Associations between the Level of Competition and the Type of Sport with health-related Quality of Life in Adolescents

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Abstract

Adolescence is a critical period marked by significant physical, psychological, and social changes, with physical activity (PA) playing a pivotal role in health-related quality of life (HRQoL) outcomes.

This cross-sectional study aimed to investigate the relationship between PA, sports participation, and HRQoL among adolescents, considering gender, age, maturation, competition level, and type of sport.

A total of 9383 adolescents aged 11–19 completed assessments of PA, HRQoL, and demographic variables. Participants were classified based on PA levels and sports competition levels. HRQoL was assessed using standardized measures, including the KIDSCREEN-52 questionnaire.

Girls reported lower scores in physical and mental HRQoL domains compared to boys, starting from Tanner maturation stage 3. All HRQoL domains, except social acceptance, declined with age and maturation, with a more pronounced decline in girls. Inactive adolescents exhibited the lowest HRQoL levels across all domains. Competitive athletes demonstrated better HRQoL than non-competitive peers, with improvements in self-perception and social acceptance at higher competition levels. Sport type influenced HRQoL outcomes, with gymnastic sports associated with lower autonomy and peer relationships, while racquet sports showed better outcomes.

This study highlights the complex interplay between PA, sports participation, and HRQoL among adolescents. Tailored interventions promoting physical activity and supporting young athletes' psychosocial needs are essential for enhancing HRQoL during this critical developmental stage.

Keywords Physical activity · Sports participation · Health-related quality of life · Gender differences · Competition level · Maturation

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1 Introduction

Adolescence is a critical developmental period characterized by significant physical, psychological, and social changes. These changes can profoundly impact adolescents' health-related quality of life (HRQoL), a multidimensional construct that encompasses physical, mental, and social well-being (Freire & Ferreira, 2018). HRQoL reflects perceived well-being and functional capacity within these domains. While definitions vary, HRQoL generally focuses on health-related aspects of life, distinguishing it from broader notions of quality of life (Karimi & Brazier, 2016).

Physical activity (PA) is widely recognized for its numerous health benefits, and its role in enhancing HRQoL among adolescents has garnered increasing attention from researchers and public health practitioners alike (Marker et al., 2018). Regular physical activity has been linked to improved physical health, psychological well-being, and social functioning in adolescents (Freire & Ferreira, 2018). It is associated with better cardiovascular health, enhanced mood, reduced anxiety and depression, and improved self-esteem (Marker et al., 2018). Participation in sports and structured physical activities can foster social skills, teamwork, and a sense of belonging, further contributing to overall well-being (McMahon et al., 2017). Given the centrality of peer relationships during adolescence, domains such as Social Acceptance, which reflect peer-related experiences including bullying, play a critical role in understanding adolescent HRQoL. These experiences of inclusion or exclusion within peer groups significantly influence psychological well-being, self-esteem, and school engagement, and are therefore essential to a comprehensive understanding of adolescent health and quality of life (Viner et al., 2015).

To assess HRQoL comprehensively, this study employs the standardized KIDSCREEN-52 questionnaire, which evaluates ten dimensions of well-being in children and adolescents. The instrument provides scores standardized with a mean of 50 and a standard deviation of 10, facilitating comparisons with normative data at national and international levels. Scores below 40 may indicate potential psychosocial or physical difficulties, while those between 40 and 60 generally reflect a satisfactory or "good enough" level of well-being (Ravens-Sieberer et al., 2005). Although higher scores generally imply better HRQoL, such differences may not always be clinically meaningful, particularly within the normative range. Therefore, interpretation should take into account not only statistical significance but also whether changes reflect meaningful improvements in perceived health.

Despite the benefits of physical activity, physical inactivity remains prevalent among adolescents, with many failing to meet the recommended levels of physical activity (Bassett et al., 2015). This inactivity is concerning, given the established association between sedentary behaviors and poorer HRQoL (Wu et al., 2017). Additionally, the level of competition in sports participation can influence the relationship between physical activity and HRQoL. While competitive sports can provide structure, goals, and social connections, the pressures and demands of high-level competition may also pose challenges to adolescents' well-being (Russell et al., 2019).

Research has indicated that gender differences exist in the experiences of physical activity and HRQoL during adolescence. Girls often report lower levels of physical activity and HRQoL compared to boys, which may be influenced by societal

norms, body image issues, and other psychosocial factors. Furthermore, the impact of maturation on HRQoL is an important consideration, as physical and psychological changes during puberty can affect adolescents' perceptions of their well-being (Davison et al., 2017).

According to all the above, this study aims to explore the diverse domains of HRQoL in adolescents participating in various sports, classified by their competition level—from physically inactive individuals to international competitors. By examining the interplay between physical activity, competition level, gender, and maturation, this research seeks to provide a comprehensive understanding of how different factors contribute to adolescents' HRQoL.

2 Materials and methods

2.1 Ethical Requirements

This study was designed as a cross-sectional investigation based on self-reported data and was conducted in accordance with the principles of the Declaration of Helsinki. The study protocol was reviewed and approved by the Clinical Research Ethics Committee of Aragón (CEICA-PI/0339).

