experimental or clinical and observational studies.

– Exclusion criteria. Articles with subjects diagnosed with diseases or chronic condition were discarded.

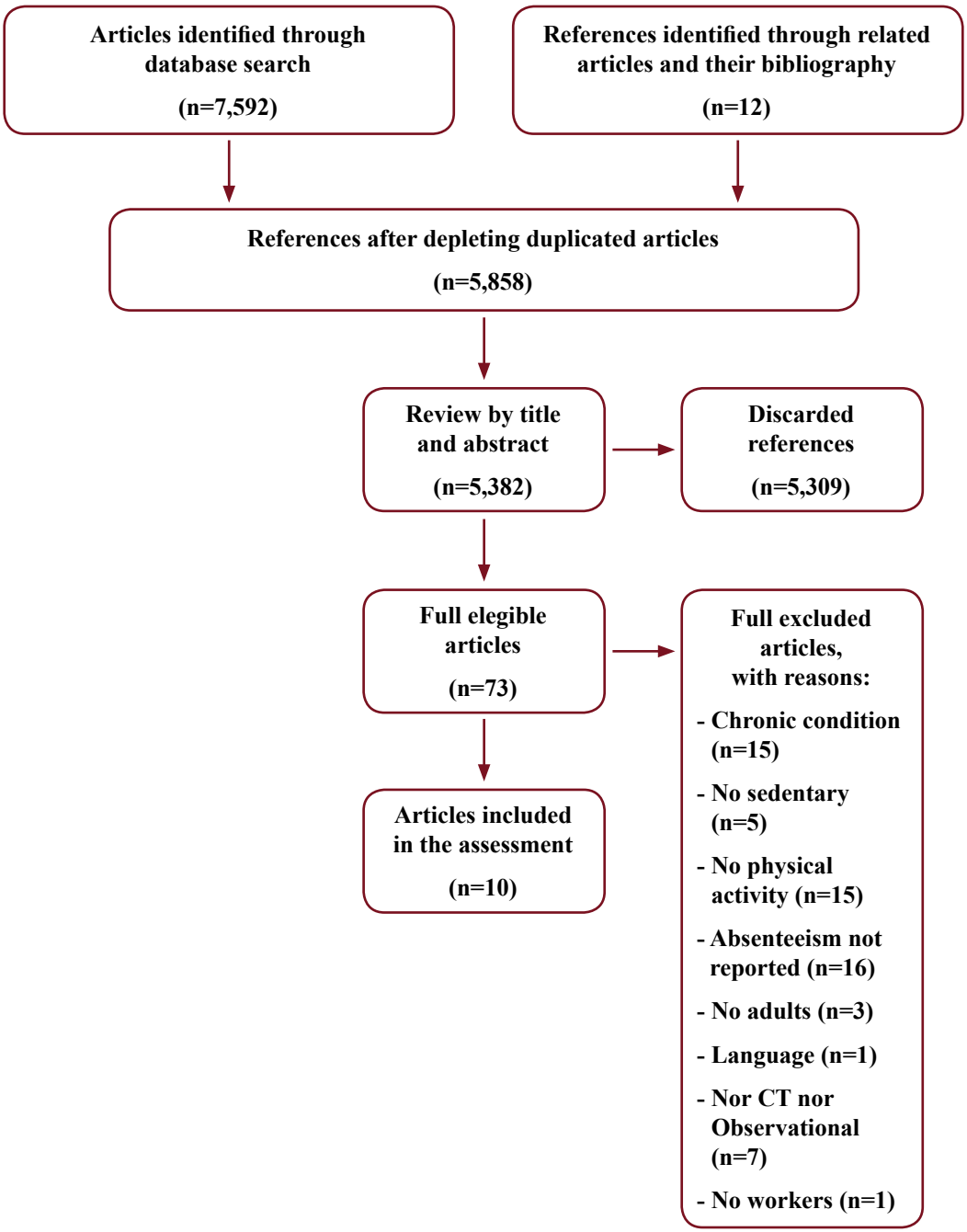
There was no disagreement about whether including articles between the two authors and, therefore, a third opinion was not necessary. There was a complete agreement between the two authors, and the kappa index[24] was 1.

Figure 1 shows the PRISMA flow chart on selected articles. A total of 7,592 original articles were identified using the defined search strategy. Twelve articles were identified as "related articles" and the cited bibliography of those. After depleting duplicated registers, it remained 5,858 original studies. Five thousand

Table 1
Search strategy used in the different databases.

Independent variable (physical activity)	Dependent variable (absenteeism)	Population
Physical activity	Absenteeism	Worksite
Physical exercise	Medical leave	Workplace
Fitness	Sick leave	Employee
Sedentary	Sickness absence	-
Sedentarism	-	-

Figure 1
Flow PRISMA chart for bibliography search.



three hundred nine articles were rejected by the reading of the title or the abstract. Of the 73 eligible studies, 63 were discarded for several reasons (figure 1).

Data extraction and quality analyses. Of the eligible articles, there were extracted, among others, the following information:

i) The principal author and the year of publication.

ii) The study design.

iii) The geographic origin of the sample.

iv) Characteristics and size sample.

v) Details about the PA intervention.

vi) The final outcome.

Concerning quality analyses of the clinical trials, the PEDro guidelines were followed [25], which gets a maximum punctuation of 11 points, whereas the STROBE[26] scale, with a maximum of 22 points, was used for observational studies.

RESULTS

Of those recovered articles (tables 2 and 3), 10 reached the eligibility criteria: 5 of which are clinical trials[27,28,29,30,31] and other 5 are observational studies[32,33,34,35,36]. The clinical trials included 4,512 participants in the intervention group and 6,483 participants as a control group. In the case of the observational studies, there were included, 20,242 participants. In general, the included studies in the review suggest an inverse association between PA and sickness absenteeism.

According to the PEDro scale, the quality of the studies for the clinical trials was ranged between 4 and 6 points (11 maximum) (table 4), whereas the range for observational studies, according to the STROBE scale, was between 11 and 19 points (22 maximum) (table 5). Sickness absenteeism was self-reported in 4 studies[31,32,34,35] and reported by the company in 6[27,28,29,30,33,36]. Concerning PA measurement, those were self-reported by the workers using different questionnaires in 9 of the studies[27,28,29,30,31,32,33,35,36] and 1 study used accelerometers[34].

Regarding the intervention control, only 1 of the studies presented an exhaustive monitoring over the participants and described PA program parameters such as contents (calisthenics, jogging, ball games), frequency (3 weekly sessions of 30 minutes long) or intensity (17 minutes over 65% of maximum heart rate)[27].

Of the five clinical trials, none of them scored in the items 3,5,6 and 7 of the PEDro scale, referred to participants allocation (Num. 3) and the study masking (Num. 5 and 6). In other cases, there were problems related to the presentation of the results[27,31], as those were not reported with group means without adjusted variability measurements.

The five clinical trials[27,28,29,30,31] show a positive effect of the PA programs over sickness absenteeism when the results between the interventions groups and the control groups are compared, either in a higher reduction of the percentage of days off from work or the overall time, measured in hours or days. There were significant differences between the pre-test and the post-test of the intervention group in 2 of them[27,29]. The study by Cox et al[27] detected statistical significant differences of 25.4% in favor of the intervention group when lowering absenteeism after the intervention term, whereas the study by Lynch et al[29] found significant differences favors to a higher days off from work reduction in both men (-0.42 ± 0.20 days), and

Table 2
Characteristics of the clinical trials included in the review.

N.	First author	Country of the sample	Design	Sample	Intervention	Results
1	Cox (1981)	Canada	CT	Employees from an insurance company (I:1,281, C:577)	30 min 3 times a week for six months Calisthenics, jogging and ball games. More 17 min over 65% of MHR	Company reported I:↓48.8% days off from work(**) C:↓23.4% days off from work
2	Baun (1986)	USA	RCT	Employees from an air conditioning cleaning company (I:221, C:296)	Self-managed training in a fitness center for one year	Company reported (absence hours) I:36.15 ± 41 C:45.02 ± 79
3	Lynch (1990)	USA	CT	Employees from a health care center (I:2,232, C:5,837)	Self-managed for 11 months, during their leisure time in the company facilities	Company reported days off from work MI:-0.42 ± 0.20(*) MC:-0.18 ± 0.19 WI:-0.99 ± 0.37(*) WC:-0.01 ± 0.27
4	Steinhardt (1991)	USA	CT	Judicial police (NPA:68, OPA:360 , RPA:306)	3 years to progress from 30% to 50% population percentile Self-managed training in the institution wellness/fitness facilities	Department reported days off from work NPA:12.46 ± 9.58 OPA:7.58 ± 6.57 RPA:7.45 ± 6.7
5	Von Thiele (2011)	Sweden	CT	Employees from a dental medical center (PA:61, RWH:51, C:65)	During 12 months 2.5 hours a week Free-chosen activity 55% to 89% MHR	Employee reported days off from work (8-29 days) PA:13% RWH:19% C:29%

(*) p<0,05; (**) p<0,001; PA=Physical activity; OPA=Occasional PA; RPA=Regular PA; C= Control group; MC=Men control; WC=Women control; CT=Controlled trial; RCT=Randomized controlled trial; MHR=Maximum heart rate; I= Intervention group; MI=Men intervention; WI=Women intervention; NPA=No PA; RWH=Reduction of working hours.

women (-0.99 ± 0.37 days) post-intervention in the intervention group.

Concerning the observational studies quality (table 5), 4 out of 5 studies[33,34,35,36] show a high score on the STROBE scale. The weakest points of these studies were the items number 1 and 4, regarding the study design, the item number 9 related to the risk of bias and its possible effect and, last, the item number 21, given its little or null discussion over results generalization. The study by Bowne et al[32] also showed more methodology gaps related to the study design, the intervention characteristics and the description of the possible origin of the risk of bias.

Table 3
Characteristics of the observational studies included in the review.

N.	First author	Country of the sample	Design	Sample	Exposition	Results
6	Bowne (1984)	USA	Cohort	Employees from an insurance company (I:184, C:121)	Self-managed, at least 20 min / 3 times a week within 70-80% MHR for 3-5 years during their leisure time in the company facilities	Average annual absenteeism reported by employees (days) I:3.35 C:7.30
7	Bernaards (2006)	Netherlands	Cohort	Office and technician workers <1 day a month 1-3 days a month 1-2 days a month ≥Three days a week (n=1,747)	Four months with a self-managed frequency by the employee	Annual absenteeism reported by the company (21 days or more) /gender adjusted <1 day a month OR: ref.1-3 days a month OR: 0.55 (0.25 -1.40) 1-2 days a week OR: 0.4 (0.20-0.90)(*) ≥Three days a week OR: 0.3 (0.10-1.20)
8	Proper (2006)	Netherlands	Cross-sectional	Representative sample of two national surveys with Holland workers (OBIN n=5,070, POLS n=8,893) OBIN-NPA:27.1% OBIN-MPA:44.8% OBIN-VPA:28.1% POLS-NPA:32.3% POLS-MPA:50.2% POLS-VPA:17.5%	Employee reported through questionnaire	Two last months absenteeism reported by the employee (days) OBIN-NMPA: 2.18 ± 7.88 OBIN-MPA: 2.34 ± 8.48 OBIN-NVPA: 2.43 ± 8.58 OBIN-VPA: 1.85 ± 7.11 POLS-NMPA: 2.21 ± 7.81 POLS-MPA: 2.40 ± 8.15 POLS-NVPA: 2.31 ± 7.98 POLS-VPA: 1.89 ± 7.19 OBIN VPA frecuency: 0 days/week: 2.74 ± 9.27 1 day/week: 2.30 ± 8.27 2 days/week 2.01 ± 7.56(*) 3 days/week 1.72 ± 6.54(**) 4 days/week or more: 1.96 ± 7.53(*) POLS VPA frecuency: 0 day/week: 2.45 ± 8.13 1 day/week: 2.05 ± 7.81 2 days/week: 1.92 ± 7.43 3 days/week: 1.55 ± 6.06(**) 4 days/week or more: 2.08 ± 7.77
9	Tolonen (2016)	Finland	Cohort	Helsinki council city servants NPA:842 MPA:1,849 VPA:1,244	Employee reported through questionnaire	Absenteeism got from the employer for 3 years (1 to 14 days) NPA:20.3 ± 24.90 days MPA:18.6 ± 20.90 days VPA: 15.5 ± 19.40 days(***)
10	Losina (2017)	USA	Cohort	Medical center workers 0-74 min week:148 75-149 min week:83 ≤150 min week:61	6 months PA hours registered through accelerometers	Absenteeism reported by the employee 0-74 min week: RR 4,106 (2.00-8.40) 75-149 min week: RR 2.72 (1.42-5.19) ≥150 min week: ref.

(*) p<0,05; (**) p<0,01; (***) p=0,0001; MPA=Moderate PA; VPA=Vigorous PA; C= Control group; MHR=Maximum heart rate; I= Intervention group; NPA=No PA; NMPA=No moderate PA; NVPA=No vigorous PA; OBIN= Injures and PA in Holland; OR=Odds Ratio; POLS=Permanent study of life conditions; RR=Relative risk.

Table 4
PEDro scale for experimental studies quality assessment.

Studies	Eligibility	Randomization	Allocation	Homogeneity of the groups	Blinding of the subjects	Blinding of the therapists	Blinding of the assessors	Key outcome measurement	Display of the results	Statistical comparison	Measurement and variability	Total
	1	2	3	4	5	6	7	8	9	10	11	
Baun (1986)	x	x	-	-	-	-	-	x	x	x	x	6
Cox (1981)	x	-	-	x	-	-	-	-	x	x	-	4
Lynch (1990)	x	-	-	-	-	-	-	x	x	x	x	5
Steindhardt (1991)	x	-	-	-	-	-	-	x	x	x	x	5
Von Thiele (2011)	x	x	-	-	-	-	-	x	-	x	x	5

Table 4
PEDro scale for experimental studies quality assessment.

Studies	Design	Background	Objectives	Design II	Setting	Participants	Variables	Data sources	Bias	Study size	Variables II	Statistics	Results I	Results II	Results III	Results IV	Other analyses	Key results	Limitations	Interpretation	Generalizability	Funding	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
Bowne (1984)	x	x	x	-	x	x	-	x	-	x	-	-	x	x	-	-	-	-	x	-	-	x	11
Bernaards (2006)	x	x	x	-	x	x	x	x	-	-	x	x	x	x	x	x	x	x	x	x	-	x	18
Proper (2006)	x	x	x	x	x	x	x	x	-	-	x	x	x	x	x	x	x	x	x	x	-	-	18
Tolonen (2016)	-	x	x	x	x	x	x	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	19
Losina (2017)	-	x	x	x	x	x	x	x	-	-	x	-	x	x	x	x	x	x	x	x	-	x	17

The five observational studies reported an inversed relationship between PA levels and the sick leave days[32,33,34,35,36]. That inverse association was informed as statistically significant in two of them[33,36].

Four studies show a dose-response association between the PA parameters such as volume or intensity and the sickness absenteeism of the workers when groups are stratified by the PA variable[33,34,35,36]. The direction of the association of these studies shows that, when measured PA, either measured in minutes, days or intensity, increases, the days of sickness absenteeism decreases. An odds ratio (OR) in favor of the sickness absenteeism reduction (OR 0.4; 95% CI 0.20-0.90), was detected with those participants exercising 1 or 2 times a week in the study by Bernaards et al[33]. Whereas the study by Losina et al[34] pointed that the relative risk (RR) of being off from work due to illness multiplied by more than 4 with the least PA quantity group (RR=4,106; 95% CI 2.00-8.40).

When PA was stratified by level of intensity, both the study by Proper et al[35] (1.85 ± 7.11 days) (1.89 ± 7.19 days) and the study by Tolonen et al[36] (15.50 ± 19.40 days) found less days of sickness absenteeism with the groups declaring do vigorous PA. In the case of the study by Proper et al[35], the number of days off from work due to illness was lower when training at vigorous intensity three days a week (1.72 ± 6.54 days) (1.55 ± 6.06 days).

DISCUSSION

The effect of the results varies depending on the studies, being difficult to compare among them because the data on absenteeism are reported in different ways or are adjusted by other variables such as sex or age. Steindhart et al[30] show a remarkable dose-response regarding PA volume, with less number of days a year off from work for those groups doing PA. That group doing more PA was the one which absents five days a year less from work than the control group.

In the study by Losina et al., PA is measured by accelerometry[34], whereas in the rest of the studies, PA is self-reported. The objective measurement of PA through accelerometry, instead of being taken by questionnaires, has been suggested by several authors as a necessity to improve quality research on this field[12,37]. Regarding absenteeism, only two studies include company reports[33,36] and the rest self-report this variable through not validated questionnaires, which points to a possible measurement risk of bias of sickness absenteeism.

It is remarkable the dose-response relationship in the study by Tolonen et al., with a difference of 5 fewer days off from work and minus 663 euros of estimated cost per worker in favor to the vigorous PA group when compared to the group which did not reach the recommended minimum levels[36]. However, it is in the study developed with Holland workers[35] in which the strongest dose-response associations take place, resulting in an appropriate weekly training level of 3 days of vigorous PA to get the highest reduction of absenteeism.

In brief, there have been found studies that report four times higher relative risk of being off from work due to illness when comparing workers doing with workers not doing PA[34], and a 5 annual days of difference between intervention and control groups showing less levels of absenteeism in the first ones[30,36]. Dose-response associations related to PA volume[33,34,35] and PA intensity[35,36] have already been detected.

It is possible to suggest a reinforcement of the association between PA and a sickness absenteeism decrease owing to the dose-response found in one of the clinical trials[30]

and four observational studies[33,34,35,36], which occurs with both short term sick leaves[36] and long term sick leaves[33,34]. However, not all the scientific literature on the issue has found that association[38]. That lack of agreement in the results could be due to the fact sedentarism have not been used as a feature of the subjects when stablishing eligibility criteria, which could result in determinant as the less active subjects could be the ones who benefit more from PA as a way to improve their health and diminish the absenteeism[21].

The present review has considered each PA intervention or PA exposition, either inside or outside the workplace. There have been found studies of the two mentioned types and the place or the time have not being considered not to diminish the number of the eligible articles. In any case, there seems to be a wide margin of improvement regarding intervention control and the quality of the studies in both cases; inside and outside the workplace[11,13,19,20,37,38].

The limitations of the selected studies are related to the fact that most of them, present self-reported PA; only one study[34] measured daily PA of the subjects objectively with accelerometers. That issue could represent a clear risk for the internal validity of most of the studies included in the present review. On the other hand, the description of the PA characteristics is a point to improve in most of the experimental studies. Another limitation is the fact that some of the reviewed studies have been carried out during the decades of the 1980 and 1990, which could point out a possible limitation in the generalization of the results as the habits of the societies from those times could have changed in comparison with the current ones. The option of including the oldest studies allowed the inclusion of higher number of studies in the review, although the risk of bias could increase when comparing studies with each other, as there are possible changes in the criteria and evidences.

In conclusion, less sickness absence is observed when comparing workers who usually do with those who do not do PA. It mainly occurs with vigorous intensity PA characterized by training of 1 to 3 weekly sessions. In order to generalize these results, research with more control over training variables and greater precision in the PA program definitions (length, intensity, content and frequency) in order to accurately define the more effective and rigorous PA strategies to reduce sickness absenteeism.

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ARTÍCULO II

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Association between physical activity and sickness absenteeism in university workers

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Background	Sedentary occupations have increased by more than 10% in Western countries over the last two decades, and the yearly global cost of physical inactivity has been estimated to be $53.8 billion. As workers tend to move less in the workplace, they are more likely to develop a sedentarism-related chronic condition and to be absent from work due to illness, although research evidence on the issue remains unclear.
Aims	To investigate associations between physical activity (PA) and sickness absenteeism in the workplace among Spanish university workers.
Methods	We conducted cross-sectional research with data from 1025 workers aged 18–65 years (43% women) from a Spanish university. Physical Activity Vital Sign (PAVS) and International Physical Activity Questionnaire (IPAQ) short versions were used to evaluate levels of PA. Workplace absenteeism was self-reported by participants. Written questionnaires distributed during medical checks included PAVS, IPAQ and the question about absenteeism among other information. The association between PA and sickness absenteeism was examined using adjusted multiple linear regression.
Results	After adjusting for age, sex, job function, chronic conditions, sedentarism and smoking, each weekly hour of PA reduced sickness absence by −1.20 (95% confidence interval: −2.40–0.00) days per year.
Conclusions	The implementation of PA promotion strategies aimed at university employees may lead to a reduction of days off work due to illness.
Key words	Sickness cost; sick leave; physical activity; university; workplace.

Introduction

While overall world trends in physical activity (PA) have remained mostly unchanged between 2001 and 2016, the population living in high-income countries and reaching World Health Organization (WHO) recommendations on PA [1], has decreased by more than 10% over the same period [2]. Even more concerning, a decreasing trend of 7% less cardiorespiratory fitness in the last five decades within high- and upper-middle-income countries has been recently found [3]. Also, jobs tend to be more sedentary in Western countries as current occupations involve more technological and engineering issues and less physical labour [4]. Although hard physical labour can also be detrimental to health [5], a completely sedentary lifestyle is hazardous to health as well. Thus, meeting the recommended guidelines of PA is of uttermost importance for public health.

As a result of the new landscape, the health of the workers in Western countries could be declining as low levels of PA are associated with non-communicable diseases such as several types of cancer, type II diabetes, cardiovascular diseases and poor mental health [6–8]. Not only is this a matter of health, but also an economic issue as low levels of PA cost the health-care systems in

Key learning points

What is already known about this subject:
- Little is known about the influence of PA on sick leave in European countries.
- Studies have mainly focused on the associations between specific conditions such as musculoskeletal injuries or mental disorders and sick leave.

What this study adds:
- Higher levels of PA in white-collar workers showed a significant inverse association with sick leave.
- 50 minutes of weekly PA may reduce a day of sick leave per year.
- University workers reaching WHO recommended levels of PA may achieve 3 days of annual reduction in health-related absenteeism.

What impact this may have on practice or policy:
- Increasing the PA of employees can help companies to save money derived from the costs of workplace absenteeism.
- Vulnerable groups, workers aged 31–40 years and those employees with chronic diseases such as hypertension or diabetes could benefit the most.

2013 approximately $53.8 billion worldwide, of which high-income countries bear most of the burden, and $13.7 billion in productivity losses [9].

Owing to their loses, companies and governmental institutions have been developing a wide range of measures to tackle associated productivity cost, some of which involve workplace policy changes, provision of counselling, computer-based interventions, individual-focused interventions, multi-component interventions, environmental changes or PA intervention aiming at work ability, presenteeism or absenteeism [10,11].

Encouraging employees to be more physically active may be an effective strategy to improve health and reduce workplace sick-leave among white-collar workers [12,13], although current research remains inconclusive because measurement tools and data collection are usually quite heterogeneous and thus difficult to compare among studies [14]. As most of the observational workplace research and interventions are separately focused on occupational, leisure or commuting PA [14] little is known about the overall effect of PA on absenteeism due to illness. Moreover, interventions to reduce either health-related problems in the workplace or sick leave are usually focused on mental disorders and musculoskeletal pain, which are two of the main reasons behind long-term absence from work [15]. University workers from the present study had access to several sports facilities such as indoor football fields and basketball courts, outdoor football fields and athletic tracks, gyms and fitness programmes of all campuses. Further, university policies encourage their employees to be more physically active subsidising a part of the tuition for those fitness programmes offered through the sports service of the university.

Therefore, the present study aimed to address current gaps in research through utilizing a workforce dataset to investigate the association between overall PA and workplace absenteeism due to illness considering possible confounders such as age, gender, job role, sedentarism or disease condition. Based on the current research, we hypothesized that there could be an inverse association between sick leave and overall PA levels among university workers.

Methods

The sample consisted of university workers from a Spanish university, ranked as the highest skill requirement, i.e. skill level 4, ISCO groups number 2 by the International Standard Classification of Occupations [16]. Academic staff included research fellows, associate lecturers, lecturers, senior lecturers, readers and full professors from all faculties and departments, whereas service staff included university employees from all campuses and a wide range of areas including administrative and technical staff. The study obtained the approval of the Aragonese Ethics Research Committee (CEICA; Identification Code PI18/027).

All data were de-identified and investigated anonymously. University staff who got the voluntary university medical check and completed a medical questionnaire from 1 January 2018 to 31 December 2018, in any of the seven available medical centres, were included in the sample. A total of 1205 workers had a medical examination during that period. Of those, 180 refused to complete the questionnaire due to different reasons (e.g. lack of time or confidentiality). Therefore, 1025 employees, including academic and service staff from all campuses, agreed to complete the questionnaire, which contained questions about all the variables investigated in the present study. Medical examinations took place individually after arranging an appointment. The

medical personnel (i.e. a general practitioner or a nurse) informed those workers who attended to medical examinations about the possibility to self-complete a questionnaire while waiting for the examination in the waiting room. Participants were encouraged to ask the medical personnel solely if they did not understand the meaning of any question from the questionnaire. All questionnaires were anonymous, allocated in medical centres and supervised by medical personnel during medical checks (i.e. the medical staff was required to assist only if the participants had any doubt on how to interpret any question from the questionnaire).