2.2 Participants and Design

A total of 9,383 participants aged 11–19 completed the baseline assessment, providing valid data for physical activity and HRQoL scores. Participants were categorized into seven groups: inactive, somewhat active, non-competitive athletes, and athletes competing at local, regional, national, and international levels. National and international athletes were recruited through the Spanish and Regional Sports Federations, High Performance Sports Centers, Sports Technique Centers, and the top 20 clubs of each Olympic sport discipline (from the Summer Olympic Games program), stratified by sex and age category. For each discipline, the 20 highest-performing clubs were identified separately for boys and girls within specific age groups, based on national rankings. Recruitment was conducted via email, letter, and telephone, with the invitation including a brief introduction to the study, an explanation of its anonymous nature, and a link to the online questionnaire.

To be included in the study, athletes had to train at least 2 days per week, and competitive athletes needed at least 6 months of experience in training and competing in a sport included in the Summer Olympic Games program. To recruit inactive, somewhat active participants, and non-competitive, locally competitive, and regionally competitive athletes, all students from secondary education centers in three representative provinces of Spain were invited to participate. These provinces were selected to capture diversity in geographical distribution, socioeconomic status, and cultural context, including both urban and rural settings, in order to ensure broad national representativeness. Inactive subjects had to indicate that they did not engage in sports and were categorized as having low levels of physical activity according to the Patient Centered Assessment and Counseling for Exercise (PACE) criteria, which

defines low activity as 0 to 2 days per week of at least 60 min of moderate to vigorous physical activity (McMahon et al., 2017). Somewhat active subjects had to indicate irregular sports participation and moderate levels of physical activity, defined as 2 to 3.5 days per week with at least 60 min of moderate to vigorous physical activity. This intermediate group was necessary to account for participants who did not qualify as athletes but still reported higher activity levels than inactive peers, ensuring that a relevant portion of the adolescent population, those who are physically active but not involved in organized sports, was not disregarded. Non-competitive athletes needed to report engaging in sports at least twice a week without participating in competitions. The criteria for limiting groups have previously been used as inclusion criteria in other studies to ensure different levels of physical activity and training in each group (Sitko et al., 2024).

Exclusion criteria for all participants included: (1) chronic illness or any physical or psychological condition that might limit physical activity levels; (2) the presence of an injury that could affect participation in their respective sports or any variable considered in this study. Data collection took place from January to March to ensure all study variables were assessed while athletes were in an advanced phase of their training season, controlling for possible seasonal effects. Table 1 presents the main characteristics of the participants, categorized by performance level.

2.3 Physical Activity and Sport

To obtain contextual information about physical activity, participants completed the Spanish version of the Physical Activity Questionnaire for Children and Adolescents (PAQ-C and PAQ-A) (Martínez-Gómez et al., 2009). They assessed their physical activity levels during free time, physical education classes, and at various times (lunchtime, afternoon, and evening) on school days and weekends over the past seven days. The PAQ-C consists of nine items, and the PAQ-A consists of eight items, both rated on a 5-point Likert-type scale. These scores were averaged to provide an overall physical activity score ranging from 1 to 5, with lower scores indicating lower levels of physical activity.

Physical activity was also measured using a modified version of the PACE questionnaire for adolescents (Prochaska et al., 2001), adapted for epidemiological studies with European adolescents. This version asks participants about the number of days they accumulated at least 60 min of moderate to vigorous physical activity in the past 14 days (McMahon et al., 2017). Additionally, participants were asked if they had engaged in at least twice-weekly training in the last six months, their priority sport, years of competitive practice, and current number of sessions and hours per week. Questions regarding their performance level, season objective, and competitive allocation were also included. Participants competing in the highest competitive category at the national level for their age, sex, and sport were classified as national-level athletes.

A traditional classification was adapted to differentiate between technical, power, gymnastic, combat, racket, team, and endurance sports (Belz et al., 2018) (Supplementary Table 1). Sports were coded as team or individual based on whether they involved three or more athletes competing simultaneously (Zhou et al., 2015). Team

Table 1 Participant characteristics according to performance level

	Inactive (n=1,031)	Somewhat Active (n=566)	Non-competitive (n=3249)	Locally competive (n=1925)	Regionally competive (n=777)	Nationally competive (n=1642)	Internationally competive (n=193)
Age (y)	15.5 (1.6)	15.3 (1.6)	14.9 (1.7)	14.6 (1.7)	14.9 (1.8)	15.4 (1.9)	16.7 (1.8)
BMI (kg/m2)	21.0 (3.9)	21.0 (4.2)	20.6 (3.5)	20.0 (2.9)	20.3 (3.0)	20.5 (3.0)	21.7 (2.8)
PA level (1–5)	1.7 (0.5)	1.9 (0.5)	2.5 (0.6)	2.8 (0.6)	2.8 (0.6)	2.9 (0.6)	2.8 (0.6)
Sport training							
Years (y)	NA	NA	3.9 (3.2)	6.2 (3.4)	6.4 (3.3)	6.8 (3.3)	9.0 (3.3)
Hours week (h/wk)	NA	NA	3.6 (2.6)	5.3 (3.1)	7.4 (4.1)	11.0 (6.0)	15.9 (5.5)
Days week (d/wk)	NA	NA	3.0 (1.5)	3.4 (1.5)	3.8 (1.2)	4.7 (1.3)	5.5 (1.2)

Values are mean (standard deviation). Abbreviations: BMI Body Mass Index; PA Physical Activity; NA Not applicable because these groups do not perform sports training. PA level based on the PAQ-C/PAQ-A; range: 1–5. Higher scores indicate greater physical activity.

sports were further classified based on whether they involved direct competition with opponents. Additionally, a group of athletes who competed both individually and in a team sport without an opponent was identified (Supplementary Table 2).

Sports were classified according to their predominant metabolism: alactic, lactic, mixed, and aerobic metabolism (Spencer et al., 2006, 2001), and to their high- or low-contact (Supplementary Table 3). A distinction was made between sports typically practiced outdoors and those practiced indoors.

2.4 Health-Related Quality of Life

The Spanish version of the KIDSCREEN-52 was used to measure HRQoL. This generic HRQoL instrument is based on a multidimensional construct and was developed as part of a European collaboration to provide a cross-cultural measure for children and young people aged 8 to 18 years (Ravens-Sieberer et al., 2001). It assesses physical, mental, and social dimensions of well-being from the perspective of the child or adolescent. The questionnaire includes 52 items, rated on a five-point Likert scale (1 to 5), reflecting the frequency of certain behaviors or feelings (never, seldom, sometimes, often, and always) or the intensity of attitudes (not at all, slightly, moderately, very, and extremely). For example, one item from the 'Social Acceptance' dimension asks: 'Have you been bullied by other children?' with response options ranging from 'never' (1) to 'always' (5). The reference period is the previous week. The 52 items are distributed across 10 dimensions: Physical well-being, Psychological well-being, Moods and emotions, Self-perception, Autonomy, Parent relations, Social support and peers, School environment, Social acceptance/bullying, and Financial resources. Scores were standardized with a mean of 50 and a standard deviation of 10, with higher scores indicating better HRQoL. KIDSCREEN dimensions have acceptable psychometric properties and reliability, with Cronbach's alpha ranging from 0.77 to 0.89 (Ravens-Sieberer et al., 2005). In our sample, the internal consistency of the KIDSCREEN 52 was adequate, with a mean Cronbach's alpha of 0.81 across the dimensions. Based on the normative interpretation guidelines of the KIDSCREEN-52 and prior literature referencing scores one standard deviation from the mean, adolescents' T-scores in each HRQoL dimension were categorized into 'low average QoL' (T-score < 40), 'normal range' (T-score 40–60), and 'high average QoL' (T-score > 60).

2.5 Socioeconomic Status

Subjective socioeconomic status (SES) was assessed with the question, "How well-off do you think your family is?" This question was originally used in the "Health Behavior in School-aged Children (HBSC)" study in 1994 as an indicator of subjective socioeconomic status in adolescents (Roberts et al., 2009). Responses were classified into four categories: poor, not very poor, normal and rich or very rich (Moreno-Maldonado et al., 2019).

2.6 Physical Evaluation

Body mass index (BMI) was calculated from reported weight and height (Cole et al., 2000). Pubertal status was evaluated using the Pubertal Development Scale (Petersen et al., 1988), which has shown acceptable validity and reliability (Bond et al., 2006). For girls, the questionnaire addresses five aspects: body hair, accelerated growth, skin changes, menarche, and breast development. For boys, it includes body hair, accelerated growth, skin changes, facial hair, and voice changes. Additionally, girls were asked about the onset and age of menstruation. A five-level categorical scale comparable to Tanner's stages of pubertal development was used (Carskadon & Acebo, 1993).

2.7 Other Variables

Participants were categorized by geographical area of Spain (north-south) and the population size of their place of residence: less than 1,000 inhabitants, 1,001 to 10,000 inhabitants, 10,001 to 100,000 inhabitants, 100,001 to 500,000 inhabitants, and more than 500,000 inhabitants.

2.8 Statistical Analysis

All analyses were conducted using IBM SPSS Statistics v.26 software (IBM Corp., Armonk, NY, USA). Descriptive statistics for the sample included means and standard deviations for continuous variables, and percentages for categorical variables. The normality of the dependent variable was tested using the Kolmogorov–Smirnov test and by examining the skewness coefficient. Generalized linear models (GLMs) assuming a gamma distribution were applied to examine the effects of the independent variables on HRQoL domains. When significant effects were detected, post hoc comparisons were conducted using Bonferroni adjustment. Confounding variables were controlled, including sex, age group, maturation stage, competition level, and type of sport. Further analysis assessed the effect of HRQoL domains on the predominant metabolism of the sport, type of competition, training environment, and to their high- or low-contact. Confounding variables positively associated with physical activity participation were used as covariates. These included SES, maturational development, place of residence, municipality size, and weekly training hours in the competition group comparisons. SES was entered as a categorical variable, and interaction effects with sport type were tested. Interactions of independent variables were controlled by performing analyses with two factors and the confounding variables. A chi-square test was performed to examine whether there was a significant association between adolescents' quality of life category and their level of competition. A p value of < 0.05 was considered statistically significant.