Participants were provided with a participant information sheet and were asked to provide explicit written consent before data were collected.

The Physical Activity Vital Sign (PAVS) short version [17] and the International Physical Activity Questionnaire (IPAQ) short form [18] were used to estimate PA levels. The PAVS questionnaire was used to estimate weekly minutes of PA, which is its primary aim, whereas IPAQ was used to categorize PA into different subgroups regarding METS (low, moderate and high). PAVS consisted of two questions asking about the number of days and minutes an individual usually takes part in PA in a regular week. Workers could select among 0, 1, 2, 3, 4, 5, 6 or 7 days of PA a week and 10, 20, 30, 40, 50, 60, 90 and 150 or more minutes each day. Weekly minutes of PA were calculated by multiplying days with minutes and later categorized into those participants who reached the WHO recommendation of 150 weekly minutes of PA and those who did not. PAVS has been previously compared with accelerometry, showing a moderate agreement among clinic administrative staff (Cohen's $\kappa = 0.46$, $P < 0.001$) [19].

IPAQ short-form estimates PA frequency (in days per week), duration (hours and minutes per day), intensity (moderate or vigorous), walking (frequency and duration) and sedentarism (daily sitting time in minutes) over the previous 7 days. IPAQ has been validated in adult populations from different countries showing acceptable validity [$\rho = 0.30$, 95% confidence interval (CI): 0.23–0.36] and reliability (Spearman's $\rho = 0.81$, 95% CI: 0.79–0.82) [18]. According to the IPAQ guidelines, groups regarding levels of PA were categorized into low (less than 600 MET minutes a week), moderate (between 600 and less than 3000 MET minutes a week) and high (3000 MET minutes a week or more).

Estimations over absenteeism due to illness were made through a question included in the university written medical questionnaire: 'How many days were you off from work due to health reasons during the last twelve months?'. Possible answers ranged from 0 to 249 (i.e. the maximum number of working days in Spain). As there were a high number of job roles reported, the job role variable was categorized into three possible groups in the questionnaire; academic staff, service staff or both. Employees were asked if they had any specific chronic condition through the following question: 'Mark with an X if you usually suffer from any of the following conditions', and possible choices comprised none, one or more of these chronic conditions: 'high blood pressure', 'diabetes', 'overweight', 'high cholesterol' or 'atherogenic index of plasma'. The method of obtaining the list of chronic medical conditions was based on the suggestions of the university medical staff and on previous studies about this topic; diabetes, overweight, sedentariness and hypertension have been associated with sickness absence or health risk factors [20–22]. Particularly, high cholesterol and the atherogenic index of plasma have been associated with other cardiovascular risk factors among university workers [23]. Employees' smoking status was estimated by a direct question included in the questionnaire with response options; yes, no.

Statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS) version 22.0 (SPSS Inc., Chicago, IL). Stratified descriptive statistics of PA and absenteeism were computed for all categorical variables, whereas normality of the continuous variables was verified using a Kolmogorov–Smirnov test. To check differences within categorical variables with two groups, a Student's *t*-test for independent samples was implemented, whereas one-way analysis of variance was computed for those categorical variables presenting more than two groups.

Multiple linear regression analyses adjusted for prespecified covariates were used to investigate associations between PA and workplace absenteeism due to health-related causes. Levels of significance were set at $P < 0.05$. The PA variable was further categorized into those reaching PA WHO guidelines for adults and those who do not to examine possible relationships. We excluded missing values for data analyses.

Due to confidentiality reasons, the age variable was previously categorized into four possible answer groups in the questionnaire.

Results

Participants in the present study represented 17% of all employees contractually linked to the university under study during 2018. A total of 1025 university employees (aged 18–65 years) out of 1205 who had the medical examination returned the medical questionnaire (85%). Overall, 438 out of 3194 women (14%) and 399 out of 3012 men (13%) from the university staff participated in the study. A total of 513 (13%) members of the academic staff and 339 (19%) employees from the service staff participated in the study. Among the participants, 55% wholly ($n = 558$) and 45% partly ($n = 467$) completed the questionnaire.

Table 1 shows participant characteristics regarding PA and sickness absenteeism. Concerning PAVS, men had more weekly minutes in PA than women (186.8 ± 173.1 versus 150.8 ± 116.7; $P < 0.001$), and differences among age groups were significant ($P < 0.001$).

Regarding workplace absenteeism, significant differences among categories concerning job role ($P < 0.05$), chronic disease condition ($P < 0.05$), WHO guidelines ($P < 0.01$) and categorized IPAQ ($P < 0.05$) were detected. Sickness absenteeism increased with age, whereas service staff showed higher levels of absenteeism than academic staff (13.0 ± 43.6 versus 7.3 ± 23.6). Those with chronic illness had a higher frequency of absenteeism (13.2 ± 37.9 versus 7.9 ± 28.2) and workers following PA WHO guidelines had fewer days absent from work due to illness (6.6 ± 33.7 versus 12.9 ± 32.2).

Table 2 shows different multiple linear regression models involving PA, absenteeism and other possible confounders such as age, gender, job role, smoking habit, chronic condition and sedentarism. The crude model is the one which offers the highest reduction in absenteeism (β = −0.02; 95% CI: −0.04 to −0.01) and the more significant P value ($P < 0.001$). When adjusting for gender and age, the β value decreases to −0.02 (95% CI: −0.04–0.00). Model 2, which considers job role variable, and model 3, adding chronic condition and smoking habit variables varies absenteeism less than model 1. After adjusting for all investigated variables (model 4), absenteeism inversion association with PA results in a significant difference ($P < 0.05$). When adjusting by all confounders, each weekly minute of PA lowers workplace absenteeism annually by −0.02 (95% CI: −0.04–0.00) days.

Table 1. Participant characteristics

	PAVS (min)				Absenteeism (days)			
$N = 1025$	n	(%)	Mean ± SD	P value[a]	n	(%)	Mean ± SD	P value[a]
Age				0.00				0.11
18–30	178	(17)	189.7 ± 131.3		189	(19)	5.4 ± 23.2	
31–40	144	(14)	131.3 ± 120.3		146	(14)	8.9 ± 33.0	
41–50	262	(26)	150.2 ± 130.5		250	(24)	10.0 ± 33.8	
51 or more	274	(27)	179.4 ± 172.7		264	(26)	13.1 ± 38.2	
Missing	167	(16)	191.7 ± 156.2		176	(17)	6.0 ± 11.7	
Sex				0.00				0.27
Men	399	(39)	186.8 ± 173.1		394	(38)	8.0 ± 30.7	
Women	438	(43)	150.8 ± 116.7		438	(43)	10.5 ± 33.9	
Missing	188	(18)	150.3 ± 133.5		193	(19)	10.5 ± 28.2	
Job role				0.74				0.04
Academic staff	513	(50)	167.7 ± 140.7		524	(51)	7.3 ± 23.6	
Service staff	339	(33)	162.6 ± 156.9		330	(32)	13.0 ± 43.6	
Both	11	(1)	191.8 ± 141.8		10	(1)	14.9 ± 25.3	
Missing	162	(16)	175.9 ± 129.8		161	(16)	7.0 ± 16.9	
Chronic disease				0.29				0.03
Yes	210	(21)	157.2 ± 145.3		213	(21)	13.2 ± 37.9	
No	608	(59)	169.3 ± 143.0		656	(64)	7.9 ± 28.2	
Missing	297	(20)	168.2 ± 164.7		156	(15)	13.2 ± 46.0	
Smoker				0.86				0.74
Yes	71	(7)	164.6 ± 150.1		71	(7)	10.5 ± 36.5	
No	710	(69)	167.7 ± 145.5		709	(69)	9.2 ± 32.6	
Missing	244	(24)	159.2 ± 146.6		245	(24)	10.1 ± 26.5	
WHO guidelines				0.00				0.00
Yes	441	(43)	273.5 ± 145.0		409	(40)	6.6 ± 33.7	
No	482	(47)	68.5 ± 39.4		452	(44)	12.9 ± 32.2	
Missing	102	(10)	-		164	(16)	2.9 ± 7.0	
IPAQ				0.00				0.00
Low PA	118	(11)	71.1 ± 112.0		123	(12)	18.8 ± 45.8	
Moderate PA	283	(28)	121.8 ± 94.8		287	(28)	10.6 ± 32.2	
High PA	508	(50)	215.6 ± 157.9		506	(49)	6.5 ± 26.3	
Missing	116	(11)	92.3 ± 79.7		109	(11)	10.0 ± 14.3	

[a]Chi-squared test.

Table 2. Adjusted multiple linear regression showing the associations between workplace absenteeism and PA

	n	β[a]	(95% CI)	*P* value
PAVS crude model	861	−0.02	(−0.04–−0.01)	0.00
Model 1[b]	755	−0.02	(−0.04–0.00)	0.00
Model 2[c]	715	−0.02	(−0.04–0.00)	0.00
Model 3[d]	623	−0.02	(−0.04–0.00)	0.02
Model 4[e]	558	−0.02	(−0.04–0.00)	0.02

[a]Multiple linear regression.
[b]PA adjusted by age and sex.
[c]PA adjusted by age, sex and job role.
[d]PA adjusted by age, sex, job role, smoking habit and chronic disease.
[e]PA adjusted by age, sex, job role, smoking habit, chronic disease and sedentarism.

Discussion

In the present sample of Spanish university employees, higher levels of PA were associated with fewer reported days off work due to absenteeism, after statistical adjustment for important potential confounding variables. However, no association between sedentary time and absenteeism was found.

Estimates from the present study suggest that one average additional minute of PA a week lowers annual days an employee would be absent from work owing to sickness by −0.02 days. It means that each weekly hour of PA may reduce annual workplace absenteeism by one day and a half per year. Those employees reaching 150 weekly minutes of PA could get a sick-leave reduction of 3 days a year.

Common illnesses such as colds and flu, musculoskeletal pain and mental disorders were the leading causes of sick leave among the investigated university staff.

Our finding that there is an inverse association between PA and absenteeism due to sickness in white-collar workers has been previously reported [12,13], but this study adds findings in a large sample of highly qualified workers. As several studies highlight the importance of sociodemographic characteristics when explaining population differences in PA levels [24], a high level of qualification could explain why university workers' PA levels are higher than those found in general adult populations from European countries [25].

A key barrier to the implementation of successful PA strategies into the workplace is a lack of managerial 'buy in' owing to limited knowledge on how such strategies will impact on the workforce productivity [26]. Therefore, figures about absenteeism might be a useful way to demonstrate the tangible benefits of PA strategies for institutions and companies. According to the results of this study, reaching PA WHO guidelines for adults could lead to a reduction in absenteeism of more than three days a year in white-collar workers, which would produce cost savings for either companies or national health services. Tolonen *et al.* found that Finnish white-collar workers doing moderate and vigorous PA were respectively absent, on average, 6 and 5 days a year due to short-term sickness absence [13], which represents a very similar figure to those found in the present study for workers with IPAQ high levels of PA (6.5 ± 26.3). Regarding PA promotion strategies, using sit-stand desks in the workplace do not compromise productivity [27], and could reduce overall cost providing that cost of implemented measures do not surpass produced savings and benefits.

Workplace research has mainly focused on occupational and leisure PA, but significant health improvements have also been found with commuting PA in adults [28]. Consequently, PA promotion strategies could embrace a wide range of possibilities regarding the characteristics of the company or institution.

Since resistance training usually requires adequate facilities, equipment, monitoring and technical skills, most of the subjects of the sample probably were not exposed to this type of workout. Hence, figures on sickness absenteeism could be even lower than observed if resistance training routines were added to those university employees who have any musculoskeletal disorder.

Strengths of the current study include using a large sample of university staff, as well as checking the PA levels through two different validated questionnaires. The fact that both questionnaires were completed in a medical environment may contribute to reliability as subjects might be less prone to overstate their level of PA during a medical check. Finally, our research considered a wide range of possible confounders suggested in other studies such as several chronic illnesses, job role or smoking habits [29]. On the other hand, two of the most critical chronic illnesses among the workforce (i.e. mental health and musculoskeletal pain) were not included in the questionnaire [15].

Several limitations have to be taken into consideration for this research. First of all, the cross-sectional nature of the study design, which excludes any possible causal inference. Secondly, since PA and absenteeism due to health reasons were self-reported, there is an inherent risk of reporting bias. Self-reported data might lead to overestimating PA and underestimating measure of absenteeism due to sickness. There is also possibly a selection bias since those volunteering for medical checks might be more health conscious than other university workers. Further, in the fully-adjusted regression model, almost half of the participants did not report data on all included variables.

Although we have mainly focused our study covariates pertaining to metabolic and cardiovascular chronic conditions, there are other potential chronic conditions such as mental or musculoskeletal disorders that might influence the association between PA and sickness absence [30]. Similarly, asking participants for the number of cigarettes, instead of solely the smoking status, might

have provided more detailed information on the habit to better understand its influence over the association between PA and SA. Another drawback is related to the fact that the PAVS questionnaire short version does not discriminate between high, moderate-intensity PA or resistance training. Therefore, some study subjects reaching between 75 and 149 minutes of weekly PA may have accomplished WHO PA guidelines although this study could not detect this.

Because it was the same group of participants who showed missing values in essential variables such as age, sex and job role, this may be due to preserving anonymity. Although the study population works in a large university, several of the participants declared that there was a possibility to identify them through the information provided in those essential variables. Regarding other variables such as chronic disease, smoking status or PA, missing values might be owing to a lack of time, as all of them were placed at the end of the questionnaire. Future research aiming at the same population would need to provide better conditions to complete questionnaires (i.e. digital questionnaire sent to e-mails) in order not to miss too many values.

Whether PA was mainly done in occupational, leisure or commute time and the amount of time devoted to each of them remains unknown. This point makes difficult possible comparisons with other studies, as most of them focus on one of the mentioned periods, and knowing more about possible habits or preferences of the workers would have been desirable to design PA promotion strategies. Because countries and companies usually have their idiosyncrasy regarding workplace policy and organization, a generalization of results should be made in the light of those specific features. However, in general terms, institutions increasing staff PA time using measures such as climbing stairs instead of using the lift, active commuting to work or meaningful active breaks might reduce SA and its associated costs. Particularly, universities encouraging their sedentary employees to enrol in PA programs during, at least, 75–150 minutes of moderate to vigorous PA per week (i.e. two to three training sessions) could significantly reduce SA levels.

In conclusion, the implementation of PA promotion strategies aimed at university workers may lead to a reduction of sickness absence. Every hour of weekly PA may reduce annual workplace absenteeism by one day and a half. Future work needs to be carried out using longitudinal analyses and more precise measures of PA before recommendations for policy and practice can be made.

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Competing interests

None declared.

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ARTÍCULO III

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ORIGINAL ARTICLE
PSYCHOLOGY

Physical activity and perceived stress at work in university workers: a cross-sectional study

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ABSTRACT

BACKGROUND: Previous research has suggested high levels of physical activity (PA), either in occupational or leisure-time, to be associated with low levels of perceived stress at work (PSW). However, because studies have been set in particular conditions, there is no possibility to generalize results on other populations of workers. This study investigated the association between PA and PSW in university workers.

METHODS: University employees (N.=757) aged from 26 to 65 years (47% female) at a large public Spanish university. Data were collected between January 2017 and December 2017. Physical Activity Vital Sign (PAVS) questionnaire and a single-item scale were used to assess PA levels and PSW. Associations were examined through an adjusted logistic regression.

RESULTS: Results showed the strongest association between high PSW and low PA levels after adjusting for age, gender and profession (odds ratio [OR] 2.60, 95% CI: 1.44-3.68). Around half of the employees (51.9%) performed at least 150 minutes of PA per week, which is higher than in most other Spanish and European worker populations.

CONCLUSIONS: Adequately high levels of PA may be beneficial for stress management in university workers as previously seen in other types of workers. Promoting PA strategies at the workplace could improve the working environment and the health of the workers.

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KEY WORDS: Physical activity; Professional burnout; Mental health; Workplace; Occupational medicine; Psychological stress.

Physical activity (PA) aids in the prevention of non-communicable disease and risk factors. The World Health Organization (WHO) ranks lack of PA as risk factor number four concerning global mortality.[1] Dose-response associations exist, *i.e.*, people who are more active live longer and are less prone to developing several types of cancer, type II diabetes, cardiovascular diseases, or suffering from poor mental health.[2-5] Moreover, PA promotes healthy ageing, and importantly, older people who exercise tend to be less frail.[6] Saint-Maurice *et al.*[7] found that PA levels tracked from adolescence to later adulthood and those with high PA levels had a 29-36% lower risk for all-cause mortality. PA during adulthood after being inactive also decreases the risk of mortality by 32-35%.

Figures from the latest European Commission report on PA estimates that 60% of the European adults never or rarely exercise.[8] Even more concerning, a downhill trend of 7.7% less cardiorespiratory fitness in the last five decades has been detected within high- and upper-middle-income countries.[9] The International Sport and Culture As-

sociation Health (ISCA) and the Centre for Economics and Business Research (CEBR) report an annual cost of 80 billion euros derived from medical care, medical treatments, functional limitations, disability, loss of dependence and a loss of working hours and productivity for European countries.[10] Lindegård *et al.*[11] reported stress-related mental disorders and musculoskeletal disorders as the two most important factors behind long-term sick leave in Sweden. Therefore, implementing measures to diminish the impact of the absenteeism regarding these two issues would be desirable.

Because jobs tend to be less physically active in western countries[10] and more workers are diagnosed with mental disorders such as too much work-related stress, anxiety, depression or psychosocial disorders,[12] institutions are trying to tackle those issues by implementing different measures in the workplace. Sit-stand desks, workplace policy changes, provision of counselling or multi-component interventions show inconsistent results when improving PA and avoiding sitting,[13] whereas implemented measures at an organizational level resulted in no significant improvement when lowering perceived stress at work (PSW).[14] However, PA-focused interventions seem to be one of the most promising actions to reduce work-related stress and psychosocial hazards, as current research report PA to improve figures on mental health[3, 15, 16] and absenteeism.[14, 17-19] Easy to implement, encouraging employees to be active (walking through the office) and to climb stairs (instead of using the elevator) are two of the principal strategies regarding PA promotion in the workplace among white-collar workers.[20] Nevertheless, PA promotion has been reported to have a low priority for small and large companies likely because they are unaware of the relationship between PA with absenteeism and productivity.[21] Thus, as occupational PA is usually less than the weekly recommended 150 minutes of moderate PA or 75 minutes of vigorous PA, to assess overall PA (leisure, occupational and commuting time) would be desirable to know whether workers are reaching recommended levels of PA.[22] Johnson *et al.*[23] reported that expensive tools were a barrier for companies as the balance between investment and cost are usually unknown. Therefore, the use of more accessible assessment and standardized instruments such as Physical Activity Vital Sign (PAVS)[24] or its electronic version (EVS)[25] could help to gain reliability and generalizability on the matter.

Moderate evidence has suggested high stress at work to be associated with lack of PA either in occupational or leisure-time.[14, 26-30] Moreover, job stress has been associated with the development of cardiovascular diseases such as atrial fibrillation, stroke, and coronary heart disease.[27, 31-34] The demand-control model, *i.e.*, an imbalance between low control over working conditions, and the effort-reward divergence model are the two most used models to assess work-related stress.[34] Individual factors and working conditions could contribute to the personal perception of job stress, but also both organizational culture and structure.[12] Little is known about PA levels among university workers because research is usually focused on university students.[35] Also, only a few low-quality studies have investigated PA determinants in the workplace within southern Europe countries such as Spain, the need for more research on the issue has been recently suggested by governmental institutions.[22] The present study aimed to investigate possible associations between PSW and PA levels among Spanish university employees.

Materials and methods

The current research was based on a cross-sectional design. The study got the approval of the Aragonese Ethics Research Committee (CEICA; Identification Code PI18/027). The sample consisted of university workers from a Northeastern Spanish university, including both academic and university staff. All data were de-identified and analyzed anonymously. University workers who got the voluntary university health check and fulfilled the medical questionnaire from January 1st, 2017, to December 31st, 2017, were included in the sample. Seven hundred fifty-seven employees, including lecturers and service staff from all campuses, agreed to wholly or partly complete the survey. All questionnaires were anonymous, allocated in medical centers, and supervised by medical personnel during medical check-ups.

The tool used to estimate PA levels among workers was the PAVS - short version.[24] This questionnaire consisted of two questions related to the number of days and minutes employees usually take part in PA in a regular week. Employees could choose among 0, 1, 2, 3, 4, 5, 6, or 7 days of weekly PA and 10, 20, 30, 40, 50, 60, 90, and 150 or more for minutes they typically do PA on average each of those selected days. Weekly minutes of PA were calculated by multiplying days with minutes. PAVS has previously been validated using accelerometry, showing a moderate agreement among the USA clinic administrative staff (Cohen's κ=0.46, P<0.001).[36] For a better understanding of

the results, obtained PA levels were categorized into three groups regarding WHO recommendations about moderate and vigorous PA. As PAVS estimates PA in bouts of 10 minutes, and WHO recommendations on PA are set in a range of 75 to 150 weekly minutes when combining both moderate to vigorous PA, 80 and 150 minutes were considered as cut-off points.

Levels of PSW were estimated through the following question: "How much labor stress are you experiencing?" Possible answers comprised a 10-point scale varying from 1 "a little" to 10 "very much" perceived work-related stress. According to previous research, single-item scales have shown content, criterion, and construct validity for group-level analysis when monitoring stress at work.[37] Several advantages such as reduced costs, increased face validity for the participant, and problems concerning the designing of sum scales support the use of single-item scales.[38] The question used for this study offered high reliability and validity (Cronbach's α=.83) when tested in 24 university employees voluntarily chosen from the sample, and showed moderate correlation (Pearson's r= 0.64, P<0.001) when compared to the validated Spanish version of the effort-reward imbalance model questionnaire (intrinsic section), which demonstrated high reliability and validity among Spanish hospital personnel (Cronbach's α=0.81).[39] According to the expertise of the Occupational Risk Division on medical checks from previous years, PSW was categorized into three equal groups using 4 and 7 score as two cut-off points. Both PAVS and PSW questions were included in the institutional medical written questionnaire designed by the University Occupational Risk Division. On the questionnaire, respondents chose from three groups related to age, two types of occupations (*i.e.* academic staff and service staff), and gender. Due to confidentiality reasons, the study did not register age by date of birth and occupation by a more complete wide range of options. For the same reason, other possible covariates such as lifestyle or demographic characteristics could not be implemented.

Statistical analysis

Statistical analyses were conducted through the Statistical Package for Social Science (SPSS) v. 22.0. To check for differences between different groups regarding PA, age, gender, profession, and PSW, a one-way analysis of variance was computed. To investigate the association between the dependent variable (PSW), and the independent variable (PA), a multiple logistic regression adjusted by factors (gender and profession) and covariate (age) was implemented. Significance was set at P<0.05.

Questionnaires with missing data (N.=289) were excluded. Therefore, four hundred sixty-eight university employees fully answered to the questions related to variables and covariates. The final cohort did not vary substantially from those who were discarded in terms of mean age (45.6±11.2 years in the final sample *vs.* 47.1±10.2 years in the excluded employees), the proportion of men (55.9% *vs.* 55.1%) and academic staff (54.4% *vs.* 52.3%).

Results

The initial sample was composed of 757 university employees. According to data provided by the institution, participants in this study represent 12.8% of all employees contractually linked to the university during 2017. Table I shows the features of the sample data with missing values. The study population was, on average, 46.6±10.8 years old, and 53.4% were academic staff. The average level of PA was 177.2±145.6 minutes per week.

Table II shows the differences between the three categories of PA. No significant differences in PA were detected in age, gender, or occupation. However, a significant difference was found among PSW groups (P=0.002).

A further analysis to estimate the association between PA and PSW adjusted for gender, age and profession showed that those employees reaching 70 minutes of weekly PA or less were more likely to have high PSW than low PSW (OR=2.60, 95% CI: 1.44-3.68). A weaker but still relevant association was also found between high PSW and medium PA (OR=2.12, 95% CI: 1.22-2.93) and medium PSW and low PA (OR=2.08, 95% CI: 1.46-2.57) (Table III).

TABLE I.—*Descriptive statistics for the Spanish university workers sample (N.=757).*

Variable	Value
Mean age, years	46.6±10.8
Missing	0 (0%)
Gender	
Male	396 (52.3%)
Female	361 (47.7%)
Missing	0 (0%)
Job role	
Service staff	319 (42.1%)
Academic staff	404 (53.4%)
Missing	34 (4.5%)
Mean PA, min/week	177.2±145.6
Missing	289 (38.2%)
Mean PSW, points	5.29±2.1
Missing	12 (1.6%)

PA: physical activity; PSW: perceived stress at work.

TABLE II.—*Cohort personal features and association with categorized levels of PA in Spanish university workers.*

Variable	Low PA (≤70 min/week)	Medium PA (80-150 min/week)	High PA (≥160 min/week)	P value
Gender				0.895
Male	58 (24.2%)	69 (28.7%)	113 (47.1%)	
Female	54 (23.7%)	70 (30.7%)	104 (45.6%)	
Age				0.985
≤41 years	45 (26.2%)	42 (24.4%)	85 (49.4%)	
42-53 years	33 (22.9%)	46 (31.9%)	65 (45.1%)	
>53 years	34 (22.4%)	51 (33.6%)	67 (44.1%)	
Profession				0.915
Service staff	47 (24.7%)	53 (27.9%)	90 (47.4%)	
Academic staff	60 (23.1%)	79 (30.4%)	121 (46.5%)	
PSW				0.002*
Low ≤4 points	26 (18.6%)	38 (27.1%)	76 (54.3%)	
Medium 5-6 points	34 (20.4%)	52 (31.1%)	81 (48.5%)	
High ≥7 points	51 (33.3%)	45 (29.4%)	57 (37.3%)	

PA: physical activity; PSW: perceived stress at work.
*P<0.005.

TABLE III.—*Associations between different categorized levels of PA and PSW in Spanish university workers adjusted for gender, age, and profession (N.=468).*

PSW level	Low PA (≤70 min/week)		Medium PA (80-150 min/week)		High PA (≥160 min/week)	
	OR	95% CI	OR	95% CI	OR	95% CI
Low PSW	1		1		1	
Medium PSW	2.08	1.46, 2.57	1.45	0.93, 2.26	1.39	0.73, 2.03
High PSW	2.60	1.44, 3.68	2.12	1.22, 2.93	1.04	0.71, 1.35

PA: physical activity; PSW: perceived stress at work; OR: odds ratio; CI: confidence interval.

Discussion

The present study examined levels of physical activity and perceived stress at work of Spanish university workers, and this is the first known study to investigate these areas in Spain. The present study found 70 or less weekly PA minutes to be associated with seven to ten PSW points in a ten graded scale when taking low PSW group as reference. University staff showed an average PA of 177 minutes per week and around half of the participants (51.90%) met the goal of 150 weekly PA minutes. According to the present study, no significant differences in gender, age, or profession on PA levels were detected among employees.

Although PA has been usually reported using different measurement tools, a previous study used electronic PAVS version (Exercise Vital Sign) on a broader adult sample finding 30.4% participants meeting the 150 minutes criteria.[25] PA has also been estimated with the British adult population through the GPAQ (Global Physical Activity Questionnaire). Estimated PA for the British population aiming for WHO recommendations were 35.40%.[40] Also, a multicenter study using accelerometry-based measurements of PA found an average of 51 weekly minutes (SD 29.5) in a sample composed of 329 Spanish adults.[41] A more recent study using AerobePAR questionnaire estimated that 33.20% of Spanish adults met the recommended PA.[42] These figures are considerably lower than those observed in the present study.

Regarding university staff, a study by Cooper and Barton[35] revealed that around half of the adult university employees reported sufficient PA concerning the recommended activity guidelines. Although that study measured PA through the International Physical Activity Questionnaire (IPAQ), those figures are comparable to those found in the present population of university workers. The use of various measurement tools and a wide range of sociodemographic differences among cohorts might explain PA differences among studies. Several studies remark the importance of sociodemographic features such as education, and occupation when explaining differences among PA population levels.[42, 43] It could clarify why figures are very close when comparing between the two university staff cohorts and quite different when comparing to a less homogeneous population.

Previous research shows that employees with low PA and high PSW are more prone to develop cardiovascular diseases such as ischemic heart disease or atrial fibrillation.[31, 33] Other studies focus more on workability, finding a significant difference in favor of those with higher exercise levels.[44] In any case, high PSW is generally related to a less PA at and outside of the workplace.[16, 26, 28, 29, 45, 46] A meta-analysis found that physical inactivity was 26% and 21% more likely among those with high-strain jobs and defined passive jobs, respectively.[47] Jonsdottir *et al.*[48] observed either light PA or moderate to vigorous PA as the only significant factor correlated with Sweden health care and social insurance workers perceived stress after adjusting by age, gender, body mass index, and educational level. Moreover, Kouvounen *et al.*[49] demonstrated public sectors employee with high strain, passive jobs or low control jobs to be less active than their counterparts with differences ranging between 2.6 to 5.2 MET (Metabolic Equivalent Task index) hours/week, even when adjusting for occupational and health factors.

Strenghts and limitations of the study

The fact that questionnaires were fulfilled in a medical setting, which may contribute to gain certainty as subjects are less likely to overstate their level of PA during a health

check.[25] Another strength of our study is related to the high number of assessed workers, which is quite challenging to reach with objective tools. On the other side, since a questionnaire was used to estimate levels of PA and PSW, the results of this research should be considered carefully because of the inherent risk of reporting bias. The PSW question has not been validated in previous research, whereas tools such as questionnaires and surveys usually lead to overestimating PA.[50, 51] Consequently, the true levels of PA may be lower than those observed in this study. Because there are different methods for assessing stress, *e.g.*, the job strain and ERI (effort-reward imbalance) model,[34] comparisons between studies are not easy to accomplish. Overall, the typical observational risk of bias involving issues such as reverse causation, residual confounding, and selection may also affect the present results. Because PAVS do not discriminate between moderate and vigorous exercise, some of the participants in the PA range between 80 and 140 minutes of weekly PA could potentially have reached recommended levels of PA. Besides, the number of missing PA values is quite high, probably as a result of several employees not having enough time to complete the whole questionnaire during the medical check. Despite that, small differences were detected between missing and valid values concerning age, gender, and profession.

Conclusions

This research observed a strong association when matching high PSW and low PA within a university workers population. There were also relationships between high PSW and medium PA, and the same occurred between medium PSW and low PA. A possible dose-response association has been detected regarding high and medium PSW and the three levels of PA. University employees PA levels might be higher than those assessed in other adult populations as universities usually develop PA programs aimed at workers.

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ORIGINAL ARTICLE

WILEY

High leisure-time physical activity reduces the risk of long-term sickness absence

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Objectives: This study examined the association of leisure-time physical activity (LTPA) with the risk of long-term sickness absence (LTSA).

Methods: A total of 10 427 subjects from the general working population in Denmark answered questions about physical activity habits, health and work environment in the 2010 Danish Work Environment Cohort Study (DWECS). Data on LTSA (≥6 consecutive weeks during 2-year follow-up) were obtained from the Danish Register for Evaluation of Marginalization (DREAM). Cox regression analysis censored for competing events and adjusted for potential confounders (age, sex, BMI, smoking habits, depression, cancer, back diseases, previous LTSA, occupational social class, and psychosocial work environment) estimated the association between the predictor (LTPA) and the outcome variable (LTSA). During the 2-year follow-up period, 9.2% of the studied population experienced LTSA.

Results: In the general working population, moderate LTPA was not associated with LTSA (HR = 0.89, 95% CI: 0.72-1.09), while high LTPA showed a tendency (HR = 0.77, 95% CI: 0.59-1.01). In subgroup analyses, women below the age of 45 years with high LTPA showed a significantly lower risk of LTSA when compared with their low LTPA counterparts (HR = 0.44, 95% CI: 0.25-0.78).

Conclusion: The results suggest that high levels of physical activity during leisure are associated with a lowered risk of LTSA, especially among younger women.

KEYWORDS

absenteeism, epidemiology, exercise, physical activity, prospective studies, sick-leave, sickness absence, workplace

1 | INTRODUCTION

There is high-quality evidence that regular physical activity reduces the risk of major chronic diseases.[1] Low physical activity levels have been associated with mortality, several types of cancer, type II diabetes, cardiovascular diseases, and poor mental health.[2-4]

Despite this, physical activity trends in European countries have remained stable for years, and approximately 60% of the adult population are never or rarely doing exercise.[5] Further, cardiorespiratory fitness within high- and upper-middle-income countries has decreased by 7.7% over the last five decades.[6] However, physical inactivity affects not only personal health but also has high societal costs: In European countries, there is an annual cost of 80 billion euros derived from medical care and treatments, functional limitations, disability as well as a loss of dependence and productivity due to physical inactivity.[7]

A large portion of the costs derived from sickness absence is usually assumed by the governments, in which long-term

sickness absence (LTSA) accounts for the major part of the expenditure. The average annual raise of sickness benefit per inhabitant in the European Union (EU) was 2.5% during the period 2008-2013, with similar values found in the Nordic countries.[8]

Sickness absence is a reliable measurement to assess the health of the workers, as it has previously been associated with both disability pensioning and mortality.[9,10] Therefore, intervening to prevent sickness absence may also, in the long term, decrease rates of disability pension. According to the Nordic Social Statistical Committee (NOSOSCO), there are different patterns of sickness absence for each of the Nordic countries. Thus, Norway and Sweden have the highest levels of LTSA, whereas Denmark and Finland are more prompted to have higher levels of short-term sickness absence.[11] Knowledge of risk factors related to sickness absence is eagerly requested and can potentially lead to more effective preventative solutions.

Because physical inactivity at the workplace is a growing problem in European countries (ie, less proportion of active jobs and more proportion of sedentary jobs),[7] several workplaces have implemented different policies and practices as preventive measures, including the promotion of physical activity at and outside the workplace. On the other hand, blue-collar workers were reporting demanding physical jobs that showed an increased risk of LTSA.[12] Thus, the type of physical activity being promoted should be health-enhancing, that is, have sufficient specify, intensity, frequency, and volume to increase physical fitness and strength.

When physical exercise has been directed toward treating specific pain or injuries in the workplace, good results have previously been reported.[13,14] In particular, leisure-time physical activity (LTPA) has been inversely associated with the risk of stroke and all-cause mortality in adults.[3,15] Even some psychosocial hazards, such as perceived stress, depression, and burnout, have been inversely associated with high levels of physical activity.[16] Therefore, as all cardiovascular diseases, musculo-skeletal and mental disorders, three of the main causes behind LTSA,[17] have shown benefits from physical activity, we hypothesized to find an inverse association between LTSA and LTPA among this population of Danish workers.

The primary aim of this study was to examine the association of different levels of LTPA with subsequent LTSA (≥6 weeks) among the general working population.

2 | METHODS

2.1 | Study design

The current study is based on a prospective cohort design and examines possible associations between different levels of LTPA and LTSA in a general population of Danish workers. Data on physical activity were extracted from the Danish Work Environment Cohort Study (DWECS) whereas data sickness absences were obtained from the Danish Register for Evaluation of Marginalization (DREAM).

2.2 | Participants and setting

A total cohort of 10 427 active general Danish employees from the 2010 DWECS were randomly sampled from the Central Register of Denmark for this study. The provided information about the characteristics of the population, health, and psychosocial work factors was obtained through a survey included in the 5-annual DWECS rounds.[18] As not all the participants completed all the survey questions, the total number of subjects included in each analysis varies depending on the employed variables.

2.3 | Ethical approval

The present study was informed to and registered with the Danish Data Protection Agency (journal number: 2007-54-0059). Due to Danish law, questionnaire-based and registered-based studies need neither approval from an ethical committee nor informed consent from the study subjects. All data were de-identified and anonymously analyzed.

2.4 | Predictor variable

Measures on LTPA were obtained through the following question used in prior research[17]: "How much time have you spent on each of the following leisure-time activities during the last year (including commuting to and from work)?" (a) "Walking, biking or other low-intensity exercises, where you do not get short of breath and do not begin to sweat (eg, Sunday walks or low-intensity gardening)?"; (b) "Exercise training, heavy gardening, or higher intensity walking/biking, where you sweat and get short of breath?"; and (c) "Strenuous exercise training or competitive sports?". Possible answers for each sub-question were: >4, 2-4, <2 h/wk or "I do not perform this activity". Low physical activity was described as performing <4 hours of low-intensity physical activity per week and not performing moderate-intensity and high-intensity activities at all. Moderate physical activity was described as performing >4 hours of low-intensity physical activity per week or moderate or high-intensity for <4 h/wk. High physical activity was described as performing a moderate or high activity for >4 h/wk or a combination of moderate and high activity for 2-4 h/wk.

2.5 | Outcome variable

Data on LTSA were obtained from DREAM and linked to the DWECS through the unique personal identification number given to the Danish citizens at birth. DREAM incorporates information on transfer payments such as a sickness absence compensation, early retirement benefits, unemployment benefits, and disability pension, among other personal information on all Danish residents.

Because employers get financial compensation for employees´ sickness absence costs after 30 days of sick-leave, LTSA was defined as registered sickness absence for at least 30 calendar days (ie, 6 weeks in the register). Previous studies have documented the high validity and reliability of the DREAM register.[10]

2.6 | Control variables

Based on previous research,[17,19-23] this study included the following potential confounders: age, gender, and variables related to lifestyle, health, occupational social class (ie, job group), and psychosocial work environment. Regarding lifestyle, body mass index (BMI) derived from self-reported height and weight (ie, weight in kilograms divided by height in squared meters) and participants were classified according to World Health Organization (WHO) guidelines[24] ("underweight, <18.5 kg m^{-2}," "normal, 18.5-24.9 kg m^{-2}," "overweight, 25.0-29.9 kg m^{-2}," and "obese, ≥30.0 kg m^{-2}"), and smoking status ("yes," "ex-smoker," and "no") were included. Concerning health, several of the chronic diseases behind most of the LTSA were included[17]: cancer ("yes" and "no, never"), depression ("yes" and "no, never"), back disorders ("yes" and "no, never"), and previous long-term sickness absence (≥1 episode of LTSA during the previous 2 years prior to baseline). Occupational social class was estimated through a Danish register managed by Statistics Denmark, including information on job groups. A total of 86 job groups comprising a wide range of job roles (ie, from blue and white-collar workers to self-employees) were represented in this research. The psychosocial work environment was measured by four dimensions from the Copenhagen Psychosocial Questionnaire,[25] including influence at work, emotional demands, support from colleagues, and support from superiors. Each of these dimensions was assessed with a 0-100-point scale.

2.7 | Statistical analysis

Employing the PROC PHREG procedure in SAS version 9.4 (SAS Institute), a Cox proportional hazard model was implemented for modeling the risk of LTSA (≥6 weeks) during the 2-year follow-up period as a function of LTPA. Using the standard Cox regression for LTSA, we assessed the hazard of an LTSA event by a competing risk procedure. When any of the study subjects had an onset of LTSA within the 2-year follow-up period (ie, from 2010 to 2012), the survival times were referred to as events of interest and non-censored, whereas respondents were censored in case of permanent drop out of the labor market based on the DREAM register (ie, statutory or early retirement, disability pension, immigration, or death). Also, the study subjects were censored at the end of the 2-year follow-up. Based on previous studies underscoring the importance of age and gender to design health-promotion strategies,[26,27] we divided participants into different subgroups regarding age and gender. A data-driven approach was used to categorize the study sample into below or above 45 years of age (ie, 45 years represented the median age of the study sample). This cut-off point was selected to ensure sufficient statistical power when comparing groups regarding age. Results are reported as hazard ratios (HRs) with 95% confidence intervals (95% CI), and the estimation method was the maximum likelihood.

3 | RESULTS

Table 1 shows the descriptive statistics for the study variables. Of the 10 427 participants (54.3% women), 960 (9.2%) had an LTSA onset during the 2-year follow-up. The participant's mean age was 43.5 ± 11.7 years.

Table 2 shows prospective associations between LTPA and LTSA among a general working population. For the entire group, high LTPA reduces more the risk of LTSA than moderate LTPA in all the implemented models when referencing to those with low LTPA. Moderate and high LTPA significantly decreases the risk for LTSA by 18% (HR = 0.82, 95% CI: 0.68-0.97) and 28% (HR = 0.72, 95% CI: 0.57-0.91), respectively (model 1).

The results observed in Table 3, with additional adjustment for smoking habits and BMI (model 2), show an increased risk estimates for both moderate (HR = 0.87, 95% CI: 0.72-1.05) and high LTPA (HR = 0.80, 95% CI: 0.62-1.02). Adjusting for these variables attenuates LTPA influence on LTSA, after which LTSA risk reduction loses statistical significance for moderate LTPA. In model 3, additionally adjusted for job group and psychosocial work environment, moderate LTPA continues increasing LTSA risk (HR = 0.89, 95% CI: 0.73-1.09) whereas high LTPA presents a LTSA risk reduction (HR = 0.76, 95% CI: 0.58-1.00). The final model (model 4), also adjusted for chronic disease and previous LTSA, observes no substantial LTSA risk estimation changes for both moderate LTPA (HR = 0.89, 95% CI: 0.73-1.09) and high LTPA (HR = 0.77, 95% CI: 0.59-1.01).

TABLE 1 Characteristics of the study population

	N	%	Mean	SD
Age	10 427		43.5	11.7
Gender				
Men	4762	45.7		
Women	5665	54.3		
Smoker				
Yes	2356	23.2		
Ex-smoker	2916	28.7		
No	4897	48.2		
BMI (kg m^{-2})				
Underweight (<18.5)	86	0.9		
Normal (18.5-24.9)	5319	52.7		
Overweight (25.0-29.9)	3399	33.7		
Obese (≥30.0)	1291	12.8		
Depression				
Yes	1272	12.5		
No, never	8938	87.5		
Cancer				
Yes	331	3.2		
No, never	9876	96.8		
Back disorder				
Yes	1650	16.2		
No, never	8551	83.8		
Previous long-term sickness absence				
Yes	883	8.5		
No	9544	91.5		
Leisure physical activity				
Low	1365	13.4		
Moderate	6853	67.5		
High	1938	19.1		
Long-term sickness absence during 2010-2012				
Yes	960	9.2		
No	9467	90.8		
Psychosocial work environment (0-100)[a]				
Emotional demands	10 154		44.6	25.1
Influence at work	10 085		67.4	24.0
Support from colleagues	9473		73.1	21.5
Support from leader	9710		69.7	25.8

[a]0-100: Normalized COPSOQ, where 0 is lowest and 100 is highest.

Table 3 also shows prospective associations between LTPA and LTSA stratified by age and/or gender, in which risk of LTSA differs by age and sex stratum. Only high LTPA exposure remains significant after fully adjustment (model 4) when meeting the conditions of being <45 years old (HR = 0.62, 95% CI: 0.41-0.96), a woman (HR = 0.72, 95% CI: 0.49-1.00) and especially, being a woman <45 years old (HR = 0.44, 95% CI: 0.25-0.78).

4 | DISCUSSION

Findings from the present study in a large cohort from the Danish general workforce showed that high LTPA reduced LTSA risk by a borderline significant 23%, even when adjusted for a broad set of potential confounders. Moderate LTPA also showed to reduce risk of LTSA but in less percentage than high LTPA. In women, a significant reduction of LTSA risk was observed for those aged less than 45 years performing high LTPA.

The results of the present study support the role of LTPA as a protective factor for LTSA. A study by Holtermann et al[26] observed LTPA reduce the risk for LTSA (≥3 consecutive weeks) among another cohort of Danish general workers. Similarly to our study, both moderate and high LTPA reduced LTSA risk; although, it was high LTPA which significantly reduced more LTSA after full adjustment. In a similar line, another study by Lahti et al[21] found significant inverse associations between LTPA and both short-term sickness absence (≤14 days) as well as LTPA (≥14 days) among Finish employees performing vigorous LTPA; that inverse association was not found for moderate-intensity LTPA.

A large body of literature has shown the effects of LTPA over general adult´s health worldwide in a dose-response manner, reducing the risk of suffering a wide range of chronic diseases[28] and all-cause as well as case-specific mortality.[29] Further, even when adjusted for sedentary time, another critical risk factor for both chronic disease and mortality,[30] physical activity showed to be a reliable predictor of all-cause mortality.[31] Thus, those LTPA protective properties might contribute to diminishing the risk of LTSA, since that has been highly associated with chronic conditions[32] and early mortality[9] Because aerobic capacity (ie, maximal oxygen consumption), as well as muscular strength, has been inversely associated with, respectively, cardiovascular disease morbidity[33] and all-cause mortality among adults,[33,34] the LTSA risk might decrease when performing either endurance or strength training during leisure. Therefore, encouraging workers to move more as a general notion, regardless of the type of physical activity, might contribute to reducing LTSA levels in a general population of workers. In opposition, intensity (ie, degree of physical effort) has been observed to be a critical issue, since vigorous-intensity LTPA has shown higher inverse associations with general sickness absence than moderate-intensity LTPA.[35]

Regarding control variables, BMI and smoking habit were the main contributors to mitigate the influence of LTPA over

TABLE 2 Age and sex, and full-adjusted hazard ratios (95% confidence interval) for the risk of long-term sickness absence in relation to moderate and high leisure-time physical activity (reference: low physical activity) in the entire study population

	Leisure physical activity	n	%	Model 1[a]	Model 2[b]
All	Low	1365	13%	1	1
	Moderate	6853	67%	0.82 (0.68-0.97)	0.89 (0.72-1.09)
	High	1938	19%	0.72 (0.57-0.91)	0.77 (0.59-1.01)

[a]Adjusted for age and gender.

[b]Model 1+ BMI, smoking habit, job group, psychosocial work environment, chronic disease, and previous LTSA.

risk reduction of LTSA in this study. It might be explained by the fact that both obesity and smoking could play an intermediary role between LTPA and LTSA since both have been inversely associated with physical activity[20,36] and directly with sickness absence (1-4 days).[37] In a lesser way, psychosocial work environment and job group variables also attenuated the risk reduction of LTSA. The first has been associated with LTPA (ie, higher job control led to higher odds of LTPA) among middle-aged workers from the United States,[19] whereas the second has shown different odds for LTPA concerning occupational classes (ie, manual classes were more prompted to be physically inactive in their leisure-time and to be less often active than professional, and semi-professional workers ranked on the two top positions) among a Finnish population of workers.[38] Finally, controlling for previous LTSA and chronic diseases (model 4) did not change the risk estimates further.

It is interesting that in the present study women aged ≤45 years found higher risk reduction of LTSA than other subgroups when performing high LTPA. One plausible explanation for this specific finding in women only might be the different baseline levels of vigorous leisure-time PA regarding gender,[5] as well as the increase of the prevalence of chronic diseases with age,[39] which would contribute to attenuate the possible influence of LTPA over LTSA.

Overall, high LTPA seems to be a protective factor for LTSA, which should be emphasized in health-promotion strategies for both companies and public institutions. Future research should focus on high-quality clinical trials involving interventions with vigorous physical activity and specific programs aimed at target groups.

Strengths of the current study include using a large and representative sample of Danish workers, as well as an objective measurement of the outcome variable through a highly reliable register. Also, a step-wise adjustment for potential confounding factors, appointed by previous research, was included in the analysis. However, several limitations should be taken into consideration for this study. Firstly, the observational nature of the research does not allow for the investigation of a causal relationship between physical activity and LTSA. Secondly, because LTPA and other control variables were self-reported, there is an inherent risk of reporting bias. However, this risk could be, in a way, attenuated due to the previous use of the questionnaire in other studies, as well as because the psychosocial work environment related-questions were extracted from the validated Copenhagen Psychosocial Questionnaire.[25] Despite the fact that we have controlled a wide range of potential confounders, other variables such as occupational physical activity might better reflect the effects of the physical efforts in the workplace, since it has been observed to affect LTPA[40] and LTSA.[12] Besides, some of the control variables, for example, chronic disease, may act as mediator rather than confounder. Thus, other types of analyses—for example, a formal mediation analysis—may lead to different results. Thirdly, self-reported data might lead to overestimating LTPA as study subjects tend to overestimate their amount of physical activity.[41] Last is that the present study could have been influenced by selection bias because a significant number of participants refused to participate in the DWECS questionnaire survey (53% response rate). Nevertheless, a robustness analysis showed that detected differences in the response rate regarding gender and educational level scarcely influenced how different job groups rated their working environment. Besides, because the present analysis of associations was mutually controlled for a relevant number of factors, non-response bias is unlikely to have influenced the results to any relevant extent. The results of the present study suggest that being highly physically active during leisure is associated with a lowered risk of LTSA, especially among younger women. Strategies aiming at this specific population should be emphasized to both prevent and equalize absence from work.