3 Results

Regardless of competition level and type of sport, boys showed better values in the physical and mental domains than girls, with no sex differences in social domains, except for economic resources and school environment domains, where girls competing in sports had better values. In both sexes, all domains, except social acceptance, worsened with age (Table 2). This worsening was more pronounced from ages 14–16 than from 17 to 19 years, with a greater magnitude for girls. Differences between sexes in the physical and mental domains were evident in Tanner stages 3, 4, and 5, but not in stages 1 and 2.

SES had a significant main effect on several HRQoL dimensions, including mood, autonomy, parent relations, peer relationships and social support, and financial resources. However, interaction effects between SES and sport type were not statistically significant, indicating that SES did not moderate the relationship between sport type and HRQoL in this sample.

In both sexes, all domains were influenced by the level of competition ($p=0.000$), with the worst values reported by inactive and somewhat active subjects (Tables 3 and 4; Fig. 1). Additionally, competitive athletes at all performance levels had better values in all domains than inactive subjects (all $p<0.05$), active subjects, and non-competitive athletes (all $p<0.05$, except in social support and peers and school environment). For the entire sample, subjects competing at the regional level had higher values of physical well-being and social acceptance than those competing at the local level, with comparable values in the remaining domains. Regardless of sex, subjects competing at the national level, compared to those competing at the local/regional level, had better values in physical well-being, self-perception, parent relations, and social acceptance, and worse values in autonomy and peer relationships, with no significant differences in the remaining domains. For the entire sample, and regardless of sex, athletes competing at the international level had worse values than those competing at the national level in all domains except self-perception, where

Table 2 Health-related quality of life according to age

	11−13 years (n=2813)	14−16 years (n=5152)	17−19 years (n=1418)	p
Physical well-being	50.3 (12.3)	46.9 (11.5)*	46.4 (11.4)*	<0.001
Psychological well-being	53.2 (12.6)	49.4 (11.5)*	47.7 (11.1)*+	<0.001
Moods and emotions	51.3 (12.8)	48.3 (12.3)*	45.8 (12.1)*+	<0.001
Self-perception	50.6 (10.3)	47.3 (9.1)*	46.9 (8.3)*	<0.001
Autonomy	48.2 (11.6)	46.3 (11.2)*	44.8 (10.8)*+	<0.001
Parent relations	51.2 (11.9)	48.7 (11.5)*	48.4 (11.2)*	<0.001
Social support and peers	54.3 (12.5)	52.7 (12.1)*	51.2 (11.8)*+	<0.001
School environment	52.4 (11.4)	48.4 (10.3)*	47.3 (9.6)*+	<0.001
Social acceptance/bullying	47.5 (11.4)	47.2 (11.5)	48.4 (11.1)	0.005
Financial resources	52.1 (9.3)	51.7 (9.3)	50.1 (9.2)*+	<0.001

Values are mean (standard deviation). HRQoL scale: 0–100, higher scores indicate better quality of life. GLM with Gamma distribution, adjusted for socioeconomic level, maturational development, place of residence and size of municipality. Bonferroni post hoc (adjusted p values): *$p<0.05$ vs. 11−13 years; +$p<0.05$ vs. 14−16 years.

Table 3 Health-related quality of life to performance level for the male sample

	Inactive (n=288)	Somewhat active (n=161)	Non-competitive (n=1394)	Locally competitive (n=1405)	Regionally competitive (n=467)	Nationally competitive (n=960)	Internationally competitive (n=100)	p
Physical well-being	37.3 (10.1)	41.0 (9.0)*	47.8 (11.1)*+	53.2 (11.2)*+^	54.0 (10.5)*+^	54.7 (10.8)*+^#	53.4 (10.0)*+^	<0.001
Psychological well-being	46.0 (13.9)	49.0 (11.4)	50.0 (12.3)*	52.8 (11.3)*+^	53.0 (10.8)*+^	52.6 (10.5)*+^	50.4 (9.3)	<0.001
Moods and emotions	47.3 (13.3)	46.9 (12.2)	48.7 (12.7)	51.1 (13.0)*+^	51.9 (12.3)*+^	52.2 (12.1)*+^	50.6 (10.5)	<0.001
Self-perception	48.2 (10.7)	47.5 (10.0)	49.1 (9.6)	49.8 (9.3)	49.6 (9.3)	50.3 (8.8)+	50.7 (9.0)	0.002
Autonomy	44.1 (12.9)	46.0 (11.6)	47.2 (11.6)*	49.4 (11.5)*+^	49.0 (11.0)*	47.9 (10.5)*#	44.5 (8.8)#©	<0.001
Parent relations	45.9 (12.9)	48.7 (11.7)	48.0 (12.1)	50.4 (11.6)*^	50.3 (11.0)*^	51.4 (10.5)*^	51.0 (10.1)*	<0.001
Social support and peers	47.9 (14.1)	53.0 (13.3)*	51.8 (12.7)*^	54.5 (12.4)*^	53.7 (12.2)*	52.6 (11.2)*#	50.2 (10.4)#	<0.001
School environment	45.8 (11.6)	50.2 (10.6)*	49.1 (11.5)*	50.0 (10.9)*	49.5 (9.8)*	49.2 (10.2)*	47.0 (8.6)	<0.001
Social acceptance/bullying	45.3 (11.8)	47.1 (11.7)	45.6 (11.8)	47.3 (11.8)^	48.6 (11.2)*^	49.5 (10.7)*^#	51.6 (9.4)*^#	<0.001
Financial resources	48.3 (10.6)	50.5 (9.7)	50.1 (9.8)	51.7 (9.2)*^	52.1 (8.8)*^	52.6 (8.7)*^	51.3 (8.8)	<0.001