5 | PERSPECTIVE

Prevention of sickness absence is a critical public health goal since the costs for workplace absenteeism are critical among countries from the EU.[42] However, it is not only the expenditure but also the health of the workforce; several studies have suggested the association between sickness absence

TABLE 3 Adjusted hazard ratios (95% confidence interval) for the risk of long-term sickness absence in relation to moderate and high leisure-time physical activity (reference: low physical activity) in the entire study population and in age and gender subgroups

	Leisure physical activity	n	%	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]
All	Low	1365	13	1	1	1	1
	Moderate	6853	67	0.82 (0.68-0.97)	0.87 (0.72-1.05)	0.89 (0.73-1.09)	0.89 (0.72-1.09)
	High	1938	19	0.72 (0.57-0.91)	0.80 (0.62-1.02)	0.76 (0.58-1.00)	0.77 (0.59-1.01)
<45 y	Low	624	13	1	1	1	1
	Moderate	3157	64	0.83 (0.62-1.11)	0.79 (0.58-1.07)	0.81 (0.58-1.13)	0.79 (0.56-1.09)
	High	1124	23	0.66 (0.46-0.95)	0.64 (0.43-0.96)	0.62 (0.41-0.95)	0.62 (0.41-0.96)
≥45 y	Low	741	14	1	1	1	1
	Moderate	3696	70	0.81 (0.65-1.01)	0.93 (0.73-1.18)	0.98 (0.75-1.27)	1.00 (0.77-1.31)
	High	814	16	0.80 (0.60-1.07)	0.94 (0.68-1.30)	0.91 (0.64-1.30)	0.96 (0.67-1.36)
Men	Low	638	14	1	1	1	1
	Moderate	2950	64	0.89 (0.66-1.21)	0.95 (0.68-1.32)	1.08 (0.75-1.55)	1.02 (0.70-1.47)
	High	1021	22	0.90 (0.62-1.30)	0.96 (0.64-1.44)	0.96 (0.62-1.49)	0.94 (0.60-1.46)
Women	Low	727	13	1	1	1	1
	Moderate	3903	70	0.78 (0.62-0.96)	0.83 (0.66-1.05)	0.84 (0.65-1.08)	0.83 (0.65-1.07)
	High	917	17	0.63 (0.47-0.85)	0.71 (0.52-0.98)	0.70 (0.49-0.98)	0.70 (0.49-1.00)
Men <45 y	Low	273	12	1	1	1	1
	Moderate	1308	60	0.81 (0.47-1.40)	0.78 (0.43-1.44)	0.82 (0.44-1.55)	0.73 (0.39-1.39)
	High	611	28	0.86 (0.47-1.59)	0.90 (0.46-1.78)	0.93 (0.45-1.89)	0.87 (0.43-1.79)
Women <45 y	Low	351	13	1	1	1	1
	Moderate	1849	68	0.83 (0.59-1.17)	0.78 (0.54-1.12)	0.77 (0.52-1.14)	0.76 (0.51-1.13)
	High	513	19	0.53 (0.33-0.85)	0.50 (0.30-0.84)	0.44 (0.25-0.78)	0.44 (0.25-0.78)
Men ≥45 y	Low	365	15	1	1	1	1
	Moderate	1642	68	0.94 (0.65-1.35)	1.02 (0.69-1.52)	1.23 (0.78-1.94)	1.13 (0.71-1.80)
	High	410	17	0.89 (0.56-1.42)	0.95 (0.58-1.58)	0.96 (0.53-1.73)	0.91 (0.50-1.66)
Women ≥45 y	Low	376	13	1	1	1	1
	Moderate	2054	72	0.73 (0.55-0.97)	0.87 (0.64-1.18)	0.93 (0.66-1.30)	0.96 (0.68-1.35)
	High	404	14	0.75 (0.51-1.09)	0.95 (0.62-1.44)	1.00 (0.63-1.58)	1.06 (0.67-1.68)

[a]Adjusted for age and gender (all participants), for gender (<45 y, ≥45 y), for age (men, women) and crude model for gender and age subgroups (men < 45 y, women < 45 y, men ≥ 45 y, women ≥ 45 y).

[b]Model 1+ smoking and BMI.

[c]Model 2+ job group and psychosocial work environment (influence at work, emotional demands, support from colleagues and leader).

[d]Model 3+ chronic disease (depression, cancer, back disease) and previous long-term sickness absence.

and both mortality and general health.[43,44] Because there are differences among job roles,[45,46] gender,[47] or age[9] regarding causes of sickness absence, to investigate possible preventive factors such as tailored physical activity aimed at a specific population of workers could help to define better strategies. The present study contributes to supporting the use of high levels of leisure-time physical activity with a general population of workers, adding more evidence to other research findings in which high levels of physical activity during leisure have significantly reduced the risk of sickness absence in different populations of workers.[48,49]

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ORIGINAL ARTICLE
EPIDEMIOLOGY AND CLINICAL MEDICINE

Higher leisure-time physical activity is associated with lower sickness absence: cross-sectional analysis among the general workforce

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ABSTRACT

BACKGROUND: Prevention of sickness absence (SA) is a major public health challenge. Sufficient levels of physical activity may be an important protective factor. In contrast to the North European countries, little is known about physical activity behavior and its influence over SA in South European countries.

METHODS: In the European Health Interview Survey (EHIS) 2014, a total of 9512 Spanish workers aged 17 to 70 (46.5% women) replied to questions about SA (last 12 months) and the frequency of leisure-time physical activity (LTPA). Multiple linear regression adjusted for age, sex, education, occupational class, smoking habits, body mass index, and chronic disease (diabetes, hypertension, neck pain, low back pain, chronic depression and anxiety) was used to assess associations.

RESULTS: The average SA among the participants was 6.9 days (SD=33.3) per year, whereas the prevalence of any SA episode was 22.0%. The prevalence of workers performing high or very high LTPA was 31.0%. In final sex and age-stratified fully adjusted models, the association between LTPA and SA remained significant for women aged 44 to 51 (β=-0.07, 95% CI: -0.42 to -0.03) for SA.

CONCLUSIONS: The results suggest that higher LTPA is associated with lower SA in a particular category of workers, that might benefit from physical activity strategies.

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KEY WORDS: Workplace; Exercise; Absenteeism; Sick leave.

Sickness absence (SA) has been in the spotlight over the last decades in response to the growing challenging labour conditions; by managing absenteeism at the workplace, institutions can achieve fruitful cost savings and better working environments.[1-3] The expenditure for absenteeism due to illness is financially significant worldwide; average cost estimation of SA is 2.5% of the gross domestic product (GDP) among the EU countries.[4] Consequently, those assuming most of the burden (*i.e.* governments and companies) want to reduce it.

Dealing with attendance is critical concerning the health and well-being of the workforce.[5] Because physical and psy-

chological demands usually differ regarding job roles and organisational policies,[6, 7] figures on SA usually comprise a wide range of values. For instance, since blue-collar workers usually deal with a higher physical workload, they are more prompted to have long-term SA than white-collar workers,[8] whereas white-collar workers on long-term SA due to musculoskeletal disorders are more vulnerable to all-cause disability pension.[9]

To address the SA issue, workplaces have implemented different strategies aimed at employees. Most of those actions performed at the workplace consisted of single or multi-component interventions involving physical work changes, policy changes, counselling (*i.e.* to provide information on health issues), and health habits modification (*i.e.* diet, physical activity and/or smoking).[10-13] In addition, higher levels of leisure-time physical activity (LTPA) have been found to significantly reduce the risk of long-term SA among different population of workers.[14] Further, the type and the cause of SA are usually linked to the nature of the work and the related tasks.[15] Besides, some illnesses have proven to increase the risk of long-term SA more than others, depending on the job role. For instance, back pain or depression have been ranked among the highest behind SA causes in healthcare workers,[15, 16] although the two illnesses have shown to improve with physical activity.[17, 18]

Whether higher physical activity exposure outside (*i.e.* while leisure) or at the workplace (*i.e.* while working hours) is better regarding long-term SA has been investigated, demonstrating a clear inverse association with leisure time,[19, 20] but less is understood on how physical activity influences short-term SA (*i.e.* from 1 to 14 days off from work due to illness). According to a Nordic report, short-term periods of SA are more prevalent than long-term SA depending on the country, the sex and the age.[21] Thus, focusing on the larger picture of the SA issue could be a suitable strategy to develop since simply extrapolating results from studies on long-term to short-term SA may not be valid. Because there are usually no fixed terms for illnesses, investigating SA as a whole could offer complementary information to better understand that phenomenon as a continuous process.

More research is warranted on SA in the workplace in the Southern European countries. Because cultural and organisational differences can influence the association between physical activity and SA,[22] institutions have recently claimed for more and better research-based evidence of this association among the Spanish workforce.[23]

We hypothesise that there will be an inverse association between levels of LTPA and SA among a representative cohort of Spanish workers.

Materials and methods

This study consisted of a survey assessing general health among a European population of citizens, in which the 2014 Spanish round was analysed to investigate potential associations between physical activity and absenteeism due to illness. In order to provide a comprehensive reporting of the data for the present cross-sectional study, the STROBE guidelines were followed.[24]

Data from the European Health Interview Survey (EHIS) 2014 were retrieved from the section of the survey conducted in Spain from January 2014 to January 2015.[25] The Spanish branch of the EHIS survey was carried out in collaboration between the Ministry of Health, Social Services and Equality, and the National Statistics Institute of Spain. A stratified three-stage sampling considering census sections, family dwellings and adults (15 years or more) was respectively implemented. First, the number of dwellings per region was distributed according to both uniformity and size proportionality. In the second sampling stage, the dwellings were chosen with systematic sampling. Finally, the random Kish method[26] was used to select the participants who were going to fulfil the Adult Questionnaire. To achieve a 95% confidence interval (CI) accuracy estimations at both national and regional level, 37,500 dwellings from 2,500 different census sections were set as the sample-size. The number of dwellings chosen for each census section was 15. After discarding those not responding dwellings (N.=14,658) (31.0%), a representative sample of the adult population resident in Spain was collected and consisted of 22,842 adults aged 15-102 years. All the participants signed an informed consent form before participating in the survey.

Those participants not working at that time were excluded (N.=13,150). Of the remaining, those aged more than 70 years (N.=12) and those not reporting data on SA (N.=168) were also discarded. Thus, a total of 9,512 workers, comprising a wide-range of job roles (*i.e.* from white and blue-collar workers to self-employees) were included in the present study.

Measures on SA were obtained through the following question "During the last 12 months, have you ever been absent from work due to illness? Take into account all types of illnesses, health problems or injuries suffered causing SA." Those participants responding "yes" to this question were considered to have had a SA episode during that term. The number of days of SA was estimated with the question "How many days were you absent from work due to illness?" Possible answers ranged from 0 to 365 days and offered "does not know" or "does not answer" as

choices. Self-reported questions on SA recall have shown moderate agreement when compared to company registers regarding frequency (Kappa=0.50, 95% CI: 0.43-0.57) and duration (Kappa=0.54, 95% CI: 0.48-0.60) of the SA.[27]

To estimate LTPA, the following single-item question included in the national survey was used: "Which one of the following choices better describe the frequency of your leisure-time physical activity?". Possible answers comprised six possible choices: "1) I do not exercise. I spend my leisure-time almost completely in a sedentary way (reading, watching TV, cinema); 2) I occasionally perform any physical activity or sport (walking, cycling, gardening, soft aerobics, recreational activities involving a light effort, etc.; 3) I perform physical activity several times a month (sports, aerobics, running, swimming, team games, etc.; 4) I perform sport or physical training several times a week; 5) Does not know; 6) Does not answer." In the analyses, answer 1 is referred to as Low, answer 2 as Moderate, answer 3 as High, answer 4 as Very High, and answers 5 and 6 as Missing LTPA. Because this variable regarding LTPA behavior has been continually assessed in the Spanish National Health Survey since 1987, an additional value of the present analysis exists, since it allows historical trends analyses. Further, different single-item questions regarding physical activity have shown strong reproducibility when using Spearman's rank correlation coefficients (r=0.72-0.82), as well as strong agreement when meeting physical activity recommendations (kappa=0.63, 95% CI: 0.54-0.72).[28]

Measurements on BMI (Body Mass Index, *i.e.* weight in kilograms divided by height in squared meters), in which obesity was set at BMI≥30 kg/m^2, derived from the self-reported height and weight. The smoking status was categorised as current smoker, former smoker, and never. Education was divided into three categories regarding the highest achieved level, corresponding the highest rank to university studies (≤primary, secondary, and ≥tertiary), and occupational class comprised up to 168 different categories grouped into six categories regarding the Spanish classification of occupations.[29] Occupational class I included executive managers and academics; occupational class II consisted of middle managers, technicians, athletes and artists. Occupational class III comprised white-collar and self-employed workers, and occupational class IV covered supervisors and skilled blue-collar workers. Finally, occupational class V consisted of both skilled blue-collar workers from the primary sector, whereas occupational class VI only included unskilled workers.

Regarding the health-related covariates, those who answered "yes" to the question ''Have you suffered from neck pain within the last twelve months?" were considered to have neck pain. The same question and procedure were used for assessing the prevalence of the remaining chronic diseases (*i.e.* hypertension, diabetes, low back pain, chronic depression and anxiety).

Statistical analysis

We conducted a statistical analysis using SPSS 22.0. Mean differences of SA by sample characteristics were assessed by Chi-squared tests. The association between LTPA (exposure) and SA (outcome) was estimated through multiple linear regression analysis conducted for the whole sample as well as by both combined sex and age subgroups. Combined sex and age-stratified analyses were adjusted for BMI, smoking status, education, occupational class, and health. To gain statistical power, the six considered chronic diseases were grouped into a single variable. With the exception of BMI (0.1%), smoking (0.1%), occupational class (0.6%) and LTPA (0.1%), the rest of the studied variables did not present missing values, which were discarded from the analyses. Cut-off points for age-categories (17–36, 37-43, 44-51 and 52-70 years) were estimated through equal percentile based on explored data option from the SPSS visual grouping procedure. As a result of the multiple linear regression analyses, we calculated standardized regression coefficients with 95% confidence intervals (CIs). The level of statistical significance was set at P<0.05. In sensitivity analyses, the outcome variable was log-transformed, and no substantial difference was found (results not shown).

Results

Table I shows the baseline characteristics of the study population. The cohort includes a population of Spanish general workers (46.5% women) on average 43.6 (SD=10.2) years old. Concerning lifestyle, 58.9% of the cohort was linked to anytime smoking habits, and 47.3% were overweight or obese. The average of SA among the study cohort was 6.9 days (SD=33.3) per year. The overall prevalence of any SA episode is 22.0%, whereas the prevalence of people performing high or very high LTPA is 31.0%. Regarding LTPA subgroups, workers from low, moderate, high and very high present a 7.5%, 7.5%, 3.3% and a 3.7% prevalence of SA, respectively.

Figure 1 shows a clear tendency to increase differences between the two lower and the two higher LTPA categories with age. When age increases with those participants

TABLE I.—*Characteristics of the study population (N.=9512).*

Characteristics	N.	(%)	Sickness absence	
			Mean	SD
Age*				
17-36	2485	26.1	4.6	25.0
37-43	2352	24.7	5.2	26.2
44-51	2309	24.3	7.0	33.4
52-70	2366	24.9	11.0	44.7
Sex*				
Men	5090	53.5	5.6	28.9
Women	4422	46.5	8.4	37.7
BMI*				
Underweight	163	1.7	10.3	46.0
Normal	4653	48.9	6.0	29.8
Overweight	3291	34.6	7.0	32.4
Obese	1208	12.7	10.3	43.9
Missing	7	0.1	4.9	35.4
Smoker**				
Never	3903	41.0	6.3	32.2
Former	2646	27.9	8.5	38.0
Smoker	2951	31.0	6.3	29.6
Missing	12	0.1	20.4	69.1
Education***				
≤Primary	1068	11.2	8.5	37.2
Secondary	5429	57.1	7.5	35.0
≥Tertiary	3015	31.7	5.3	28.0
Occupational Class*				
I	1421	14.9	4.9	24.9
II	1065	11.2	7.2	33.5
III	2240	23.6	5.9	30.2
IV	976	10.2	5.4	27.4
V	2527	26.6	9.3	41.3
VI	1228	12.9	7.7	33.0
Missing	55	0.6	1.2	4.9
Chronic disease*				
Yes	3045	32.0	13.6	49.0
No	6467	68.0	3.8	21.6
LTPA*				
Very high	1477	15.5	4.9	24.8
High	1472	15.5	4.8	25.5
Moderate	3386	35.6	7.0	33.4
Low	3166	33.3	8.8	39.2
Missing	11	0.1	0.2	0.7

SD: standard deviation.
*P<0.001; **P<0.05; ***P<0.01.

performing high or very high LTPA, there is a linear trend to reduce SA prevalence from 4.6% to 2%, and from 5.5% to 2.5% respectively.

When performing adjusted analyses, LTPA was associated with a significant reduction for SA in models comprising sex, age, BMI, smoking status, education, and educational and occupational class (Table II). In sex and age-segmented analyses, the full adjusted association between LTPA and SA only remains significant for women ranging 44 to 51 years (Table III).

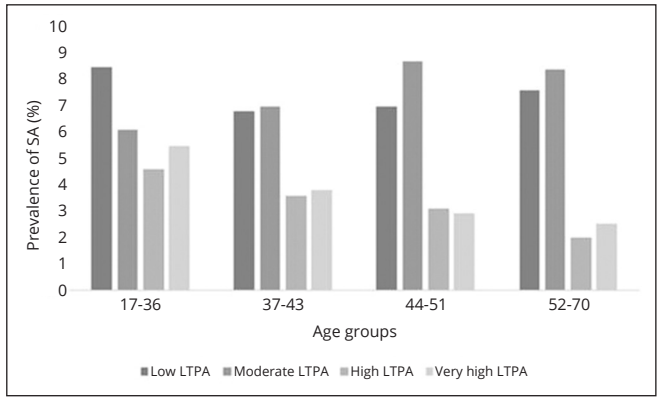

Figure 1.—Prevalence of sickness absence (SA) by level of leisure-time physical activity (LTPA) and by age groups.

TABLE II.—*Adjusted linear regression models showing the associations between SA and LTPA.*

	N.	β	(95% CI)
LTPA crude model *	9501	-0.04	(-0.09 to -0.03)
Model 1[a] **	9501	-0.03	(-0.05 to -0.01)
Model 2[b] **	9298	-0.02	(-0.04 to 0.00)
Model 3[c] ***	9247	-0.02	(-0.03 to 0.00)
Model 4[d]	9247	-0.01	(-0.02 to 0.00)

CI: Confidence Interval; SA: sickness absence; LTPA: leisure-time physical activity.
[a]LTPA adjusted by age and sex; [b]LTPA adjusted by age, sex, body mass index and smoking habit; [c]LTPA adjusted by age, sex, body mass index, smoking habit, education and occupational class; [d]LTPA adjusted by age, sex, body mass index, smoking habit, education, occupational class and chronic disease; *P<0.001; **P<0.01; ***P<0.05.

TABLE III.—*Adjusted linear regression model showing the associations between sickness absence and leisure-time physical activity regarding sex and age subgroups.*

Sex	Age (years)	N.	β[a]	(95% CI)
Men	17-36	1245	0.01	(-0.01 to 0.02)
	37-43	1263	-0.01	(-0.02 to 0.01)
	44-51	1240	0.00	(0.00 to 0.00)
	52-70	1236	-0.02	(-0.07 to 0.03)
Women	17-36	1168	-0.02	(-0.05 to 0.02)
	37-43	1035	-0.00	(-0.01 to 0.01)
	44-51	1009	-0.07	(-0.42 to -0.03)
	52-70	1051	-0.01	(-0.06 to 0.03)

CI: confidence interval.
[a]Leisure-time physical activity adjusted by body mass index, smoking habit, education, occupational class and chronic disease.

Discussion

In the present cohort of Spanish general workers, LTPA was significantly associated with decreased SA, with the exception of the fully adjusted model including chronic disease. In the sex and age-stratified analyses adjusted by

the rest of the control variables, the association between LTPA and SA remained only significant for women aged 44 to 51 years. Prevalence of SA observed a clear trend to diminish with the ageing process when achieving high or very high levels of LTPA, whereas those workers performing lower levels of LTPA presented the highest prevalence of SA in all age categories.

As previously observed with different populations of workers,[1, 30] in this study high levels of LTPA were associated with less SA, even when adjusted for different control variables such as sex and age. Owing to the use of a graded question to measure physical activity, the present study focus LTPA on the quantitative (*i.e.* frequency) instead of the qualitative element (*i.e.* intensity) of the exposure. Thus, achieving a meaningful value of LTPA days, regardless the way physical activity has been performed (*i.e.* different possible combinations of high, moderate and low physical activity to achieve the same amount of days), could result in a significant inverse association of SA. A clinical trial by Losina *et al.*[30] had also an insight on the quantitative aspect of LTPA, finding significantly higher rate ratios of unplanned illness-related absenteeism when comparing participants performing low (0–74 minutes per week) (RR=3.5, 95% CI: 1.7–7.2) and medium (75-149 minutes per week) LTPA values (RR=2.4, 95% CI: 1.3–4.5) with those participants achieving≥150 minutes per week (*i.e.* high LTPA). On the contrary, another research emphasized more the qualitative aspect of the LTPA; finding significant risk reductions of short (≤14 days) and long-term SA (>14 days) with vigorous (from 14–30 to over 50 MET-hours per week including vigorous activity; *i.e.* jogging, running or equivalent activities) but not with moderate-intensity LTPA (14–30 MET-hours per week in only moderately intensive activity; *i.e.* walking, brisk walking or equivalent activities) among a local population of Finnish employees.[31] Further, it has been vigorous instead of moderate-intensity LTPA what has been repeatedly underscored to reduce more the risk of long-term SA among different populations of workers.[1, 20]

When adjusted for occupational class (*i.e.* job role), our proposed model showed significant modifications in the association between LTPA and SA; this finding highlighting the differences among job categories, probably due to different work demands, is consistent with those observed in other studies carried out with a general population of Danish workers, in which high levels of occupational physical activity (*i.e.* work pattern of carrying heavy burdens and carrying out physically strenuous work) were observed to significantly increase the risk of long-term SA (≥3 weeks) and global health.[20] Similarly, another study by Andersen *et al.*[19] focused more on the nature of the physical work demands and its relationship with long-term SA (≥6 weeks) found how each of the analyzed factors increased the risk of long-term SA in a dose-response fashion. Although there are clear methodological differences among the studies, it would also be worth-examining that reverse association between occupational physical activity and SA among Spanish workers, since managerial and cultural differences among countries, could further test the certainty of that discovery.[22]

We found a clear trend to diminish the prevalence of SA with the age when unadjusted analyses and categorized into four quartiles. Regardless of age, the prevalence of SA remained lower for workers performing high and very high LTPA, whereas those workers achieving lower levels of LTPA held SA steady for all the age categories. Thus, the age factor seems to take its part when explaining SA and older but not younger workers could be more sensitive to physical activity exposure. Similar findings were observed among female eldercare workers, in which physical exertion at the workplace increased the disability pension risk in older (>45 years) but not in younger workers (≤45 years).[32] In our case, it was solely women aged 44 to 51 who presented a significant inverse association between LTPA and SA when adjusted by all the control variables. There might be explanations to this finding related to a joint inverse association of women, usually suggested at higher risk for physical inactivity,[33] and a declining work ability at that particular age range[34] with SA.

Several of the health confounders used in our study have been ranked as one of the most prevalent among the workforce.[35, 36] Although there are usually different values among job roles (*i.e.* blue and white-collar workers) regarding mental and physical disorders, both back pain and chronic depression are frequently behind the major causes of long-term SA.[15, 16] However, despite the high influence of chronic diseases in the proposed model, the inverse association between LTPA and SA remained significant for a specific category in this study. Furthermore, the significant association between chronic disease covariate and SA suggests that those highlighted health risk factors for long-term SA could also be substantial for overall SA. Except for BMI, which did not find a significant association, the rest of the covariates observed a significant influence over SA when included in the full model. These results support the findings of other studies outlining the association of

current smoking habits with a higher risk of general SA in specific populations of workers (*i.e.* local employees and health workers), though differs from another research suggesting the influence of BMI over SA.[37, 38]

Overall, achieving a frequency of several days a month to several days a week of LTPA seems to be associated with SA solely in a specific combined sex and age category among a general population of workers. Health-promotion strategies aiming at women aged 44 to 51 performing lower levels of LTPA or those suffering from those considered chronic diseases might reduce SA prevalence. Future research should involve such job roles with a higher risk of SA to better discriminate the causes which most trigger that outcome.

Strengths and limitations of the study

Strengths of the current study comprise using a large random sample of Spanish workers, as well as measuring variables through a survey carried out by a reputable institution. In addition, a representative set of covariates covering a wide range of risk factors for SA was considered for the implemented regression model. However, this research should be interpreted in light of its limitations. First, the observational design of the study does not permit to draw conclusions about a causal relationship between LTPA and SA. Therefore, lower categories of LTPA may lead to high levels of SA with women aged 44 to 51, but the reverse association may also be present, *i.e.* those being sick are less likely to perform physical activity. Second, the subjective nature of the measured variables represents an inherent risk of reporting bias. Third, the dataset did not provide SA information regarding specific causes, which might have helped to understand which are the most common illnesses behind LTSA. However, the information provided is highly relevant for workplaces aiming to reduce SA, regardless of the actual underlying disease. Last, the implemented survey does not discriminate between vigorous or moderate LTPA, which limits the scope of the study.

Conclusions

In conclusion, the results of the present study suggest that a determined frequency of LTPA (from several times a month to several times a week) is associated with low SA in women from a specific age range. Health strategies aiming at this specific population might reduce levels of SA. However, before formulating recommendations for practice, further longitudinal research is required to establish the direction of causality.

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Authors' contributions.—Rubén López-Bueno: study concepts/study design, data acquisition, data interpretation, literature research; Joaquín Calatayud: study concepts/study design, manuscript revision for important intellectual content; Lee Smith: data acquisition, data analysis, data interpretation; Guillermo F. López-Sánchez: data acquisition, data analysis, draft the work; Lars L. Andersen: study concepts/study design, data interpretation, study design; José A. Casajús: study concepts/study design, manuscript revision for important intellectual content, guarantor of integrity of entire study.

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ARTÍCULO VI

Journal of Sports Sciences

Vigorous and moderate leisure physical activity reduces the risk of long-term sickness absence among 4699 healthy eldercare workers

--Manuscript Draft--

Full Title:	Vigorous and moderate leisure physical activity reduces the risk of long-term sickness absence among 4699 healthy eldercare workers
Manuscript Number:	RJSP-2019-2057
Article Type:	Original Manuscript
Keywords:	healthcare; workplace; physical activity; absenteeism; sick leave
Abstract:	We investigated the association of leisure-time physical activity (PA) with the risk of long-term sickness absence (LTSA). After screening for chronic musculoskeletal pain, depressive symptoms and previous LTSA, a total of 4699 healthy Danish eldercare women answered questions on PA, health and work environment from a survey in 2005. Data on LTSA (≥3 consecutive weeks during 1-year follow-up) were acquired from the Danish Register for Evaluation of Marginalization (DREAM). Time-to-event analyses calculated the hazard ratio (HR) for LTSA from PA during leisure. Analyses were adjusted for age, BMI, smoking habits, psychosocial work environment (emotional demands, influence at work, role conflicts, and quality of leadership), physical exertion during work, and education. During the 1-year follow-up period, 594 (12.6%) workers experienced LTSA. Eldercare workers showed significant reduced risk of LTSA when performing moderate (HR 0.67, 95% CI 0.47–0.96) and vigorous (HR 0.45, 95% CI 0.25–0.81), but not light PA (reference group: sedentary). In subgroup analyses, women over 45 years showed an even more pronounced risk reduction of LTSA. The results suggest that vigorous or moderate, but not light PA, during leisure is associated with a reduced risk of LTSA in a dose-response fashion.
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Vigorous and moderate leisure physical activity reduces the risk of long-term sickness absence among 4699 healthy eldercare workers

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Running title: Physical activity reduces sickness absence among eldercares

Abstract

We investigated the association of leisure-time physical activity (PA) with the risk of long-term sickness absence (LTSA). After screening for chronic musculoskeletal pain, depressive symptoms and previous LTSA, a total of 4699 healthy Danish eldercare women answered questions on PA, health and work environment from a survey in 2005. Data on LTSA (≥3 consecutive weeks during 1-year follow-up) were acquired from the Danish Register for Evaluation of Marginalization (DREAM). Time-to-event analyses calculated the hazard ratio (HR) for LTSA from PA during leisure. Analyses were adjusted for age, BMI, smoking habits, psychosocial work environment (emotional demands, influence at work, role conflicts, and quality of leadership), physical exertion during work, and education. During the 1-year follow-up period, 594 (12.6%) workers experienced LTSA. Eldercare workers showed significant reduced risk of LTSA when performing moderate (HR 0.67, 95% CI 0.47–0.96) and vigorous (HR 0.45, 95% CI 0.25–0.81), but not light PA (reference group: sedentary). In subgroup analyses, women over 45 years showed an even more pronounced risk reduction of LTSA. The results suggest that vigorous or moderate, but not light PA, during leisure is associated with a reduced risk of LTSA in a dose-response fashion.

Keywords: healthcare; workplace; physical activity; absenteeism; sick leave.

Introduction

Since the mid-twentieth century, when the central core of the labour legislation consolidated in the Western countries, sickness absence has been a delicate and complicated matter to deal with for both governments and companies. According to the World Health Organization (WHO), the last average figures from 2016 pointed annually 11.8 days of sickness absence per employee in the European Union (1). It has been estimated that the total expenditure regarding work disability and sickness absence were 2.5 times those of unemployment and that that tendency was rising (2). Against this background, it comes as no surprise that worksites have been trying to implement promotion strategies to enhance workplace attendance in recent years with inconclusive results (3).

Sickness absence constitutes a multicausal phenomenon comprising both lifestyle and occupational factors such as occupational hazards, physical demands and psychosocial working conditions. It has proven to have a predictive value for the workforce as it has been associated with a higher risk of disability pensioning and mortality (4,5). Regarding personal lifestyles, previous studies have found associations between risk factors such as smoking, obesity and leisure-time physical activity (PA) on the one side and long-term sickness absence (LTSA) on the other (6–8). Further, occupational PA does not seem to confer the same health benefits as shorter bouts of targeted PA performed during leisure (9,10), since that has been related to atrial fibrillation (11), mortality (12), and a higher risk of LTSA (13). In addition, high physical demands at work and adverse psychosocial working conditions (i.e. high psychological demands, discrimination, bullying, low-job promotion and work-life imbalance) have also associated with a higher risk of sickness absence (14–16).

Previous research has also shown differences concerning age, gender and sickness absence patterns. In the Nordic countries, women usually have more sickness absence than men, whereas older workers tend to suffer more from LTSA, and younger workers have more short-term sickness absence (17). Other possible confounders in the association between leisure-time PA and LTSA might be socioeconomic status, and occupational class since both of them modifies the association between lifestyle factors such as poor diet, smoking and lack of PA and risk of LTSA (6,18,19).

Because job roles differ in terms of physical and psychological demands, studies involving different occupational classes and different types of physical activity exposures are necessary. For instance, it has been shown that white-collar workers reduced LTSA with vigorous physical activity during leisure (20), whereas blue-collar workers with physically demanding jobs might benefit more from exercise programs focused on preventing occupational injuries such as specific musculoskeletal disorders (21). In particular, those occupational classes with high levels of sickness absence (i.e. healthcare sector) (22) deserve special attention due to their high costs for individuals, workplaces and society. The profile of these job roles is usually characterized by high-perceived physical exertion (23) often combined with poor psychosocial safety (24).

Eldercare health workers are confronted with a wide range of occupational risk factors for developing musculoskeletal disorders (e.g. excessive pressure over low back when handling patients) and consequently, LTSA. Such imbalance between physical demands at the workplace and physical capacity might be attenuated by enhancing physical fitness (25). Moreover, because eldercare workers usually experience a combination of both high psychosocial and physical demands, a high risk of LTSA has been reported among them (26,27).

Because European Union forecasts have doubled figures for elderly European population at the end of the century (28), the number of eldercare workers is also expected to grow. Thus, research about occupational hazards and possible preventive factors such as leisure-time PA for this growing-expected population of workers could contribute to both increasing work performance and lowering LTSA.

The present study aims to examine the influence of leisure-time PA over LTSA among healthy female eldercare workers. We hypothesised that high levels of leisure-time physical activity would be prospectively associated with lower levels of long-term sickness absence.

Materials and methods

Study design and population

The design of the present study corresponds to a prospective cohort study with one-year register follow-up. In order to ensure comprehensive reporting of the data for the present study, the STROBE guidelines were followed (29). To obtain data on LTSA, a linkage to the Register for Evaluation of Marginalization (DREAM), a register on social transfer payments (30) was made. Collection of the baseline data started in the fall of 2004 up to the spring of 2005, in which a total of 9949 out of 12744 eldercare workers (78%) from 36 Danish municipalities enrolled in the study, responded to the sent postal questionnaires. For the present analyses, we excluded male workers (n=234) and those who were not directly engaged in care services such as secretaries or janitors, among others (n=763). Of the remaining population, we excluded 4253 respondents considered not healthy. The definition of being healthy was based on the following notion previously highlighted by Andersen et al. (27) regarding some of the more influential conditions over LTSA; i) without chronic musculoskeletal pain (>30 days during the previous year) in the

low back, neck/shoulders or knees (not in any of the regions) (31); ii) scoring normally on the major depressive inventory (i.e. less than 20) (32); and iii) without any ongoing LTSA during the year previous to the study (21). Altogether, the three conditions were required to be fulfilled. Therefore, a total of 4699 healthy female eldercare workers, comprising nurses, therapists, and social and healthcare assistants, among other care staff, were included in the present study.

Risk factor

Measures on LTPA were obtained through the following question used in prior research (33,34): "Which description most precisely covers your pattern of physical activity at leisure time during the last 12 months?" Four response categories (ranging from low to high volume and intensity) were used: (i) "Mainly sedentary or light physical activity for less than 2 hours per week (e.g. you read, watch television, go to the cinema)"; (ii) "Light physical activity for 2–4 hours per week (e.g. you go for a walk, light gardening, light physical exercise)"; (iii) "Light physical activity for more than 4 hours per week or vigorous physical exercise for 2–4 hours per week (e.g. fast jogging or cycling, heavy gardening, exercise where you are sweating and breathing heavily)"; (iv); "Vigorous physical exercise for more than 4 hours per week or taking part in regular competitive sports several times a week". In the tables, these are referred to as sedentary (reference group), light, moderate and vigorous leisure-time PA. Sedentary respondents were presented as the reference group so that we could compare the effects of different levels of leisure-time physical activity with sedentary.

Outcome

Data on LTSA were obtained from DREAM, which incorporates information on transfer payments such as a sickness absence compensation, early retirement benefits,

unemployment benefits, and disability pension, among other personal information on the Danish population.

Because employers got financial compensation for employees sickness absence costs after 14 days of sick leave, LTSA was defined as registered sickness absence for at least 21 calendar days (i.e. three weeks in the register). The DREAM register has been previously validated, showing high validity and accuracy (35).

Confounders

The baseline questionnaire included questions on the following confounders; age, education (categories of different healthcare education, e.g. therapist, social and health care helper, social and health care assistant, nurse, nurse aide, none), body mass index (BMI) (kg/m^2, continuous variable) and smoking status (yes/no). Physical work demands were based on Borg's Rate of Perceived Exertion (RPE) scale (36). Using a 7-point scale, participants answered the question: "How would you rate your physical exertion while working with the patients?" Participants answered on a scale of 1) "very, very light"; 2) "very light"; 3) "light"; 4) "somewhat strenuous"; 5) "strenuous"; 6) "very strenuous"; and 7) "very, very strenuous". Finally, the psychosocial work environment was assessed by four dimensions from the Copenhagen Psychosocial Questionnaire (37), including influence at work, emotional demands, role conflicts and quality of leadership. Each of these dimensions was assessed with a 0-100 point scale.

These confounders were chosen as education, lifestyle, physical work demands at work and psychosocial work environment have been associated with the risk of LTSA (21,34,38,39).

Statistical analysis

We used a Cox proportional hazards model to calculate hazard ratios (HR) and 95% confidence intervals (95% CI) of the leisure-time PA variable for suffering from LTSA during follow-up. The follow-up time was one year or until censoring, if voluntary state pension, early-retirement pension, immigration or death occurred. When a worker got a sickness absence benefit payment during at least three weeks within the follow-up period, the survival times were non-censored and referred to as event times. Maximum likelihood and the PHREG procedure of SAS 9.4 (SAS Institute, Cary, NC, USA) was used as the estimation method.

The analyses were adjusted for age in Model 1, adding education, smoking, BMI, physical exertion and psychosocial work environment in Model 2. Based on the work by Andersen and colleagues (27), we also tested leisure-time PA for interaction with age.

Results

Table 1 shows the overall and age-stratified baseline characteristics of the study population. The mean age of the healthy female eldercare workers is 44.7 (SD 10.3), and the mean BMI remains in a normal 24.6 (SD 4.2). Around 36% are smokers, and most of them show light levels of leisure-time physical activity. Both younger and older eldercare workers show similar health style patterns.

A total of 594 (12.6%) eldercare health workers suffered from LTSA during a one-year follow-up. Table 2 shows the overall and age-stratified results for the risk of LTSA. In the analyses involving all the eldercare workers, vigorous leisure-time physical activity significantly reduces the risk of LTSA in the model 1 (HR 0.47, 95% CI 0.27–0.83) as well as in the model 2 (HR 0.45, 95% CI 0.25–0.81), whereas the moderate leisure-time physical activity reduces the risk of LTSA solely in model 2 in a lesser way. When

stratifying for age, younger workers do not show any significant LTSA risk reduction in any of the two implemented models. The older workers show significant risk reduction of LTSA in model 2 with the moderate subgroup (HR 0.54, 95% CI 0.32–0.90) and the vigorous leisure-time physical activity subgroup (HR 0.43, 95% CI 0.18–0.99).

Discussion

The major finding of the present study is that both moderate and vigorous leisure-time PA, even when adjusted for altogether age, lifestyle, physical and psychosocial work factors, and education, showed a significant risk reduction of LTSA in a cohort of healthy female eldercare workers during the one-year follow-up. When stratified for age, we observed that the risk estimates only remained significant – and even appeared to become even lower (i.e. higher protective effect of physical exercise) - for the older workers.

Although there were no significant LTSA risk reductions for younger workers, we observed a clear trend to get LTSA risk figures lowered in model 2 when workers progressively achieved higher levels of leisure-time PA. This leisure-time PA dose-response fashion was also observed for the whole cohort and the older worker's subgroup.

Concerning characteristics of PA, vigorous leisure-time PA seems to reduce the risk of sickness absence more than light or moderate leisure-time PA. Several studies have found similar results (20), in some cases highlighting the effects of intensity (degree of effort) at the expense of volume (i.e. quantity). In particular, it was vigorous leisure-time PA but not a high volume of moderate leisure-time PA which reduced more the short sickness absenteeism (1-14 days) and the LTSA (> 14 days) among Finnish municipal employees (8). Further, women benefited more from vigorous leisure-time PA than men when reducing both short and long-term sickness absence (8). The differences between men and women responses to sickness absence when exposed to PA might be explained for

the different baseline levels of vigorous leisure-time PA (40). Because same physical stimuli usually lead to different organic adaptations in different populations, those workers with higher levels of physical fitness (i.e. men) might need another type of PA exposure (e.g. more vigorous or another PA profile) to reduce LTSA. On the other hand, women would have benefited more from vigorous leisure-time PA exposures because PA doses would have been more suitable according to their previous physical fitness levels. Furthermore, considering the link between vigorous leisure-time PA and good work ability in physically demanding jobs (38), it could be plausible that this would result in an LTSA reduction.

In agreement with other studies, our findings underscore that age plays an important role when explaining LTSA among eldercare health workers. A recent study by Andersen et al. (27) found that higher levels of physical exertion increased the risk for disability pension among older female eldercare workers, whereas moderate levels of emotional demands were associated with reduced risk among the younger eldercare workers. Because physical fitness declines with age, the relative workload during occupational tasks, e.g. patient handling at the hospital, is likely to increase. Thus, an imbalance between demands of the work and capacity of the worker is more likely to occur and consequently lead to poor health. Further, prior studies have observed that the more occupational PA, the less leisure-time PA in a suggested compensation way (41). This inverse association would progressively reinforce the habits of performing less leisure-time PA during the ageing process and, consequently, increasing the risk of LTSA among the older eldercare workers.

Regarding lifestyle, in which levels of physical activity accounts for prominent participation, dose-response associations have been previously found in Danish eldercare workers, although smoking and lower or higher body mass index (BMI) found stronger

associations than leisure-time PA for LTSA in the same study (34). More recently, sleeping problems (i.e. insomnia or disturbing thoughts) has been added to the set of risk factors associated with future sickness absence, which occurs separately (42) or in conjunction with other predictor variables such as PA during leisure and smoking in a cohort of Finnish municipal employees (43).

In summary, both vigorous and moderate leisure-time PA seems to be a protective factor for LTSA, especially among older eldercare women workers. Implementing controlled interventions with regards PA at the workplace would help to increase the level of evidence on the issue, as it has been previously suggested (44).

The main strength of our study is the robust design. We used a large cohort of Danish women eldercare workers being healthy at baseline, (i.e. free from chronic musculoskeletal pain, previous sickness absence, and depressive symptoms) which reduces possible misclassification bias of exposures. The homogeneity of the study cohort (i.e. women from the same country working in the healthcare sector) diminishes the bias from socioeconomic confounders such as education or income. Further, data on LTSA were collected from a highly reliable register (4,35) with a narrow margin of error.

In contrast to other studies, our research presents a wider range of PA categories, which might better reflect the dose-response association between the exposure and the outcome variable. Last, a step-wise adjustment for such potential confounders commonly appointed by prior studies was included in the analysis. However, there are also limitations to our study. First, due to the inclusion criteria, in which only women were included in the study, interpretations should be only done over populations with similar characteristics and avoid generalising to other worker populations with other working demands. By contrast, most of the employees working in the healthcare sector are women. Therefore, the results of the present study might represent a reliable source or research

for this sector. Second, the observational design of the research does not allow for the examination of a causal inference between leisure-time PA and LTSA. Nevertheless, the prospective design where we included only healthy individuals at baseline increases the likelihood of the observed associations being causal. Third, several possible confounders such as diet or sleep disturbance have not been adjusted in the models (45). Finally, self-reporting of the exposure and most of the possible confounders represents an inherent risk of reporting bias. A previous study by Dyrstad et al. (46) observed that vigorous leisure-time PA was overestimated among a general sample of the adult population even when using a well-known PA questionnaire such as IPAQ-Short Form. However, if all subjects overestimate to the same extent this should not results in marked bias when comparing the different levels of PA.

In closing, the results of the present study suggest that performing either vigorous or moderate PA during leisure is associated with a lowered risk of LTSA among Danish eldercare women, especially with the older ones. Age has appointed to be a risk factor to consider when designing PA strategies at the workplace with this population of workers.

Ethical approval

The Danish Data Protection Agency was informed of and registered the present study. Due to Danish law, questionnaire-based and registered-based studies need neither approval from an ethical committee nor informed consent from the respondents. Participants were informed about the content and purpose of the study and gave their written informed consent to participate All data were de-identified and anonymously analysed.

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Author contributions LLA, JAC, JC, TC and RLB designed the study. LLA collected the data and performed the analyses. TC, JC, JAC and RLB prepared the manuscript and all authors discussed results and contributed to the final article.

Availability of data and materials

The authors encourage collaboration and use of the data by other researchers. Researchers interested in using the data for scientific purposes should contact the project leader Prof. Lars L. Andersen, lla@nfa.dk.

Declaration of interest statement

The authors report no conflict of interest.

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Table 1. Baseline characteristics of the study population of 4699 healthy female eldercare workers. Age-stratified groups ≤ and > 45 years are also shown.

	All			age ≤ 45 years			age > 45 years		
	Mean	SD	%	Mean	SD	%	Mean	SD	%
N	4699			2336			2363		
Age	44.7	10.3		36.2	6.6		53.1	4.9	
Sex									
Women			100			100			100
Men			0			0			0
Body mass index (kg/m^2)	24.6	4.2		24.7	4.5		24.6	4	
Smoking									
Yes			35.8			34.0			37.7
No			64.2			66.0			62.3
Physical activity during leisure									
1. Sedentary			4.7			5.3			4.1
2. Light activity			40.0			41.4			38.7

3. Moderate activity			50.4		47.6	53.2
4. Vigorous activity			4.9		5.7	4.1
Psychosocial work environment (0-100)[a]						
Emotional demands	43.6	18.1	42.9	17.9	44.3	18.4
Influence at work	47.3	20.2	46.9	19.6	47.7	20.8
Role conflicts	39.9	15.3	41.3	14.9	38.4	15.6
Quality of leadership	59.3	21.3	59.2	21.4	59.4	21.3
Physical exertion during work (1-7)[b]	3.6	1.1	3.7	1.1	3.6	1.1

[a]Normalized COPSOQ, where 0 is lowest and 100 is highest

[b]Seven point physical exertion scale from "very, very light" to "very, very strenuous"

Table 2. Hazard ratios (HR) and 95% confidence intervals (CI) for long-term sickness absence during 1-year follow-up among the 4699 healthy female eldercare workers.

Physical activity during leisure				Model 1[a]		Model 2[b]	
		N	%	HR	95%CI	HR	95%CI
All	Sedentary	215	4.7	1.00		1.00	
	Light	1844	40.0	0.81	(0.57-1.15)	0.73	(0.51-1.05)
	Moderate	2320	50.4	0.72	(0.51-1.02)	0.67	(0.47-0.96)
	Vigorous	226	4.9	0.47	(0.27-0.83)	0.45	(0.25-0.81)
Younger	Sedentary	121	5.3	1.00		1.00	
	Light	953	41.4	0.84	(0.51-1.38)	0.87	(0.52-1.46)
	Moderate	1096	47.6	0.85	(0.52-1.38)	0.86	(0.51-1.43)
	Vigorous	132	5.7	0.45	(0.20-1.01)	0.50	(0.21-1.16)
Older	Sedentary	94	4.1	1.00		1.00	
	Light	891	38.7	0.77	(0.46-1.27)	0.62	(0.37-1.05)
	Moderate	1224	53.2	0.61	(0.37-1.01)	0.54	(0.32-0.90)
	Vigorous	94	4.1	0.50	(0.22-1.11)	0.43	(0.18-0.99)

[a]Adjusted for age

[b]Adjusted for age, smoking, body mass index, physical and psychosocial work factors, and education

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ARTÍCULO VII

Lower physical activity is associated with higher odds of chronic conditions among the Spanish workforce

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Availability of data and materials

Data are free available from

https://www.mscbs.gob.es/estadEstudios/estadisticas/encuestaNacional/home.htm

Lower physical activity is associated with higher odds of chronic conditions among the Spanish workforce

Abstract

Introduction

Prevention of chronic conditions among the workforce is a major public health challenge, and achieving minimum recommended levels of physical activity (PA) aids in this objective. The aim of the present study was to investigate if levels of PA were associated with the prevalence of common chronic conditions among the workforce.

Methods

We retrieved data from the Spanish National Health Survey 2017 (n = 9695) in which mean age of participants was 44.4 (SD, 10.4) years and 47.4% were women. Workers self-reported a set of six chronic conditions (i.e. chronic low-back pain, chronic neck pain, diabetes, hypertension, depression, and anxiety), whereas the International Physical Activity Questionnaire (IPAQ) short form served to estimate PA. Multivariable logistic regression adjusted for possible confounders was performed to assess associations between PA and chronic conditions.

Results

The final adjusted model showed that performing less than 600 MET-minutes/week of PA was associated with significantly higher odds for chronic conditions (aOR = 1.18; 95% CI, 1.07-1.30). Of the sex and age subgroups analyzed, this association was significant in men aged 17 to 44 years (aOR = 1.21; 95% CI, 1.00-1.46). Among chronic conditions, low-back pain and anxiety were associated with lower levels of PA, whereas

covariates such as body mass index, smoking habits, educational level, and occupational class had an important influence on the association between PA and chronic condition.

Conclusion

The results suggest that achieving sufficient PA could play an important role to prevent lower chronic conditions among a Spanish population of workers.

KEYWORDS occupational health, workplace, physical activity, public health, non-communicable disease

Introduction

One key indicator related to the health status of a country is the health of its workforce. A higher prevalence of chronic diseases and conditions in a working population can lead to a set of undesirable consequences ranging from sickness absenteeism to a rise in disability pension as well as lower productivity (1,2). In addition, the national financial cost due to sickness absence related to chronic musculoskeletal disorders in countries such as Holland amounted to €1.3 billion annually (3); thus,acquiring knowledge related to health behaviours of working populations can aid in the implementation of successful strategies to improve health, and to reduce related cost. Particularly, chronic diseases are the leading cause of death among the Spanish population, whereas chronic conditions such as low-back pain and neck pain are the primary reasons for disability-adjusted life years (DALYs) (4). On the other hand, healthy habits such as regular physical activity (PA) have been usually associated with a longer lifespan; for instance, altogether work and household PA have been observed to reduce mortality risk in Spanish men and women, while similar mortality risk reductions for leisure-time PA have been solely shown in Spanish women (5); such distinction among PA domains as well as between genders is worth-noting, since PA during leisure has been usually linked to lower risk of mortality in both men and women, and differently, higher levels of occupational PA have been observed to increase the mortality risk only in men (6,7). Furthermore, higher leisure-time PA was associated with lower prevalence of hypertension, diabetes, hypercholesterolemia, depression and anxiety, as well as lower use of prescription medication in a dose-response fashion among a general population of Spanish adults (8). Contrarily, occupational PA has been observed to increase both, the risk for disability pension, and the risk for long-term sickness absence (9,10).