Values are mean (standard deviation). HRQoL scale: 0–100, higher scores indicate better quality of life. GLM with Gamma distribution, adjusted for socioeconomic level, maturational development, place of residence and size of municipality. Bonferroni post hoc (adjusted p values): *$p<0.05$ vs. Inactive; +$p<0.05$ vs. Somewhat active; ^$p<0.05$ vs. Non-competitive; #$p<0.05$ vs. Locally competitive; ©$p<0.05$ vs. Regionally competitive; ~$p<0.05$ vs. Nationally competitive.

Table 4 Health-related quality of life to performance level for the female sample

	Inactive (n=743)	Somewhat active (n =405)	Non-competitive (n=1,855)	Locally competitive (n=520)	Regionally competitive (n=310)	Nationally competitive (n=682)	Internationally competitive (n=93)	p
Physical well-being	35.6 (8.0)	40.0 (9.3)*	44.4 (10.1)*+	49.0 (10.2)*+^	52.4 (10.7)*+^#	52.1 (10.2)*+^#	50.5 (7.9)*+^	<0.001
Psychological well-being	45.5 (11.7)	48.4 (12.4)*	49.1 (11.3)*	50.6 (11.2)*	51.7 (11.4)*+^	51.0 (10.7)*+^	50.0 (10.4)*	<0.001
Moods and emotions	43.0 (12.1)	46.8 (12.2)*	45.6 (11.8)*	47.2 (12.3)*	48.6 (12.5)*^	49.1 (12.0)*+^	46.8 (9.9)	<0.001
Self-perception	45.3 (9.2)	46.9 (9.2)	46.4 (9.1)	46.8 (9.5)	48.1 (9.7)*^	49.1 (9.4)*+^#	48.9 (9.3)*	<0.001
Autonomy	43.5 (11.8)	45.2 (11.4)	45.7 (10.8)*	47.3 (10.8)*	46.5 (11.6)*	44.3 (10.3)#©	42.3 (8.4)#©	<0.001
Parent relations	47.1 (12.1)	48.4 (12.4)	49.0 (11.7)*	49.3 (11.5)*	50.6 (10.3)*	51.4 (11.0)*+^#	51.3 (10.2)*	<0.001
Social support and peers	51.1 (12.5)	52.2 (12.5)	53.8 (12.0)*	53.9 (12.3)*	54.8 (11.4)*+	53.2 (10.7)*	50.7 (10.3)©	<0.001
School environment	47.1 (10.6)	48.8 (11.6)	49.7 (10.2)*	50.8 (11.3)*	51.5 (9.8)*+	51.0 (10.3)*+	48.7 (10.6)	<0.001
Social acceptance/bullying	47.0 (11.5)	46.4 (11.6)	47.0 (11.4)	47.2 (11.5)	49.2 (10.6)+	50.3 (10.1)*+^#	50.5 (10.2)+	<0.001
Financial resources	50.2 (9.7)	51.0 (9.5)	51.8 (9.3)*	52.8 (8.7)*	53.6 (8.2)*+^	53.5 (8.3)*+^	53.2 (8.5)	<0.001