Overall, World Health Organization (WHO) recommends that adults perform at least 150 minutes of moderate-intensity PA, or 75 minutes of vigorous-intensity PA, or an equivalent combination of moderate- and vigorous-intensity PA achieving at least 600 MET-minutes/week. Because higher PA has been associated with lower prevalence of chronic diseases and conditions in general populations of adults and workers from other countries (8,11), it is reasonable to expect that achieving recommended PA guidelines could be associated with lower prevalence of several of the most common chronic diseases and conditions among the Spanish workforce. A recent study by López-Sánchez et al. (12) has estimated that 30.2% of the Spanish population are not achieving current international guidelines regarding weekly PA, hence, there is still a chance that insufficient PA will also be a critical issue concerning chronic conditions among the general working population; further, such PA levels could substantially vary depending on gender and age (i.e. higher percentage of men and younger achieve PA guidelines) (13). Besides, since most of the studies involving workers and health habits are referred to populations from different countries, little is known about how PA may affect chronic conditions in a population of workers from Spain with different working conditions and lifestyle (14,15). Thus, the present study aimed to investigate the association between PA and chronic conditions among Spanish workers; an inverse association between PA and a set of the most prevalent chronic conditions in the workforce was hypothesized.

Methods

Study design and population

Data from the Spanish National Health Survey 2017 (ENSE 2017), a regular survey assessing general health among the Spanish population of both children and adults each five years, were retrieved for this study. The data collection was carried out through a survey set in Spain from October 2016 to October 2017 under the responsibility of the

Ministry of Health, Social Services and Equality, and the National Statistics Institute; data series from the current and previous rounds of the survey are shown anonymized in a publicly available dataset from an institutional web server (16). A computer-assisted personal interview (CAPI) was conducted in the homes of the selected participants, who were assisted by trained interviewers. A stratified three-stage sampling considering census sections, family dwellings and participants (≥15 years) was respectively implemented. The dwellings were selected using systematic sampling, and the random Kish method was used to select the participants who were going to complete the questionnaire. The sample was distributed throughout all the Spanish regions assigning both a uniform part and other variable part according to proportional regional size, and accounting for studied characteristics, type of respondent, and information regarding other additional surveys . The sections were selected within each stratum with probability proportional to their size. In each section, the dwellings were selected with equal probability by systematic sampling, prior arrangement by size of the dwelling. This procedure leads to self-weighting samples in each stratum. The random Kish method was used for the selection of the person who had to complete the questionnaire; this assigns equal probability to all potential participants in the household (16).

The original sample comprised 37500 dwellings distributed in 2500 sections, in which 30.1% (n = 11287) of the selected dwellings did not reply to the survey due to several reasons (i.e. absence, empty dwelling, refusal or inability to answer). As a result, a representative sample of the Spanish adult population comprising 23089 participants aged 15-103 years (i.e. a survey response rate of 69.9%) was collected.

Since the International Physical Activity Questionnaire (IPAQ) short form was not included in the questionnaires for participants aged ≥70 years, those participants were excluded from the study analyses (n = 5310). Of the remaining population, those below

the legal working age (i.e. under 16) or unemployed participants were also excluded (n = 7894). Overall, data from 22 survey questions were retrieved for the purpose of this study: 7 questions regarding PA, 1 question each regarding age, sex, height, weight, educational level, occupational class, occupational PA, smoking status, and fruit consumption, and 6 regarding chronic conditions. In addition, those remaining participants presenting missing values in any of the study variables (n = 190) were also removed from the statistical analyses. Therefore, a total of 9695 participants from a general working population were included in the present study.

Data were reported in adherence to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [16]. All the participants gave signed consent before completing the survey.

Chronic condition (Outcome)

For the purpose of this research, we identified several of the most prevalent chronic conditions among the workforce (1). Measures on chronic conditions were obtained through the following question: ‘‘Have you suffered from hypertension within the last twelve months?” Participants answering “yes” to this question were considered to have experienced hypertension during that term. The same procedure was used for assessing the prevalence of the remaining chronic conditions from the study set (i.e. diabetes, chronic neck pain, chronic low back pain, depression and anxiety). Finally, an outcome variable concerning the experience of having suffered from, at least, one of the mentioned chronic conditions was created; those participants answering “yes” to one or more chronic condition were included in the chronic condition category.

Physical activity (Exposure)

The IPAQ short version embedded in the survey (i.e. the questions of the IPAQ short-version were included in the healthy habits section of the survey) was used to estimate PA (17). The IPAQ has shown to be a valid and reliable PA estimation when tested in different adult populations worldwide presenting sufficient validity (ρ = 0.30; 95% CI, 0.23-0.36) and reliability (Spearman's ρ = 0.81; 95% CI, 0.79-0.82) (17). Overall PA MET (Metabolic Equivalent of Task, i.e. a caloric expenditure unit) minutes/week were estimated using the formula: *sum of Vigorous + Moderate + Walking MET-minutes/week scores* (18). Following the analysis protocol of the IPAQ, PA was categorized into METS regarding WHO guidelines: "1) fewer than 600 MET-minutes/week" and "2) at least 600 MET-minutes/week" (18).

Covariates

According to prior work, the present study was controlled for sociodemographic factors (age, sex, educational level and occupational class), and lifestyle factors (body mass index, occupational PA, fruit consumption and smoking status) (19–22).

Educational level was divided into three categories regarding the highest educational achievement, corresponding the highest rank to holding a university degree (i.e. primary or lower, secondary, and tertiary or higher). The categorization of occupational class (168 different groups) into six different groups was conducted using the Spanish national list of occupations (23); occupational class I included executive managers and academics; occupational class II consisted of middle managers, technicians, athletes and artists; occupational class III comprised white-collar and self-employed workers, and occupational class IV covered supervisors and skilled blue-collar workers from the secondary sector. Finally, occupational class V consisted of skilled blue-collar workers from the primary sector, whereas occupational class VI only included unskilled workers.

Body Mass Index (BMI) was derived from self-rated height and weight (i.e. weight in kilograms divided by height in squared meters) with categories set according to WHO guidelines as follows: BMI ≥30 kg/m^2 (obese), overweight (25-29.9 kg/m^2), normal (18.5-25 kg/m^2) and underweight (<18.5 kg/m^2). According to the findings of a study with industrial workers and cardiovascular risk factors, fruit consumption was divided into two groups regarding those who reached a weekly consumption of, at least, one piece of fresh fruit (excluding juices) a week, and those who do not (24).

Occupational PA was estimated through the following question: "Which of the following better describes your main activity during the working hours?". Possible answers comprised: "sit most of the working hours" (sedentary), "standing up most of the working hours without performing high efforts" (low), "walking, carrying any weight, with frequent displacements" (moderate) and "performing high physically demanding tasks" (high).

Finally, the smoking status was categorised as "current smoker", "former smoker", and "never smoker".

Statistical analyses

Statistical analyses were carried out using SPSS 22.0. Differences in the prevalence of chronic conditions among subgroups within each variable were assessed by Chi-squared tests. The association between PA (exposure) and chronic condition (outcome) were estimated through multivariable logistic regression analysis conducted for the whole sample as well as by sex and age subgroups. To ensure sufficient statistical power when comparing groups regarding age, the mean age of the sample was set as cut-off point. Sex and age-segmented analyses were adjusted for educational level, occupational class, occupational PA, BMI, fruit consumption and smoking status, while the analysis for the

overall sample was also adjusted for sex and age. All covariates were included in the models as categorical variables. Associations were calculated between having one or more of the six chronic conditions examined and PA as well as between each of the chronic conditions and PA.

Participants with missing data (2%) were discarded from the analyses. We calculated adjusted odds ratios (AORs) with 95% confidence intervals (CIs) through logistic regression analyses. The level of statistical significance was set at $P<0.05$.

Results

Table 1 shows the characteristics of the study sample (n = 9695). It comprises a general population of Spanish workers (56.6% men) with a mean age of 44.4 years (SD, 10.4).

A majority of the workers (69.6%) reached the WHO guidelines regarding weekly PA (≥600 MET-minutes/week of PA). Significant differences among subgroups in relation to prevalence of chronic conditions were found for most of the covariates: age, sex, BMI, smoking status, educational level, occupational class, and occupational PA.

The final adjusted model on the entire study sample showed that less than 600 MET-minutes/week of PA was associated with significantly higher odds for chronic condition (aOR = 1.18; 95% CI, 1.07-1.30) (Table 2). Women, higher age, former and current smoker, primary and secondary education, obesity and overweight condition, and no weekly fruit consumption subgroups were also associated with significantly higher odds for chronic condition compared with their reference in each covariate, whereas the contrary, significant lower odds for chronic condition occur with the occupational class subgroup I when compared with its reference (Table 2).

In sex and age segmented and adjusted analyses (Table 3), the association between PA and chronic conditions remained significant among the subgroup formed by men aged 17 to 44 years (aOR = 1.21; 95% CI, 1.00-1.46).

Finally, table 4 shows associations between PA and each of the examined chronic conditions; achieving recommended PA guidelines associate with significant lower odds for low-back pain (aOR = 0.80; 95% CI, 0.70-0.91) and anxiety (aOR = 0.67; 95% CI, 0.54-0.84).

Discussion

The present study suggests that performing less than 600 MET-minutes/week of PA is associated with significantly higher odds for chronic conditions among a general population of Spanish workers. When stratified by sex and age, men aged 17 to 44 years not achieving 600 MET-minutes/week of PA had more odds for chronic conditions than the other subgroups. In addition, those participants reporting less than 600 MET-minutes/week of PA were found to have significant higher odds for experiencing low-back pain and anxiety. These results are consistent with our hypothesis as well as with previous research, which has observed significant associations between lower PA and chronic conditions among a Spanish adult population (8). The present study adds to the existing literature the importance to achieve PA international guidelines in order to prevent some of the most prevalent chronic conditions usually experienced by working populations.

Because chronic conditions have been identified as major causes for sickness absenteeism and disability pension (25,26), it is of upmost importance to implement strategies in order to reduce the current figures, and this study suggest that perform the recommended values

of PA could be a way forward. Both sickness absenteeism and disability pension entail a substantial economic cost to society (27), and constitute a public health issue (28,29).

Interestingly, findings from the present study also suggest that older workers not performing current PA guidelines are more likely to experience chronic conditions that their younger counterparts. The aging process itself is usually related to a higher probability of experiencing chronic conditions (30); however, as observed in our results, healthy habits such as performing regular PA could contribute to reduce the prevalence of chronic conditions in this specific age range. As suggested by Brawner et al. (11), there is still a chance that such association were bidirectional, since older adults with chronic conditions have been associated with lower PA levels. Particularly, our study found PA significantly linked with lower prevalence of low-back pain and anxiety, which supports the results of previous studies specifically focused on these conditions; a meta-analysis of prospective cohort studies found risk of chronic low-back pain reduced by 11%-16% with leisure-time PA, whereas other observational study found that meeting PA guidelines was associated with 13.5% lower odds of anxiety (31,32).

Although our study did not discriminate among PA domains, previous research has underscored the benefits of both leisure-time and commuting PA, whereas the opposite has been observed for occupational PA (9,33). Thus, because differences regarding PA levels and domains have been observed among European countries (14), generalizations over working populations from other countries might be mediated for these variations. Furthermore, the strong influence that both higher occupational class and lower education level had over the relationship between PA and chronic conditions suggest that other socioeconomic characteristics could also exacerbate these variation; previous research has already appointed the strong association between PA and both occupational class and educational level (i.e. those from lower occupational classes and educational levels tend

to perform lower levels of PA and have worse health-related habits and, consequently, more likely to suffer from chronic condition) (34,35).

The strengths of the present study consist of using a large representative sample, as well as estimating PA through a validated tool. In addition, a broad range of covariates were used to control the relationship between the exposure and the outcome variables. Nevertheless, for a better interpretation of the results, several limitations should be considered. First, since answers may have been influenced by common method variance, in which a person's mood or disease status have affected the answers, the possibility of a recall bias exist. Second, the IPAQ short form do not discriminate PA domains, which could shed more light on the circunstances that PA usually have higher beneficial properties concerning chronic conditions. Last, the cross-sectional study design does not allow causal interpretations, thus, some of the chronic conditions may reduce participation in PA.

In conclusion, the results of this study suggest that achieving WHO guidelines regarding PA might be an essential component to reduce chronic conditions in the studied population. Particularly, older workers and those experiencing either low-back or anxierty were observed to be the most adversely influenced by insufficient PA; thus, strategies aimed at workers with these features could be critical to prevent from experiencing chronic conditions.

Acknowledgments

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Summary

What is already known on this topic?

There is high-quality evidence that physical activity reduces risk of the most prevalent chronic conditions.

What is added by this report?

Insufficient weekly levels regarding physical activity associates with higher odds of chronic conditions among a Spanish population of workers.

What are the implications for public health practice?

Physical activity strategies reaching recommended guidelines might reduce levels of some of the most prevalent chronic conditions among the workforce.

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Table 1. Participant Characteristics, 2017 Spanish National Health Survey

			[a]Has one or more chronic condition	
Total (N = 9695)	**n**	**%**	**%**	***[b]P Value***
Age (years)				< .001
17-44	4915	50.7	20.3	
45-69	4780	49.3	44.5	
Sex				< .001
Men	5100	52.6	29.8	
Women	4595	47.4	34.9	
Body Mass Index				< .001
Underweight	180	1.9	25.0	
Normal	4556	47.0	26.1	
Overweight	3600	37.1	35.4	
Obese	1359	14.0	45.0	
Smoking status				< .001
Never	4188	43.2	27.7	
Former	2608	27.0	38.2	
Smoker	2889	29.8	32.7	
Educational level				< .001
≤Primary	950	9.8	45.6	
Secondary	5885	60.7	33.6	
≥Tertiary	2914	29.5	24.8	
Occupational Class				< .001
I	1299	13.4	22.4	
II	979	10.2	23.7	
III	2210	22.8	30.5	
IV	1018	10.5	30.2	
V	2850	29.4	32.8	
VI	1319	13.7	34.4	
PA weekly METS				< .001
≥ 600	6748	69.6	30.3	
< 600	2947	30.4	36.6	
Weekly fruit consumption				0.398
Yes	9172	94.6	32.0	
No	523	5.4	33.7	
Occupational PA				< .05
Sedentary	3180	32.8	30.4	
Low	4179	43.1	32.6	
Moderate	1812	18.7	33.5	

High	524	5.4	35.2

Abbreviations: SD, standard deviation; PA, physical activity.
[a]Hypertension, diabetes, chronic neck pain, chronic low back pain, depression and anxiety.
[b]Chi square test.

Table 2. Association of physical activity and covariates with chronic condition (outcome) estimated by multivariable logistic regression (adjusted odds ratios with 95% confidence intervals of chronic condition).

Characteristic		[a]Has one or more chronic condition
		[b]aOR (95% CI)
Physical activity (MET-minutes/week)	< 600	1.18 (1.07-1.30)[c]
	≥ 600	ref
Age (years)	45-69	2.92 (2.65-3.21)[e]
	17-44	ref
Sex	Women	1.59 (1.44-1.76)[e]
	Men	ref
Educational level	≤ Primary	1.55 (1.27-1.90)[e]
	Secondary	1.24 (1.07-1.43)[d]
	≥ Tertiary	ref
Smoking status	Current	1.20 (1.08-1.35)[d]
	Former	1.29 (1.16-1.45)[e]
	Never	ref
Body Mass Index ($kg \cdot m^{-2}$)	Obese	2.13 (1.45-3.12)[e]
	Overweight	1.51 (1.04-2.19)[c]
	Normal	1.05 (0.73-1.52)
	Low	ref
Occupational class	I	0.71 (0.56-0.89)[d]
	II	0.94 (0.76-1.18)
	III	0.91 (0.77-1.08)
	IV	1.02 (0.84-1.24)
	V	1.05 (0.91-1.22)
	VI	ref
Weekly fruit consumption	No	1.23 (1.00-1.50)[c]
	Yes	ref
Occupational PA	Sedentary	0.94 (0.75-1.18)
	Low	0.86 (0.70-1.07)
	Moderate	0.85 (0.68-1.06)
	High	ref

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; PA, physical activity.

[a]Hypertension, diabetes, chronic neck pain, chronic low back pain, depression and anxiety.

[b]Each variable has been adjusted for the rest of the variables.

[c]Significant at $P < .05$.

[d]Significant at $P < .01$.

[e]Significant at $P < .001$.

Table 3. Association between physical activity (<600 MET-minutes/week) and chronic condition estimated by multivariable logistic regression (adjusted odds ratios with 95% confidence intervals of chronic condition).

Sex	**Age (years)**	
		[a]aOR (95% CI)
Men	17-44	1.21 (1.00-1.46)[b]
	45-69	1.21 (0.98-1.48)
Women	17-44	1.11 (0.93-1.33)
	45-69	1.22 (0.96-1.56)

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.
aAdjusted for educational level, body mass index, smoking status, occupational class, fruit consumption and occupational physical activity.
[b]Significant at $P < .05$.

Table 4. Association between levels of physical activity and specific chronic diseases estimated by multivariable logistic regression (adjusted odds ratios with 95% confidence intervals for each chronic condition).

Chronic disease	[a]Association between physical activity (≥ 600 MET-minutes/week) and specific chronic disease
	aOR (95% CI)
Hypertension	0.89 (0.76-1.03)
Diabetes	1.03 (0.79-1.34)
Low back pain	0.80 (0.70-0.91)[b]
Neck pain	0.97 (0.83-1.14)
Anxiety	0.67 (0.54-0.84)[c]
Depression	1.10 (0.84-1.44)

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.
[a]Adjusted for sex, age, education, body mass index, smoking habit, occupational class, fruit consumption and occupational physical activity.
[b]Significant at $P < .01$.
[c]Significant at $P < .001$

ARTÍCULO VIII

Science et Sports

Higher leisure-time physical activity is associated with lower activity limitation: Cross-sectional analyses among the Spanish working population

--Manuscript Draft--

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Abstract:	SUMMARY Objectives: Prevention of disability in all its forms is a major public health challenge, and promoting a healthy lifestyle with sufficient physical activity may be a way forward. In contrast to long-term deprivation of usual activities, usually linked to critical injuries or conditions, little is known about shorter periods of those limitations in working populations. Equipment and methods: We used data from the Spanish National Health Survey 2017 (n=9,885 ≥17 years; 47.4% women). Workers self-reported usual activity limitation due to health problems (AL) (≤14 days) whereas the International Physical Activity Questionnaire (IPAQ) short form was used to measure leisure-time physical activity (LTPA). After calculating MET-minutes/week, workers were divided into two categories: 1) Less than 600 MET-minutes/week. 2). At least 600 MET-minutes/week. We conducted a multivariable logistic regression to assess associations. Covariates were age, sex, education, occupation, smoking habits, BMI, diabetes, hypertension, neck pain, low back pain, chronic depression, and anxiety. Results: The overall prevalence of AL was 10.7%, whereas the overall prevalence of workers performing less than 600 MET-minutes/week of LTPA was 29.6%. In final adjusted models, those workers performing less than 600 MET-minutes/week of LTPA subgroup were associated with significantly higher odds for AL (OR 1.33, 95%CI 1.15-1.54). This association was strongest in workers aged 37-43 (OR 1.75, 95%CI 1.27-2.41), and 53-69 years (OR 1.67, 95%CI 1.22-2.28). Conclusions: The results suggest that reaching ≥600 MET-minutes/week of LTPA is associated with lower odds of AL among a general working population, especially among specific age ranges.
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Short title: Physical activity associates with lower activity limitation among workers

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Higher leisure-time physical activity is associated with lower activity limitation: Cross-sectional analyses among the Spanish working population

Une activité physique plus intense pendant les loisirs est associée à une limitation d'activité plus faible: analyses transversales parmi la population active espagnole

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SUMMARY

Objectives: Prevention of disability in all its forms is a major public health challenge, and promoting a healthy lifestyle with sufficient physical activity may be a way forward. In contrast to long-term deprivation of usual activities, usually linked to critical injuries or conditions, little is known about shorter periods of those limitations in working populations. **Equipment and methods:** We used data from the Spanish National Health Survey 2017 (n=9,885 ≥17 years; 47.4% women). Workers self-reported usual activity limitation due to health problems (AL) (≤14 days) whereas the International Physical Activity Questionnaire (IPAQ) short form was used to measure leisure-time physical activity (LTPA). After calculating MET-minutes/week, workers were divided into two categories: 1) Less than 600 MET-minutes/week. 2). At least 600 MET-minutes/week. We conducted a multivariable logistic regression to assess associations. Covariates were age, sex, education, occupation, smoking habits, BMI, diabetes, hypertension, neck pain, low back pain, chronic depression, and anxiety. **Results:** The overall prevalence of AL was 10.7%, whereas the overall prevalence of workers performing less than 600 MET-minutes/week of LTPA was 29.6%. In final adjusted models, those workers performing less than 600 MET-minutes/week of LTPA subgroup were associated with significantly higher odds for AL (OR 1.33, 95%CI 1.15-1.54). This association was strongest in workers aged 37-43 (OR 1.75, 95%CI 1.27-2.41), and 53-69 years (OR 1.67, 95%CI 1.22-2.28). **Conclusions:** The results suggest that reaching ≥600 MET-minutes/week of LTPA is associated with lower odds of AL among a general working population, especially among specific age ranges.

KEYWORDS: usual activity, workplace, physical exercise, disability, sick leave

RÉSUMÉ

Objectifs: La prévention du handicap sous toutes ses formes est un défi majeur de santé publique et la promotion d'un mode de vie sain avec une activité physique suffisante peut être une voie à suivre. Contrairement à la privation à long terme des activités habituelles, généralement liée à des blessures ou des conditions critiques, on sait peu de choses sur les périodes plus courtes de ces limitations dans les populations actives. **Équipement et méthodes:** Nous avons utilisé les données de l'Enquête nationale espagnole sur la santé 2017 (n = 9 885 ≥17 ans; 47,4% de femmes). Les travailleurs ont déclaré une limitation de leurs activités habituelles en raison de problèmes de santé (LA) (≤ 14 jours), tandis que le questionnaire abrégé du Questionnaire international sur l'activité physique (IPAQ) a été utilisé pour mesurer l'activité physique pendant les loisirs (APPL). Après avoir calculé les MET-minutes / semaine, les travailleurs ont été divisés en deux catégories: 1) Moins de 600 MET-minutes / semaine. 2). Au moins 600 MET-minutes / semaine. Nous avons effectué une régression logistique multivariable pour évaluer les associations. Les covariables étaient l'âge, le sexe, l'éducation, la profession, les habitudes tabagiques, l'IMC, le diabète, l'hypertension, les cervicalgies, les lombalgies, la dépression chronique et l'anxiété. **Résultats:** La prévalence globale de l'LA était de 10,7%, tandis que la prévalence globale des travailleurs effectuant moins de 600 MET-minutes / semaine de APPL était de 29,6%. Dans les modèles ajustés finaux, les travailleurs effectuant moins de 600 MET-minutes / semaine de sous-groupe APPL étaient associés à des cotes significativement plus élevées pour LA (OR 1,33, IC à 95% 1,15-1,54). Cette association était la plus forte chez les travailleurs âgés de 37 à 43 ans (OR 1,75, IC à 95% 1,27-2,41) et de 53 à 69 ans (OR 1,67, IC à 95% 1,22-2,28). **Conclusions:** Les résultats suggèrent que l'atteinte ≥ 600 MET-minutes / semaine de APPL est associée à une plus faible probabilité de LA parmi une population active générale, en particulier dans des tranches d'âge spécifiques.

MOTS CLÉS: activité habituelle, lieu de travail, exercice physique, handicap, arrêt de travail

1. INTRODUCTION

The boundaries between impairment, disability, and functional and activity limitation (AL) are not clear. From a holistic view, the frontiers between health and illness are fragile and represent a continuum and reversible process across life. According to the International Classification of Functioning, Disability, and Health (ICF), "an activity limitation is a difficulty encountered by an individual in executing a task or action" [1]. That could range from slight to a severe deviation regarding quantity or quality in the manner or the extent that is expected of people without the health condition [1]. The notion of AL is usually considered under the umbrella of disability, involving daily activity restrictions (e.g. showering or dressing), and, in some cases, assistance for health care [2]. The severity of that disability depends on a wide variety of factors [3] (i.e. type of disease/disorder, symptoms, and health service support), and comprises a wide range of status from total dependence up to timely assistance [4]. Further, that disability status preventing from performing daily and usual activities could even lead to a general practitioner to certificate a sickness absence or, in the worst-case scenario, a disability pension [3].

Normally, research about AL has focused more on the types of usual task restrictions, using a long-term reference for those (i.e. 6 months) [5–8]. However, we have no knowledge about shorter-term values of AL (≤14 days), which are also important to estimate since these might precede more frequent or more extended periods of AL. It is a well-known fact that either illnesses or critical injuries lead to a reduction or limitation of the usual activity (i.e. working, housework, leisure-time activities, and studying) [9,10]. Thus, work ability and sickness absence might result affected by a temporary loss of physical or mental capabilities. Because either moderate or severe AL also contribute extensively to higher health care expenditures in the absence of chronic conditions [11], those assuming high burden (i.e. governments and companies) want to reduce it. However, not only is a question of financial costs but also a health and well-being issue as global AL (i.e. health disorders and conditions impacting people's usual activities) has also been associated with mortality [5].