Values are mean (standard deviation). HRQoL scale: 0–100, higher scores indicate better quality of life. GLM with Gamma distribution, adjusted for socioeconomic level, maturational development, place of residence and size of municipality. Bonferroni post hoc (adjusted p values): *p<0.05 vs. Inactive; +p<0.05 vs. Somewhat active; ^p<0.05 vs. Non-competitive; ©p<0.05 vs. Locally competitive; ©p<0.05 vs. Regionally competitive; ~p<0.05 vs. Nationally competitive. #p<0.05 vs. Non-competitive.
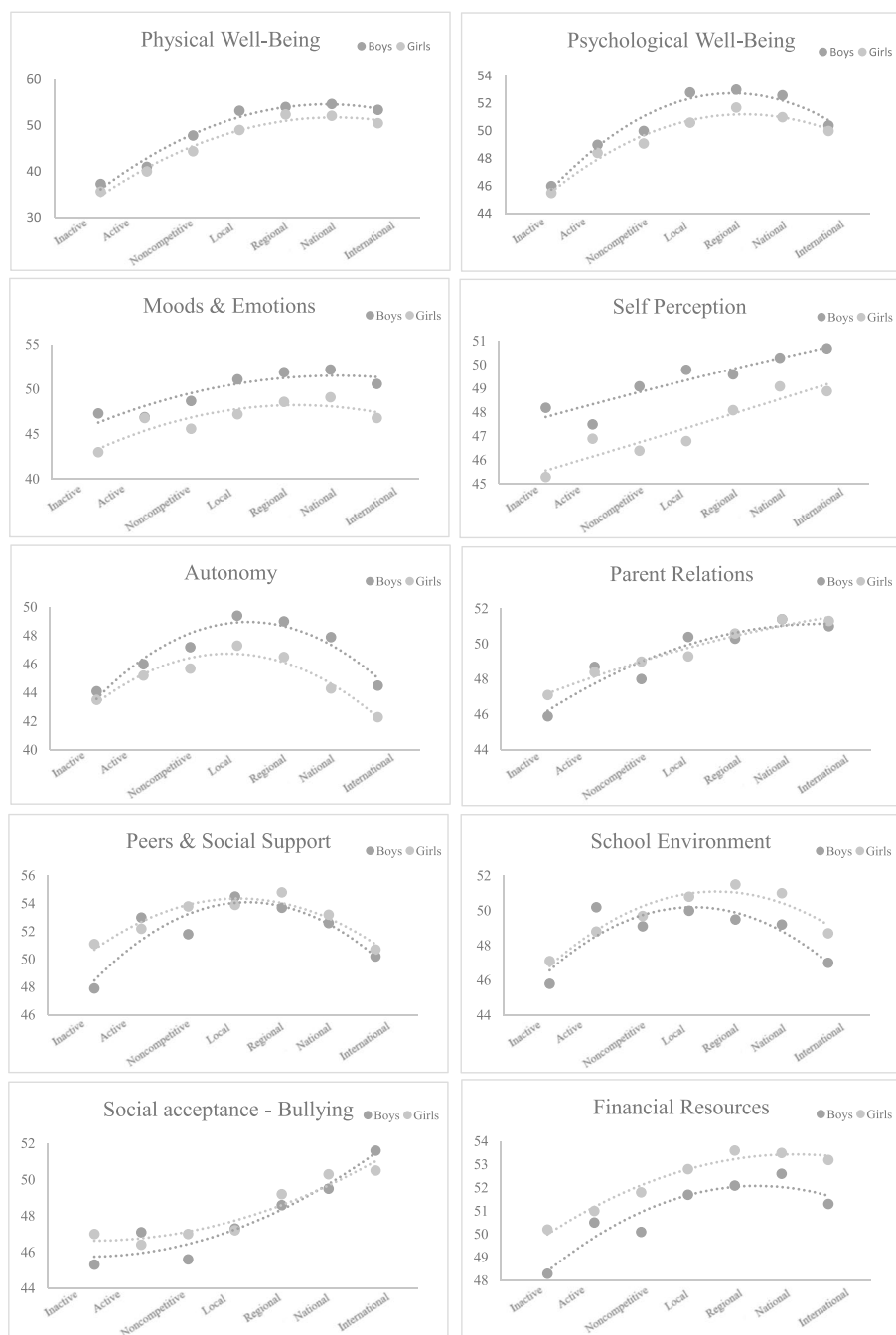
Fig. 1 Evolution of health-related quality of life with performance level. Definition: Black and white graphic with no shading

values were comparable, and social acceptance, where international level athletes had higher values. However, the differences were only significant for autonomy, with worse values for international level athletes.

Among boys, no significant differences were found in any domain based on the type of sport. This was also true for girls competing at the local/regional level. For girls competing at the national/international level, gymnastic sports showed the worst values in autonomy and peer relationships, with some significant comparisons to other sports. Racquet sports athletes had the best values in most domains, with some significant comparisons to other sports (Tables 5 and 6). A significant interaction between sex and sport type was found for physical well-being ($p<0.001$). Girls scored higher in physical well-being when involved in gymnastic or racquet sports, but lower in all other sport types, with the largest gender differences observed in technical, team, and endurance sports. In both sexes, athletes competing in team sports had better values in peer relationships compared to those competing in individual sports, with comparable values in the remaining domains. However, for girls, those competing in individual sports had significantly higher values in physical well-being and self-perception. Finally, the level of physical contact in sport (low vs. high) had a limited influence on HRQoL, affecting only a few dimensions. Among boys, participation in low-contact sports was associated with better self-perception, while

Table 5 Health-related quality of life according to sport type for the male sample

	Technical (n=82)	Power (n=69)	Gymnastic (n=22)	Combat (n=133)	Racket (n=131)	Team (n=2045)	Endurance (n=422)	p
Physical well-being	54.5 (11.1)	56.3 (11.1)	51.9 (12.2)	53.4 (10.4)	53.0 (11.0)	53.8 (11.0)	54.4 (10.7)	0.445
Psychological well-being	53.7 (9.2)	52.3 (9.8)	53.9 (11.9)	52.6 (11.2)	53.7 (11.9)	52.8 (11.1)	51.6 (10.2)	0.275
Moods and emotions	54.0 (11.9)	52.8 (11.1)	52.4 (10.0)	50.2 (12.9)	52.1 (12.8)	51.5 (12.7)	51.5 (12.0)	0.648
Self-perception	50.3 (9.3)	51.8 (8.8)	48.5 (11.7)	48.8 (7.8)	50.6 (9.9)	49.8 (9.3)	50.2 (8.5)	0.291
Autonomy	48.3 (10.8)	49.2 (9.5)	47.1 (9.5)	47.3 (9.6)	49.7 (10.7)	48.8 (11.3)	48.4 (10.4)	0.551
Parent relations	52.6 (9.4)	49.4 (10.4)	52.5 (10.5)	50.2 (11.4)	50.8 (11.7)	50.7 (11.3)	50.9 (10.3)	0.467
Social support and peers	52.0 (9.8)	54.7 (9.7)	52.0 (11.7)	51.5 (11.6)	52.9 (12.8)	54.1 (12.2)	52.2 (11.3)	0.015
School environment	50.4 (8.2)	48.7 (8.1)	51.2 (12.0)	49.3 (10.8)	51.2 (12.5)	49.5 (10.5)	49.3 (10.1)	0.378
Social acceptance/ bullying	48.8 (10.7)	51.2 (7.6)	46.7 (11.4)	48.5 (12.2)	47.5 (11.2)	48.3 (11.4)	48.4 (11.3)	0.475
Financial resources	54.0 (8.1)	52.4 (7.4)	51.7 (7.5)	52.4 (8.8)	52.6 (8.7)	52.0 (9.1)	52.0 (9.0)	0.485

Values are mean (standard deviation). HRQoL scale: 0–100, higher scores indicate better quality of life. GLM with Gamma distribution, adjusted for socioeconomic level, maturational development, place of residence, size of municipality and weekly training hours. Bonferroni post hoc (adjusted p values): *$p<0.05$ vs. Technical; ~$p<0.05$ vs. Power; ©$p<0.05$ vs. Gymnastic; +$p<0.05$ vs. Combat; #$p<0.05$ vs. Racket; ^$p<0.05$ vs. Team.

Table 6 Health-related quality of life according to sport type for the female sample

	Technical (n=80)	Power (n=57)	Gymnastic (n=314)	Combat (n=73)	Racket (n=88)	Team (n=637)	Endurance (n=328)	p
Physical well-being	48.9 (10.4)	53.5 (10.2)	52.1 (9.9)	51.2 (10.6)	53.6 (11.1)	49.9 (9.9)©#	51.5 (10.6)	<0.001
Psychological well-being	51.1 (11.1)	49.9 (9.0)	51.4 (11.2)	50.0 (11.4)	53.6 (10.5)	50.5 (11.1)	51.0 (11.1)	0.241
Moods and emotions	48.9 (11.9)	46.8 (9.0)	48.7 (11.9)	46.7 (13.5)	52.1 (12.7)	47.6 (12.1)#	48.2 (12.5)	0.032
Self-perception	47.5 (7.4)	50.0 (9.4)	48.9 (9.5)	48.6 (10.4)	49.7 (10.0)	46.9 (9.1)	48.9 (10.1)	0.004
Autonomy	45.0 (10.7)	45.2 (9.2)	43.9 (10.5)	43.8 (9.7)	47.6 (11.7)	46.1 (11.0)©	46.1 (10.4)	0.009
Parent relations	51.2 (10.6)	50.9 (10.0)	51.8 (10.3)	51.5 (12.6)	52.1 (11.5)	49.6 (11.1)	50.3 (11.3)	0.093
Social support and peers	52.5 (10.9)	53.2 (10.0)	51.9 (11.1)	52.6 (12.0)	56.0 (11.5)	54.3 (11.8)©	53.8 (10.8)	0.021
School environment	51.1 (10.8)	49.9 (9.1)	51.5 (10.4)	49.9 (10.9)	55.7 (11.8)~©+	50.4 (10.5)#	50.3 (10.3)#	<0.001
Social acceptance/bullying	49.2 (10.6)	51.6 (9.5)	49.4 (10.5)	49.7 (12.0)	51.6 (9.9)	48.2 (10.9)	49.4 (10.6)	0.032
Financial resources	54.3 (9.5)	52.1 (9.5)	53.9 (7.7)	51.9 (9.1)	53.3 (8.3)	52.8 (8.7)	53.8 (7.9)	0.178

Values are mean (standard deviation). HRQoL scale: 0–100, higher scores indicate better quality of life. GLM with Gamma distribution, adjusted for socioeconomic level, maturational development, place of residence, size of municipality and weekly training hours. Bonferroni post hoc (adjusted p values): *$p<0.05$ vs. Technical; ~$p<0.05$ vs. Power; ©$p<0.05$ vs. Gymnastic; +$p<0.05$ vs. Combat; #$p<0.05$ vs. Racket; ^$p<0.05$ vs. Team.

high-contact sports were linked to higher scores in social support. Among girls, low-contact sports were associated with higher scores in social acceptance and financial resources.

Depending on the HRQoL dimension, between 15% and 30% of adolescents presented low scores. No significant differences were found in the distribution of QoL categories across different competition levels, nor between athletes and non-athletes.