While AL has been previously studied with older populations or particular conditions during long periods [12–16], little is known about the AL prevalence among other

specific populations such as workers. An onset of AL might involve restrictions related to work, although it does not necessarily lead to sickness absence, because it could solely occur during leisure or non-working days (e.g. affecting housework, education, and leisure-time activities). Further, suffering from an illness or condition does not strictly mean to remain in bed, since prior research has reported a third of workers had gone to work two or more times a year when feeling sick instead of taking sick leave [17]. Thus, to investigate both prevalence and potential ways of preventing AL among a general working population covers a research gap between sickness absence and sickness presenteeism, two of the highest-ranked costs for both governments and companies [18].

On the other hand, living a healthy lifestyle could contribute to reducing AL since leisure-time physical activity (LTPA), normal BMI, and smoking deprivation have shown to associate with better-perceived health [19]. Particularly, LTPA has been found to significantly reduce all-cause mortality [20], long-term sickness absence [21], and presenteeism [22] risks; therefore, we hypothesised that higher LTPA might associate with a lower prevalence of AL. Also, vigorous LTPA has been estimated to achieve higher all-cause mortality risk reductions [23], thus, the intensity of physical activity might play a critical role in this association. Regarding other possible variables influencing AL, we assumed that those behind the highest risk for sickness absence [24], such as cardiovascular diseases (i.e. hypertension), and musculoskeletal (i.e. back pain) or mental disorders (i.e. chronic depression and anxiety) [24] might also influence AL.

The primary aim of this research was to examine the association of different levels of LTPA with AL (≤ 14 days) among the general Spanish working population.

2. METHODS

This study consists of a survey assessing general health among a Spanish population of citizens, in which the 2017 round was analyzed to investigate potential associations between LTPA and short AL. In order to ensure comprehensive reporting of the data for the present cross-sectional study, the STROBE guidelines were followed [25].

2.1 The survey

Data from the Spanish National Health Survey 2017 was employed for this analysis. Data were collected through a survey carried out in Spain from October 2016 to October 2017 [26]. A stratified three-stage sampling considering census sections, family dwellings, and adults (15 years or more) was respectively implemented. The dwellings were chosen using systematic sampling, whereas the random Kish method was used to select the participants who were going to complete the Adult Questionnaire. A computer-assisted personal interview (CAPI) was conducted in the homes of the selected participants, who were assisted by trained interviewers. A total of 30.1% (n=11,287) of the chosen dwellings did not reply to the survey due to different reasons (i.e. empty dwelling, absence, refusal, or inability to answer). As a result, a representative sample of the adult population resident in Spain was collected and consisted of 23,089 adults aged 15-103 years. All the participants signed an informed consent form before responding to the survey.

Because the age group of adults ≥70 years did not fulfill the IPAQ (International Physical Activity Questionnaire) short form (i.e. the tool used for assessing the LTPA) embedded in the Adult Questionnaire, we excluded them for the present analyses (n=5,310). Of the remaining population, those participants not working at that time were also excluded (n=7,894). Thus, a total of 9,885 workers, comprising a wide-range of job roles (i.e. from white and blue-collar workers to self-employees) were included in the present study.

2.2. Activity limitation (Outcome)

Measures on AL were obtained through the following question ‘‘Have you had to reduce or limit your usual activity during the last two weeks, for at least half a day, due to either one or several pains or symptoms?”. Those participants responding “yes” to this question were considered to have had an AL onset during that term. According to the survey methodology, that usual activity comprised working activities, housework, attendance to learning centres or leisure-time events usually shared with family and friends.

2.3. Leisure-time physical activity (Exposure)

The short version of the IPAQ served to assess LTPA [27]. The IPAQ has proved to have good validity (ρ=0.30, 95%CI 0.23-0.36) and reliability (Spearman's ρ=0.81, 95%CI 0.79-0.82) when used in different adult populations worldwide [27]. Total LTPA MET (Metabolic Equivalent of Task, i.e. a caloric expenditure unit) minutes/week were calculated adding the METS from three types of LTPA with the formula: *sum of Vigorous + Moderate + Walking MET-minutes/week scores* [28]. To further check the LTPA association with AL, we also categorised LTPA into quartiles regarding METS.

In consonance with the data processing and analysis protocol of the IPAQ, the respondents were divided into two categories: "1) fewer than 600 MET-minutes/week" and "2) at least 600 MET-minutes/week" [28], which is equivalent to achieve the current WHO guidelines.

2.4. Covariates

According to the current research on the issue, the selected covariates included sociodemographic (age, sex, education, and job role), lifestyle (body mass index and smoking), and health variables (diabetes, hypertension, neck pain, low back pain, chronic depression, and anxiety).

Measurements on BMI (Body Mass Index, i.e. weight in kilograms divided by height in squared meters), in which obesity was set at BMI ≥ 30 kg/m^2, derived from the self-reported height and weight. The smoking status was categorised as a current smoker, former smoker, and never. Education was divided into three categories regarding the highest achieved level, corresponding the highest rank to university studies (≤ primary, secondary, and ≥ tertiary). The categorisation of job role (168 different groups) was made in accordance with the Spanish national list of occupations [29].

Regarding the health-related covariates, those who answered "yes" to the question ''Have you suffered from neck pain within the last twelve months?" were considered to have neck pain. The same question and procedure were used for assessing the prevalence of the remaining health variables.

2.5. Statistical analysis

We conducted a statistical analysis using SPSS 22.0. Differences in the prevalence of AL by sample characteristics were assessed by Chi-squared tests. The association between LTPA (exposure) and AL (outcome) was estimated through multivariable logistic regression analysis conducted for the whole sample as well as by age subgroups (15–36, 37-43, 44-52, and 53–69 years). Age-segmented analyses were adjusted for sex, BMI, education, smoking, job role, diabetes, hypertension, neck pain, low back pain, depression, and anxiety, while the analysis for the overall sample was also adjusted for age. Except for age, included as a continuous variable, all variables were included in the models as categorical variables. Participants with missing data (n=190) were not considered for the analyses. Cut-off points for age-segmentation and METS were estimated through equal percentile based on explored data option from the SPSS visual grouping procedure. As a result of the logistic regression analyses, we calculated odds ratios (ORs) with 95% confidence intervals (CIs). The level of statistical significance was set at $P < 0.05$.

3. RESULTS

Table 1 shows the baseline characteristics of the study population. The cohort includes a population of Spanish general workers (47.4% women) on average 44.4 (SD 10.4) years old. Concerning lifestyle, 56.8% of the cohort is linked to anytime smoking habits, and 51.1% show overweight or obesity. The overall prevalence of AL is 10.7%, whereas the overall prevalence of people doing less than 600 MET-minutes/week of LTPA is 29.6%. Regarding LTPA guidelines subgroups, workers doing less and more than 600 MET-minutes/week of PA present a 13.2% and a 9.7% prevalence of AL, respectively. In estimates without adjustment, women, former smokers, less LTPA, diabetes, hypertension, neck pain, low back pain, depression, and anxiety were associated with a significantly higher prevalence of AL.

Table 1 over here

Figure 1 shows a linear trend in the prevalence of AL, from 10.9% to 17.4%, when age increasing with those participants in the first LTPA quartile. The fourth LTPA quartile observes the less prevalent values for AL for the three older subgroups.

Figure 1 over here

When performing adjusted overall analysis, the less than 600 MET-minutes/week of LTPA subgroup was associated with significantly higher odds (OR 1.33, 95%CI 1.15 - 1.54) for AL (Table 2). Advanced age, former smoker, hypertension, neck pain, low back pain, depression, and anxiety were also associated with significantly higher odds for AL (Table 2). The full adjusted association between LTPA and AL remains significant among those subgroups formed by workers aged 37 to 43, and 53 to 69 when age-stratified (Table 3).

Table 2 over here

Table 3 over here

4. DISCUSSION

In the present sample of Spanish general workers, following the recommended IPAQ guidelines regarding LTPA was significantly associated with lower AL in the proposed adjusted model (Table 2). In the age-stratified analyses, AL remained only significant for both 1) 37-43 years, and 2) 53-69 years´ subgroups achieving LTPA guidelines. The prevalence of AL observed a clear trend to diminish with the ageing process when achieving very high levels of LTPA, whereas those workers performing low levels of LTPA presented the highest odds of AL in the three subgroups with older workers (Figure 1). Therefore, in order to reduce AL values, LTPA strategies aiming at the older population of workers would be desirable.

Prevalence of several of the most common cardiovascular, metabolic, physical, and mental disorders among the workforce observed significant values regarding AL for the present sample. Except for diabetes, all the diseases showed significantly increased odds for AL in the adjusted model, although both low back pain and depression presented the highest significant association with AL.

Owing to the use of the IPAQ short-form tool, the present study focus LTPA on the quantitative (i.e. total amount of METS) instead of the qualitative element (i.e. intensity) of the exposure. Thus, achieving a meaningful value of METS (i.e. IPAQ and WHO guidelines), regardless of the way those have been achieved (i.e. different possible combinations of high, moderate LTPA and walking to get the same value), could result in a significant reduction of odds for AL. Although we have not found

specific research investigating the association between physical activity and AL, several studies have suggested the inverse relationship of both quantitative and qualitative aspects of LTPA with short (≤ 14 days) and long-term sickness absence (> 14 days) [30,31], even with a different population of workers [21,32].

When adjusted for occupational class (i.e. job role), our proposed model did not show significant modifications in the association between LTPA and AL; this finding contrasts with those observed in other studies carried out with a general population of Danish workers, in which high levels of occupational physical activity were observed to significantly increase the risk of worse global health [21].

Regarding age, we found a clear trend to increase odds for AL when adjusted by the rest of the variables. When unadjusted and categorised into quartiles (figure 1), the odds of AL remained higher for the older workers performing low LTPA and lower for those older workers achieving very high levels of LTPA. Thus, the age factor seems to take its part when explaining AL, and older but not younger workers could be more sensitive to LTPA. Similar findings were observed among female eldercare workers, in which physical exertion increased the disability pension risk in older but not in younger workers [33].

Several of the health confounders used in our study have been ranked as one of the most prevalent among the workforce [34,35]. However, despite the high influence of hypertension, back pain, and mental disorders in the proposed model, the association between LTPA and AL remained significant for this study. Furthermore, the significantly increased AL odds for five out of six of the health variables suggests that those highlighted health risk factors for long-term sickness absence could also be substantial for AL. Except for the category of former smokers, current smokers or other confounders such as BMI or education did not find a substantial increase of odds for AL when adjusted for the remaining variables. These results differ from the findings of other studies outlining the association of both current smoking habits and obesity with a higher risk of general sickness absence in specific populations of workers (i.e. local employees and health workers) [36,37].

Overall, achieving a minimum of 600 weekly METS of LTPA may contribute to reducing AL among a general population of workers. Health strategies aiming at older workers performing low levels of LTPA or those suffering from anxiety, depression, or back pain might reduce AL. As it happens with the association between sickness absence and disability pension [38], future research on AL might investigate the use of AL as a potential marker for the two of them, although longitudinal research would be first required to confirm the suggested association.

The strengths of the current study comprise using a large random sample of Spanish workers, as well as measuring the exposure variable with a reliable tool. To further avoid a possible recall bias in the outcome variable, only onsets, instead of days, of AL were contemplated. In addition, a representative set of confounders covering a wide range of possible risk factors for AL were considered for the implemented logistic model. However, several limitations make this research to be carefully considered. First, the observational design of the study does not permit the inspection of a causal relationship between LTPA and AL. Thus, low levels of LTPA may lead to AL, but the reverse association may also be present, i.e. those with activity limitations are more prone to not being sufficiently physically active. Second, the subjective nature of the measured variables, which represents an inherent risk of information bias. As previously suggested by Dyrstad et al. [39], self-reported data on LTPA usually lead to overestimating overall LTPA. Last, according to the IPAQ protocol, the final values of that tool do not discriminate among vigorous or moderate physical activity, which limits the scope of the study.

5. CONCLUSIONS

All things considered, the results of the present study suggest a determined level of LTPA (≥ 600 METS/week) to associate with lower AL, particularly among older workers. Health strategies aiming at this specific population might reduce levels of AL.

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DISCLOSURE OF INTEREST

The authors declare that they have no competing interest.

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Table 1 Characteristics of the study population

					AL[a]		
	N	**%**	**Mean**	**SD**	**N**	**%**	**P-value[b]**
Age (years)	9885		44.4	10.4			
Sex							
Men	5199	52.6			483	9.3	<0.001
Women	4686	47.4			580	12.4	
Education							0.620
≤ Primary	970	9.8			100	10.3	
Secondary	6001	60.7			660	11.0	
≥ Tertiary	2914	29.5			303	10.4	
Smoking							0.010
Current	2951	29.9			333	11.3	
Former	2656	26.9			315	11.9	
Never	4269	43.2			414	9.7	
Missing	9	0.0					
BMI ($kg \cdot m^{-2}$)							0.241
Low	180	1.9			20	11.1	
Normal	4556	47.0			500	11.0	
Overweight	3600	37.1			364	10.1	
Obese	1359	14.0			164	12.1	
Missing	190	1.9					
Leisure-time physical activity (MET-minutes/week) WHO guidelines							<0.001
< 600	2930	29.6			386	13.2	
≥ 600	6862	69.5			665	9.7	

Missing	93	0.9			
Leisure-time physical activity (MET-minutes/week)					<0.001
Low (0-480)	2514	25.5	349	13.9	
Moderate (481-1386)	2914	29.5	299	10.3	
High (1387-2826)	1932	19.5	190	9.8	
Very high (2827 or more)	2432	24.6	213	8.8	
Missing	93	0.9			
Diabetes					0.026
No	9585	97.0	1019	10.6	
Yes	300	3.0	44	14.7	
Hypertension					<0.001
No	8761	88.6	895	10.2	
Yes	1122	11.4	167	14.9	
Missing	2	0.0			
Neck pain					<0.001
No	8702	88.0	768	8.8	
Yes	1183	12.0	295	24.9	
Low back pain					<0.001
No	8304	84.0	689	8.3	
Yes	1581	16.0	374	23.7	
Depression					<0.001
No	9514	96.3	926	9.7	
Yes	368	3.7	136	37.0	
Missing	3	0.0			
Anxiety					<0.001
No	9362	94.7	914	9.8	
Yes	523	5.3	149	28.5	

[a] Number (and percentage) of individuals with that sample characteristics who have had an activity limitation spell

[b] P-value was calculated with Chi-squared tests.

Table 2 Association of leisure-time physical activity and other covariates with activity limitation (outcome) estimated by multivariable logistic regression

Characteristic		**Activity limitation**	
Leisure-time physical activity	< 600	1.33***	[1.15, 1.54]
(MET-minutes/week)	≥ 600	ref	
Age (years)	Per unit increase	0.98**	[0.98, 0.99]
Sex	Men	0.91	[0.76, 1.09]
	Women	ref	
Education	≤ Primary	0.91	[0.65, 1.27]
	Secondary	1.04	[0.83, 1.31]
	≥ Tertiary	ref	
Smoking	Never	ref	
	Former	1.22*	[1.03, 1.45]
	Current	1.11	[0.94, 1.32]
BMI (kg m^{-2})	Low	ref	
	Normal	1.12	[0.67, 1.87]
	Overweight	0.95	[0.56, 1.61]
	Obese	1.06	[0.61, 1.82]
Diabetes	No	ref	
	Yes	1.19	[0.82, 1.73]
Hypertension	No	ref	
	Yes	1.32*	[1.06, 1.63]
Neck pain	No	ref	
	Yes	1.88***	[1.55, 2.28]
Low back pain	No	ref	
	Yes	2.31***	[1.94, 2.76]
Depression	No	ref	
	Yes	2.99***	[2.23, 4.01]
Anxiety	No	ref	
	Yes	1.46**	[1.11, 1.91]

Estimates are odds ratio [95% confidence interval].

Models are adjusted for all variables in the Table and job role.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Table 3 Association between different levels of leisure-time physical activity and activity limitation (outcome) estimated by multivariable logistic regression

Age (years)	**Association between leisure-time physical activity (< 600 MET-minutes/week) and activity limitation**	
17-36	1.09	[0.78, 1.51]
37-43	1.75**	[1.27, 2.41]
44-52	1.10	[0.82, 1.48]
53-69	1.67**	[1.22, 2.28]

Estimates are odds ratio [95% confidence interval].

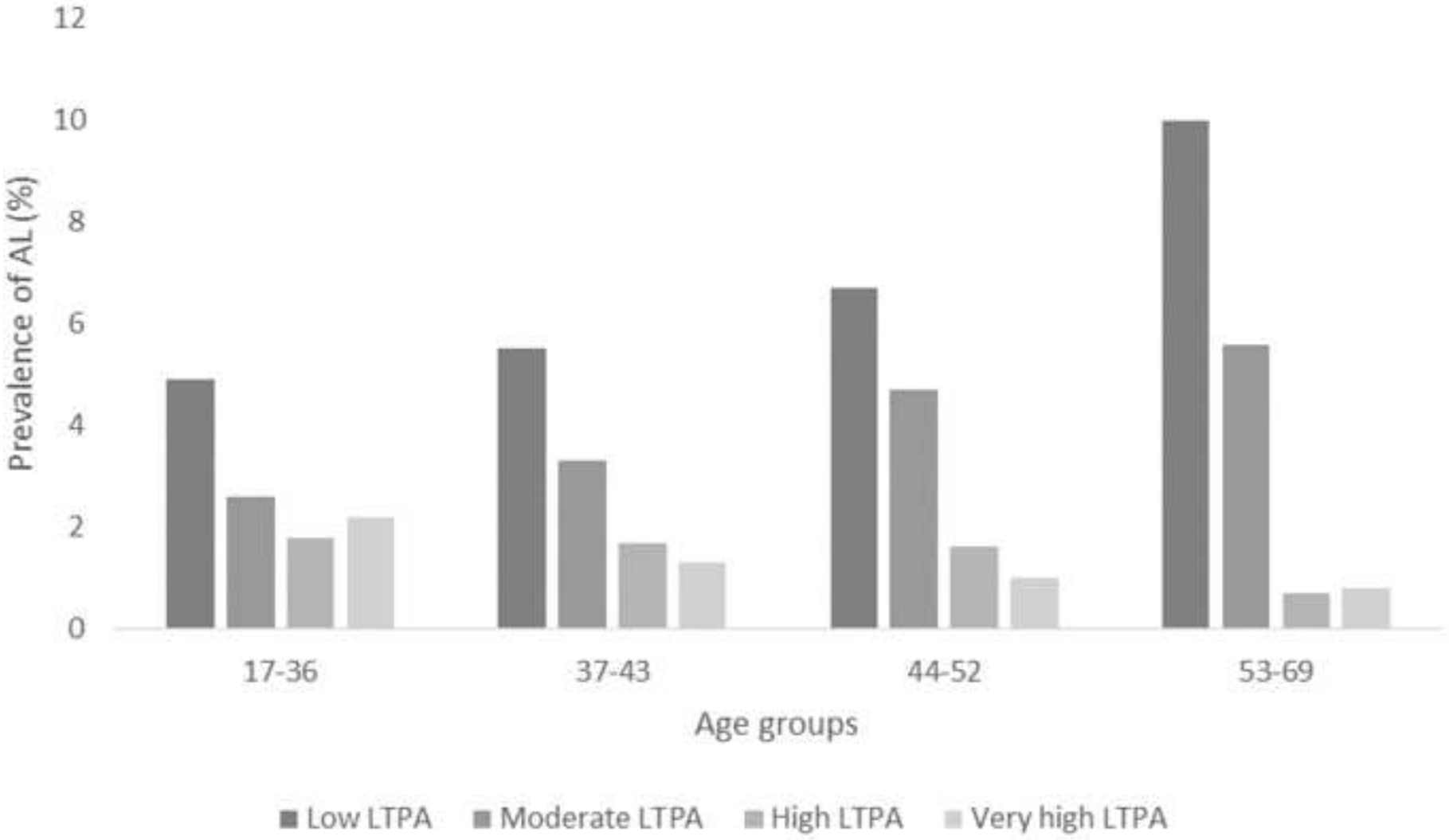
Models are adjusted for sex, education, BMI, smoking, job role, diabetes, hypertension, neck pain, low back pain, depression and anxiety.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Figure 1 Prevalence of activity limitation (AL) by level of leisure-time physical activity (LTPA) and by age groups


12
10
8
6
4
2
0
Prevalence of AL (%)
17-36
37-43
44-52
53-69
Age groups
Low LTPA
Moderate LTPA
High LTPA
Very high LTPA

6. Conclusiones

- **Artículo I.** Según los estudios experimentales incluidos, la AF podría reducir los niveles de ALE en diferentes poblaciones de trabajadores. Por otro lado, los estudios observacionales sugieren asociación inversa entre AF y ALE. El hecho de que algunos estudios sigan una tendencia exposición-respuesta, con mayores niveles de respuesta observados para la práctica de AF vigorosa, refuerzan la posibilidad de que dicha asociación exista.
- **Artículo II.** El estudio sugiere una asociación inversa entre AF y ALE entre trabajadores universitarios. El cumplimiento con los niveles de AF recomendados por la OMS apunta a una reducción anual de días de ALE.
- **Artículo III.** Mayores niveles de AF se asocian a menores niveles de estrés percibido en el trabajo entre trabajadores universitarios. Dicha asociación sigue una tendencia exposición-respuesta.
- **Artículo IV.** Los resultados sugieren que niveles altos de AF en el tiempo libre reducen el riesgo de ALE de larga duración entre trabajadores daneses. Esta reducción del riesgo se observa especialmente significativa entre mujeres jóvenes.
- **Artículo V.** Los resultados apuntan a una asociación entre mayor nivel de AF en el tiempo libre y menor nivel de ALE en trabajadores españoles.
- **Artículo VI.** El estudio sugiere que realizar AF vigorosa o moderada durante el tiempo libre reduce el riesgo de ALE de larga duración por enfermedad en cuidadoras de ancianos. Dicha reducción del riesgo, relacionada con el nivel de exposición, se observa más pronunciada entre las cuidadoras de mayor edad.
- **Artículo VII.** Alcanzar las recomendaciones mínimas de la OMS en relación con la AF podría estar asociado a un menor número de enfermedades crónicas en trabajadores españoles.
- **Artículo VIII.** Los resultados sugieren que alcanzar los niveles de AF recomendados por la OMS se asocia a menores limitaciones de la actividad cotidiana en trabajadores españoles. En particular, el subgrupo de trabajadores comprendido entre los 37 y 43 años de edad presenta la asociación más fuerte entre las dos variables.

6. Conclusions

- **Manuscript I.** According to the included experimental studies, PA might reduce the levels of SA among different populations of workers. On the other hand, observational studies suggest an inverse association between PA and SA. The fact that several studies follow an exposure-response fashion, with higher levels of response observed in the vigorous PA, strengthens the possibility of the existence of the mentioned association.
- **Manuscript II**. The study suggests an inverse association between PA and SA in university workers. The achievement of the recommended levels of PA by the World Health Organization (WHO) points to an annual reduction of days of SA.
- **Manuscript III**. Higher levels of PA associates with lower levels of self-perceived work-related stress among university workers. This association follows an exposure-response trend.
- **Manuscript IV**. The results suggest that high levels of PA during leisure reduce the risk of SA among Danish workers. This risk reduction is observed to be particularly significant in Young women.
- **Manuscript V**. The results point towards an association between higher levels of PA during leisure and lower SA in Spanish workers.
- **Manuscript VI**. The study suggests that performing vigorous or moderate PA reduces the risk of long-term SA in eldercare workers. Such a risk reduction, related to the level of exposure, is observed more pronounced among older eldercare workers.
- **Manuscript VII**. To reach the minimum WHO recommendations regarding PA might be associated with a lower chronic diseases in Spanish workers.
- **Manuscript VIII**. The results suggest that to reach the WHO recommended levels regarding PA associates with lower usual activity limitations in Spanish workers. Particularly, the subgroup of workers aged between 37 and 43 years presents the strongest association between the two variables.

7. Aportaciones principales de la Tesis Doctoral

- A través de la revisión sistemática fue posible apuntar una posible asociación inversa entre AF y ALE, siendo esta asociación más pronunciada con la AF vigorosa.
- Los estudios transversales sugirieron una asociación inversa entre la AF y el ALE en diferentes poblaciones de trabajadores españoles. Así, fue posible incluso apuntar a una cifra estimada de reducción de días de ALE por año y trabajador. La AF también se asoció de manera inversa con el estrés percibido en el trabajo, la limitación de actividades cotidianas y un conjunto de enfermedades y condiciones crónicas comunes en poblaciones de trabajadores. Estos trabajos son relevantes en un contexto de escasez de bibliografía sobre el asunto en países del sur de Europa, y permiten sugerir nuevas vías de investigación que proporcionen un mayor grado de evidencia, como los estudios de carácter longitudinal o experimental.
- Mediante los estudios de cohortes se observó una reducción del riesgo de ALE de larga duración asociado a mayores niveles de práctica de AF en el tiempo libre. Dichas reducciones del riesgo fueron significativamente más importantes en subgrupos específicos como mujeres jóvenes o cuidadoras de edad más avanzada con mayores niveles de AF. Estos trabajos refuerzan la evidencia observada en otras poblaciones de trabajadores de países nórdicos y sugieren mayores reducciones del riesgo de ALE con niveles altos de AF en el tiempo libre.

7. Main findings of the present Thesis

- Through the systematic review was possible to point at a potential inverse association between PA and SA, showing this link a more pronounced association with vigorous PA.
- The cross-sectional studies suggested an inverse association between PA and SA among different populations of Spanish workers. Thus, it was able to estimate an annual SA reduction of days per worker. PA also inversely associated with self-perceived work-related stress, usual activity limitations and a set of common chronic diseases and conditions among different populations of workers. These works are relevant in the context of bibliography scarcity of this issue in South European countries and allow suggesting new study lines such as longitudinal or experimental studies, to provide a higher evidence level.
- Due to the cohort studies, a reduction of the long-term SA risk associated with higher levels of PA during leisure was observed. Such risk reductions were significantly more relevant in specific subgroups such as young women or older eldercare workers performing higher levels of PA. These works strengthen the observed evidence in other worker populations from the Nordic countries and suggest higher long-term SA risk reductions with high levels of PA during leisure.

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Apéndice [Appendix]

Listado de artículos con ranking y factor de impacto de cada revista en *ISI Web of Knowledge – Journal Citation Reports* dentro de su correspondiente área del conocimiento.

[List of articles with ranking and impact factor of each journal according to ISI Web of Knowledge – Journal Citation Reports within their respective knowledge area].

Artículos publicados o aceptados [Published or accepted manuscripts]:

Artículo [Manuscript]	**Revista** [Journal]	**Factor de impacto** [Impact factor]
I.	**Revista Española de Salud Pública** Ranking in 2018 ISI – JCR: 155/164 (Public, Environmental & Occupational Health-SSCI) – Q4	**0.635**
II.	**Occupational Medicine – Oxford** Ranking in 2018 ISI – JCR: 150/186 (Public, Environmental & Occupational Health-SCIE) – Q4	**1.222**
III.	**The Journal of Sports Medicine and Physical Fitness** Ranking in 2018 ISI – JCR: 66/83 (Sport Sciences) – Q4	**1.302**
IV.	**Scandinavian Journal of Medicine & Science in Sports** Ranking in 2018 ISI – JCR: 11/83 (Sport Sciences) – Q1	**3.631**
V.	**The Journal of Sports Medicine and Physical Fitness** Ranking in 2018 ISI – JCR: 66/83 (Sport Sciences) – Q4	**1.302**
VII.[a]	**Preventing Chronic Disease** Ranking in 2018 ISI – JCR: 87/186 (Public, Environmental & Occupational Health-SCIE)– Q2	**2.038**

[a]: Anexo II. Carta de aceptación [Acceptance letter]

Artículos sometidos [Submitted manuscripts]:

Artículo [Manuscript]	**Revista** [Journal]	**Factor de impacto** [Impact factor]
VI.	**Journal of Sports Sciences** Ranking in 2018 ISI – JCR: 20/83 (Sport Sciences) – Q1	**2.811**
VIII.	**Science & Sports** Ranking in 2018 ISI – JCR: 76/83 (Sport Sciences) – Q4	**0.684**

Contribución del doctorado en cada uno de los trabajos

En el artículo I, correspondiente a una revisión sistemática, el doctorando llevo a cabo una búsqueda sistemática de artículos a través de distintas bases de datos, realizó la evaluación y la selección de dichos artículos en base a los criterios de inclusión establecidos, y redactó el artículo.

En los artículos II y III, el doctorando contribuyó a la recogida de datos y su posterior exportación a las correspondientes bases de datos, a partir de las cuales realizó los análisis estadísticos, y escribió los artículos.

En los artículos IV y VI, el doctorando participó en el proceso de análisis de los datos y llevó a cabo la redacción de los artículos.

Finalmente, en los artículos V, VII y VIII, el doctorando realizó la extracción de datos de bases de datos de acceso público, realizó los análisis estadísticos y redactó los artículos.

Contribution of the PhD candidate to each of the manuscripts

In the manuscript I, corresponding to a systematic review, the PhD candidate carried out a systematic search of articles through different databases, assessed and selected articles according to the set criteria, and wrote the manuscript.

In manuscripts II and III, the PhD candidate contributed to the data collection and the subsequent data exportation to the datasets, from which the statistical analyses were conducted, and wrote the manuscripts.

In manuscripts IV and VI, the PhD candidate took part in the data analyses and wrote the manuscripts.

Finally, in manuscripts V, VII and VIII, the PhD candidate retrieved data from public access datasets, conducted the statistical analyses, and wrote the manuscripts.

Agradecimientos [Acknowledgements]

Realizar una Tesis Doctoral es algo que llevaba en mente desde que obtuve el título de Licenciado en Ciencias de la Actividad Física y el Deporte, allá por el año 2003. Ha pasado mucho tiempo desde entonces, y el trayecto no ha sido fácil, pero la espera ha merecido la pena. Durante estos años he tenido la suerte de conocer a decenas de personas que, de una u otra manera, han influido en el desarrollo de este trabajo. Por eso, me gustaría agradecer a través de los siguientes párrafos la colaboración, dedicación y comprensión recibidas por su parte.

En primer lugar querría agradecer a José Antonio Casajús la oportunidad de haber podido contar con su apoyo y dirección. Me gustaría destacar su buena disposición, confianza y paciencia, gracias a las cuales puedo escribir hoy estas líneas. Ha sido un auténtico privilegio trabajar con él durante estos casi cinco años.

Querría agradecer a Nuria Garatachea su disposición para colaborar en la publicación de mi primer artículo en una revista científica con factor de impacto. Fue un momento importante, gracias al cual fui consciente de que era posible lograr el objetivo.

I would like to acknowledge Lee Smith for his support and kindness, particularly when I was visiting him in Cambridge. Thanks to him I learned how academic journals really work. His hard work and determination will lead him to be a full professor in the short term.

Agradezco a Guillermo López su apoyo y colaboración en varios de los artículos que componen esta Tesis Doctoral. Sospecho que tiene un futuro brillante en el campo de la investigación y docencia universitarias.

I am also very grateful to the workers of the National Research Centre for the Working Environment. The invitation of Lars Andersen gave me the opportunity to know how a high-performance team work. I would also like to thank Emil Sundstrup, Jonas Vinstrup, Rúni Bláfoss, Mikkel Brandt, Markus Due Jacobsen and the rest of the team for their valuable support.

También me gustaría agradecer a Joaquín Calatayud sus valiosas aportaciones en varios de los estudios. Espero seguir colaborando con él en el futuro.

Agradezco a los técnicos de la Unidad de Prevención de Riesgos Laborales de la Universidad de Zaragoza, Luis Cásedas y José Luis Dolz, y al responsable de los Servicios de Vigilancia de la Salud, Javier Mompel, las facilidades recibidas para poder desarrollar los estudios.

Gracias igualmente a los técnicos del Servicio de Actividades Deportivas de la Universidad de Zaragoza, al grupo de investigación GENUD, al Colegio de Licenciados de Educación Física de Aragón (COLEFA) y a Germán Vicente, Decano de la Facultad de Ciencias de la Salud y el Deporte, por la amabilidad y el apoyo recibidos.

Por último, me gustaría agradecer a mi familia toda la comprensión que han tenido durante estos años, especialmente a mi pareja, Amaia, mi hija Alicia, mis padres, Luis y Elena, y mi hermano, Alberto, que va camino de convertirse en un gran emprendedor, si no lo es ya.

Anexos [Annexes]

Anexo I

Dña. María González Hinjos, Secretaria del CEIC Aragón (CEICA)

CERTIFICA

1º. Que el CEIC Aragón (CEICA) en su reunión del día 14/02/2018, Acta Nº 03/2018 ha evaluado la propuesta del Trabajo:

Título: PHYSICAL ACTIVITY INFLUENCE IN ABSENTEEISM OF ZARAGOZA UNIVERSITY EMPLOYEES

Alumno: Rubén López Bueno
Director: José Antonio Casajús Mallén

Versión protocolo: Versión 2.0

2º. Considera que

- El proyecto se plantea siguiendo los requisitos de la Ley 14/2007, de 3 de julio, de Investigación Biomédica y los principios éticos aplicables.
- El Tutor/Director garantiza la confidencialidad de la información, el cumplimiento de la LOPD y la correcta utilización de los recursos materiales necesarios para su realización.

3º. Por lo que este CEIC emite **DICTAMEN FAVORABLE a la realización del proyecto**.

Lo que firmo en Zaragoza

GONZALEZ HINJOS MARIA - DNI 03857456B
Firmado digitalmente por GONZALEZ HINJOS MARIA - DNI 03857456B
Fecha: 2018.02.16 15:23:09 +01'00'

María González Hinjos
Secretaria del CEIC Aragón (CEICA)

Anexo II

Gmail

R L <rlopezbu53@gmail.com>

Preventing Chronic Disease - Manuscript PCD-20-0105.R1

Preventing Chronic Disease <onbehalfof@manuscriptcentral.com> 12 de mayo de 2020, 20:50
Responder a: pcdeditor@cdc.gov
Para: rlopezbu@unizar.es

PREVENTING CHRONIC DISEASE
PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

12-May-2020

Dear Mr. López-Bueno:

Thank you for submitting your manuscript. It has been evaluated by the editors and peer-reviewers, and we are pleased to inform you that "***Global Perspectives Collection***: Lower physical activity is associated with higher odds of chronic conditions among the Spanish workforce" has been accepted for publication in Preventing Chronic Disease as a/an Original Research article.

The article will undergo substantive editing for organization, sense, clarity, grammar, and journal style. Additional revisions and deletions may be required after acceptance. PCD technical editors will make the final decision on whether to include supplementary items at the time of publication. Final acceptance of a manuscript for publication does not guarantee publication of the accompanying appendices and other supplemental files. However, please DO NOT make any changes to your manuscript until you are contacted by one of our staff editors. A final content proof will be sent to you for review before publication.

Thank you again for sending us your article. We look forward to working with you in the months ahead.

Sincerely,

Leonard Jack, Jr, PhD, MSc
Editor in Chief
Preventing Chronic Disease

Editorial Review Comments

Associate Editor: Jack, Leonard
Comments to the Author:
(There are no comments.)

Anexo III

ESPECIFIQUE SU CENTRO DE TRABAJO: FACULTAD/ESCUELA /INSTITUTO/SERVICIO/OTROS …

01.	ESCUELA DE INGENIERIA Y ARQUITECTURA (EINA)	**09.**	FACULTAD DE ECONOMIA Y EMPRESA F. EMPRESA Y G. PUBLICA
02.	CAMPUS HUESCA (VICERRECTORAD, ESCUELA POL. SUPERIOR, FACULTAD DE CIENCIAS DE LA SALUD Y EL DEPORTE	**10.**	FACULTAD DE FILOSOFIA Y LETRAS
03.	CAMPUS DE TERUEL (VICERRECTORADO, ESCUELA POL. SUPERIOR, FACULTAD DE CIENCIAS SOCIALES Y HUMANIDADES)	**11.**	FACULTAD DE MEDICINA
04.	FACULTAD DE CIENCIAS	**12.**	FACULTAD DE VETERINARIA
05.	FACULTAD DE CIENCIAS DE LA SALUD	**13.**	**INSTITUTOS Y NAVES DE INVESTIGACIÓN** (I. NANOCIENCIA –INA-, CIBA, I3A, BIFI, ISQCH, CIRCE, ICE ..)
06.	FACULTAD DE CIENCIAS HUMANAS Y DE LA EDUCACION	**14.**	PARANINFO
07.	FACULTAD DE CIENCIAS SOCIALES Y DEL TRABAJO	**15**	**SERVICIOS DE ASISTENCIA:** INFORMATICA, BIBLIOTECAS, S. ACTIVIDADES DEPORTIVAS –SAD-, UNIVERSA, COLEGIOS MAYORES
08.	FACULTAD DE DERECHO	**16.**	**SERVICIOS CENTRALES:** JURIDICOS, MANTENIMIENTO, UNIDAD UTCM, SAI, SEGURIDAD, UPRL…

ESPECIFIQUE SI SU ACTIVIDAD ES P.A.S., P.D.I. O COMPAGINA AMBAS

ENCUESTA ANÓNIMA SOBRE EL ESTRÉS Y ACOSO EN UNIZAR	**SI**	**NO**
1. ¿Considera usted que tiene problemas de salud derivados de su trabajo?		
2. ¿Qué nivel de estrés o tensión laboral diría que padece usted del 1 al 10, siendo 1 poco estrés y 10 mucho estrés?		
3. Cuándo termina su jornada laboral ¿continua pensando en el trabajo?		
4. Las relaciones con otras personas de la empresa ¿le producen más tensión de la habitual?		
5. ¿Se ha considerado en el último año maltratado psicológicamente de forma continua, por conductas, actitudes u otras formas de relacionarse con Vd. por parte de algún compañero o superior en el trabajo?		
6. ¿Ha recibido usted en su trabajo, en el último año por parte de compañeros o superiores, alguna conducta física, o proposición verbal o no verbal, de carácter sexual, que considere usted inaceptable?		
7. Si tiene problemas en su trabajo ¿Puede contar con el apoyo de otras personas de la empresa?		
8. ¿Su horario laboral incluye turno de noche o es usted trabajador nocturno? (más de 3 horas entre las 22:00-6:00).		
9. ¿Considera los horarios un problema para su salud o su vida social y familiar?		
10. ¿Cómo calificaría su grado de satisfacción en relación con sus condiciones laborales actuales, siendo 1 poco satisfechas y 10 muy satisfechas?		
11. Para aminorar el nivel de estrés que puede generar su actividad laboral, ¿actualmente realiza actividades que puedan prevenir estas situaciones de tensión, tales como **ejercicio físico habitual?**		
12. En los últimos dos años, ¿ha necesitado asistencia médica o psicológica por estrés?		

RECUERDE…EL INFORME DEL RECONOCIMIENTO MÉDICO LO RECIBIRÁ EN EL E-MAIL QUE HAYA PROPORCIONADO, Y LO HABITUAL ES RECIBIRLO ANTES DE UNA SEMANA. EN EL CASO DE DEMORA, RECOMENDAMOS CONTACTAR CON EL TEL. DE CITACIONES, 608385324 ó por E-MAIL: *ceslava@spmas.es* ***/*** *Si se le solicitan algunas pruebas complementarias específicas por exposición a agentes químicos o biológicos, es probable que el tiempo en recibir el informe del reconocimiento médico sea superior a una semana.*

PUESTO DE TRABAJO DESEMPEÑADO / DEPARTAMENTO / SERVICIO	**FECHA ACTUAL** (dd/mm/aaaa):

EDAD (señale lo que proceda): □ **De 18 a 30 años** □ **De 31 a 40 años** □ **De 41 a 50 años** □ **51 años o más**	**GENERO:** □ **MUJER** □ **HOMBRE** **FUMADOR:** □ **SÍ** □ **NO**

NIVEL DE ACTIVIDAD FÍSICA QUE REALIZA

Conteste estas preguntas rodeando con un círculo el número que corresponda

A. ¿Cuantos días a la semana hace actividad física moderada-intensa? (**ejemplo caminar rápido**) **0**, **1, 2, 3, 4, 5, 6, 7 días**
B. De media, ¿**cuantos minutos al día** hace actividad física a esta intensidad? **10**, **20, 30, 40, 50, 60, 90, 120,** más de **150**

CUESTIONARIO INTERNACIONAL DE ACTIVIDAD FÍSICA – IPAQ

INSTRUCCIONES: Las preguntas se referirán acerca del tiempo que usted utilizó siendo físicamente activo (a) en los **últimos 7 días.** Por favor responda cada pregunta aún si usted no se considera una persona activa. Por favor, piense en todas aquellas actividades que usted hace como parte del trabajo, en el jardín y en la casa, para ir de un sitio a otro, y en su tiempo libre de descanso, ejercicio o deporte.

ACTIVIDADES FÍSICAS INTENSAS: requieren esfuerzo físico fuerte y le hacen respirar más fuerte que lo normal.

1.- Durante los **últimos 7 días**, ¿Cuántos días realizó **actividades físicas intensas** como levantar objetos pesados, excavar, aeróbicos, o pedalear rápido en bicicleta?
_____**días por semana** (Si su respuesta es 0 pase directamente a la pregunta 3)

2.- ¿Cuánto tiempo le tomó realizar **actividades físicas intensas** en uno de esos días que las realizó?
_____**horas por día** _____**minutos por día** Si no está seguro, indíquelo con una X aquí_____

ACTIVIDADES FÍSICAS MODERADAS: requieren esfuerzo físico moderado y respira más fuerte de lo normal.

3.- Durante los **últimos 7 días**, ¿Cuántos días hizo **actividades físicas moderadas**, tales como cargar objetos livianos, pedalear en bicicleta a paso regular, o jugar dobles de tenis? No incluya caminatas.
_____**días por semana** (Si su respuesta es 0 pase directamente a la pregunta 5)

4.- ¿Cuánto tiempo dedica en uno de esos días haciendo **actividades físicas moderadas**?
_____**horas por día** _____**minutos por día** Si no está seguro, indíquelo con una X aquí_____

5.- Durante los **últimos 7 días**, ¿Cuántos días **caminó** usted por al menos 10 minutos continuos?
_____**días por semana** (Si no caminó pase directamente a la pregunta 7)

6.- ¿Cuánto tiempo gastó usted en uno de esos días **caminando**?
_____**horas por día** _____**minutos por día** Si no está seguro, indíquelo con una X aquí_____

7.- Durante los **últimos 7 días**, ¿Cuánto tiempo permaneció **sentado (a)** en un **día a la semana**?
_____**horas por día** _____**minutos por día** Si no está seguro, indíquelo con una X aquí_____

*.- Cuánto tiempo estima que se ha **ausentado** del trabajo por motivos de salud en los **últimos 12 meses**?
_____**meses** _____**días**

.- ¿Qué tipo de **dolencia motivó más su ausencia por razones de salud durante ese período? Marque con X.
□ **musculoesquelética** □ **metabólica** □ **enfermedad común** □ **otra** _____

***.- Señale con una X si usted presenta habitualmente alguna de las siguientes **características**. Marque con X.
□ **hipertensión arterial** □ **diabetes** □ **sobrepeso** □ **colesterol elevado** □ **índice aterogénico elevado**

Todos los datos de este cuestionario serán tratados de manera anónima y confidencial con fines de investigación.

Anexo IV

INVESTIGACIÓN Con la colaboración de la Unidad de Cultura Científica de la Universidad de Zaragoza

SALUD LABORAL

>ACTIVIDAD FÍSICA Y PRODUCTIVIDAD VAN UNIDAS

La promoción de la actividad física en el entorno laboral ha demostrado ser una estrategia eficaz para mejorar la salud de los empleados, mejorar el ambiente de trabajo y reducir el absentismo laboral. El reto ahora es encontrar cuáles son los programas mejor ajustados a las necesidades de las empresas y conocer las dosis que producen mayores beneficios en las diferentes poblaciones de trabajadores. La Universidad de Zaragoza investiga en este ámbito tan poco estudiado en los países del sur de Europa

Trabajadores realizando ejercicios con banda elástica durante su jornada laboral. MUTUA NAVARRA

EN MOVIMIENTO Los trabajadores más activos son también más productivos. Así lo constata un estudio realizado sobre 1.000 trabajadores de la Universidad de Zaragoza (UZ). El diagnóstico es claro: quienes realizan un mínimo de 150 minutos de actividad física moderada a la semana –la recomendación mínima establecida por la Organización Mundial de la Salud– faltan de media al trabajo por baja médica tres días menos que quienes son más inactivos.

Tras publicar los resultados de esta investigación, cuyo primer autor es Rubén López, doctorando de la UZ, en la revista 'Occupational Medicine', el siguiente objetivo es poder realizar intervenciones, ensayos clínicos aleatorizados con muestras de trabajadores.

Ya que más movilidad significa más salud y más productividad, y dado que el trabajo es el lugar donde más horas pasamos (despiertos), empieza a plantearse la promoción de la actividad física dentro de la jornada laboral. La Universidad de Copenhague ya incluye una hora a la semana de gimnasio entre las horas de docencia de sus profesores.

Además, los beneficios del fomento de la actividad física en el trabajo no solo se limitan a menos bajas por enfermedad. Los resultados de otra investigación realizada en colaboración con la Unidad de Prevención de Riesgos Laborales de la UZ, registraron un descenso significativo de la percepción del estrés laboral entre los trabajadores que realizaban actividad física de manera regular igual o por encima del mínimo recomendado. Dicho estudio fue gestado en el marco de la iniciativa Exercise is Medicine, impulsada por el Colegio Americano de Medicina del Deporte. Esta institución americana reconoció a la UZ como Gold Campus en los años 2018 y 2019 por sus buenas prácticas en la promoción de la salud.

EL ESTUDIO

■ **OBJETIVOS** Identificar las estrategias de promoción de la actividad física más eficientes para fomentar la salud de los trabajadores y reducir las bajas laborales. Analizar las tendencias de actividad física en el entorno laboral.

■ **SOCIOS** El proyecto, liderado desde la Universidad de Zaragoza (investigador principal: José Antonio Casajús), cuenta con el apoyo y asesoramiento del National Research Centre for the Working Environment de Copenhague (Dinamarca), el Colegio Americano de Medicina del Deporte (EE. UU.) y el Cambridge Centre for Sport and Exercise Sciences (Reino Unido).

■ **EJECUCIÓN** Cuatro años a partir de 2020 para implementar nuevos ensayos clínicos.

¿ES BUENA LA ACTIVIDAD FÍSICA EN EL ENTORNO LABORAL?

Recientemente, Pieter Coenen, investigador en el Amsterdam Public Health Research Institute (Holanda), coordinó un estudio en el que se analizó a 200.000 trabajadores. Se observó una importante asociación entre actividad física en el trabajo y mortalidad: a mayor actividad física realizada en el desempeño del trabajo, más riesgo de morir prematuramente tenían los trabajadores. Este estudio ha reforzado los hallazgos de trabajos anteriores sobre la llamada paradoja de la salud, que apuntan a un efecto beneficioso para la salud cuando la actividad física es realizada en el tiempo libre y a un efecto nocivo cuando la actividad física se realiza con motivo de las tareas del trabajo. Este fenómeno pone de relieve la importancia de la dosificación de los esfuerzos en el trabajo, así como los peligros de la repetición de movimientos y posiciones forzadas mantenidas. Por el contrario, la actividad física realizada en el tiempo libre compensa los esfuerzos físicos y los movimientos realizados habitualmente en el trabajo o en la actividad cotidiana, lo que tiene efectos probados sobre la salud y también sobre las bajas laborales.

La investigación en el ámbito de la salud laboral es una prioridad en los países nórdicos, que cuentan con unidades específicas que estudian los efectos de la actividad y el ejercicio físico en diferentes tipos de trabajadores. En Holanda también se están invirtiendo muchos recursos en diferentes líneas de investigación.

¿QUÉ ACTIVIDAD FÍSICA ES LA MEJOR PARA LA SALUD Y PRODUCTIVIDAD DEL TRABAJADOR?

Podríamos afirmar que cualquier tipo de actividad física mejora la salud, ya que somos entidades biológicas diseñadas para el movimiento. Debemos concienciar a trabajadores y empresarios de que las pausas activas –en las que caminar, tonificar, estirar, descansar los ojos o beber agua– han de implementarse en la jornada laboral como tareas imprescindibles para mantener la salud y mejorar la productividad. También utilizando la bicicleta o caminando ganamos salud, pero podemos conseguir más. Cuando el ejercicio físico es el adecuado, observamos una relación dosis-efecto. Pero el ejercicio (hay cientos de posibilidades) se debe adaptar a las necesidades y preferencias del sujeto. No hay ejercicios malos, simplemente están mal prescritos.

JOSÉ ANTONIO CASAJÚS PROFESOR DE ACTIVIDAD FÍSICA Y SALUD Y CATEDRÁTICO DE LA UNIVERSIDAD DE ZARAGOZA

¿CUÁL ES EL COSTE DE FALTAR AL TRABAJO POR ENFERMEDAD?

Según la Asociación de Mutuas de Accidentes de Trabajo, en España se pierden más de 25.000 millones de euros al año a causa de las ausencias del trabajo por enfermedad y el estrés laboral. A pesar de estas cifras, son muy pocas las instituciones y empresas españolas que están haciendo algo al respecto, como muestra un informe reciente publicado por el Instituto Nacional de Seguridad, Salud y Bienestar en el Trabajo.

Las estrategias de promoción de la actividad física entre los trabajadores diseñadas y puestas en práctica por profesionales cualificados han demostrado ser efectivas a la hora de reducir las ausencias al trabajo por enfermedad, con o sin baja médica, o reducir la prevalencia de enfermedades crónicas como el dolor de espalda o cuello, hipertensión, diabetes, ansiedad y depresión, tan extendidas en algunos entornos laborales.