The type of metabolism did not influence any domain. Boys competing outdoors had significantly better indicators of physical well-being, mood, and autonomy. Girls competing outdoors had better values in self-perception and autonomy.

4 Discussion

This is the first study to analyze the various HRQoL domains in adolescents participating in different sports, classified according to their performance level: from physically inactive to international competitors. The main findings of this study were: (1) girls reported lower scores in the physical and mental domains than boys starting from Tanner maturation stage 3; (2) HRQoL scores across most domains, except social acceptance, tended to decline with age and maturation stage, with a more pronounced pattern in girls; (3) inactive subjects showed the lowest HRQoL levels; (4)

competitive athletes show higher HRQoL scores than non-competitive athletes; (5) among competitive athletes, the level of competition does not influence psychological well-being, mood, school environment, and economic resources; self-perception and social acceptance increase with higher levels of competition; physical well-being and parent relations improve up to the national competition level; autonomy and peer relationships decrease with higher levels of competition; (6) HRQoL differences according to sport characteristics seem small, although some disciplines may be linked to higher or lower scores in specific domains.

4.1 Gender Differences

The findings of this study highlight the complex relationship between physical activity, competition level, and HRQoL in adolescents. As observed, girls tend to report lower scores in the physical and mental domains compared to boys, starting from Tanner maturation stage 3. This gender disparity aligns with previous research indicating that girls often experience a decline in physical self-perception and mental well-being during adolescence, potentially due to societal pressures and body image concerns (Davison et al., 2017). Biological factors may also contribute to these differences, as the onset of menstruation and the fluctuations in sex hormones have been associated with an increased vulnerability to depression and sleep disturbances from puberty onwards, which can significantly impair their well-being (Morssinkhof et al., 2020). The European multicenter study of 21,590 children using the KIDSCREEN-52 found that girls and boys displayed similar scores until early adolescence. However, as they grew older, girls' HRQoL declined significantly more than boys', suggesting that puberty (with its hormonal component and physical development) has a greater negative impact on adolescent girls (Michel et al., 2009). Additionally, menstrual disorders such as dysmenorrhea, heavy menstrual bleeding, and amenorrhea are commonly reported among adolescent girls and have been shown to negatively affect physical, emotional, and social functioning. These conditions are associated with significantly lower quality-of-life scores (Knox et al., 2015).

The consistent decline in HRQoL domains, excluding social acceptance, with increasing age and maturation stage underscores the critical need for interventions targeting mental health and well-being during adolescence. The more pronounced decline in girls suggests that tailored strategies may be necessary to support female adolescents effectively. These interventions could include promoting positive body image, enhancing social support networks, and encouraging participation in physical activities that are perceived as enjoyable and rewarding (Camacho-Miñano et al., 2011).

4.2 Effects of Competition Level

Our study also emphasizes the impact of physical activity on HRQoL. Inactive participants reported the lowest HRQoL levels across all domains, reinforcing the importance of promoting regular physical activity to enhance overall well-being. While we do not include clinical symptom-related measures, these findings align with previous research indicating a positive association between physical activity and HRQoL

based on self-reports (Marker et al., 2018). Public health strategies should aim to reduce barriers to physical activity and create supportive environments that encourage active lifestyles among young people (Rees et al., 2006). Interestingly, while competitive athletes demonstrated better HRQoL than their non-competitive counterparts, the proportion of individuals with low T-scores in QoL dimensions remained similar across groups. This suggests that structured sports participation may provide additional psychological and social benefits beyond general physical activity (Eime et al., 2013), but may not necessarily reduce the number of adolescents experiencing low HRQoL.

According to the standardized scoring of the KIDSCREEN-52 (M = 50, SD = 10), scores below 40 are generally interpreted as indicative of potential psychosocial or physical difficulties, while scores between 40 and 60 fall within the normative range and are typically considered satisfactory or "good enough" (Ravens-Sieberer et al., 2005). Although competitive athletes showed higher average scores, the clinical significance of improvements within the normative range remains uncertain, as increases in already adequate HRQoL may not reflect meaningful changes in well-being. This suggests the importance of focusing not only on average group differences but also on the proportion of individuals at risk.

Moreover, the relationship between competition level and HRQoL is nuanced. While self-perception and social acceptance improved with higher levels of competition, physical well-being and parent relations peaked at the national level and then declined at the international level. This decline at the highest competition levels could be attributed to increased pressure, stress, and time demands associated with elite sports (Russel et al., 2019).

The observed decrease in autonomy and peer relationships with higher levels of competition indicates potential negative social impacts of intense sports participation. Athletes at higher competition levels may experience reduced time for social activities and greater dependence on structured training schedules, which could limit their opportunities for autonomous decision-making and peer interaction. Coaches and sports programs should be mindful of these potential drawbacks and strive to create balanced training environments that support athletes' social and emotional needs (Purcell et al., 2022).

4.3 Sport Type Analysis

While HRQoL differences based on sport characteristics appear small, specific sports may influence certain HRQoL domains differently. For example, gymnastic sports were associated with lower autonomy and peer relationship scores, likely due to the demanding nature and individual focus of these sports (Kipp, 2012). In contrast, racquet sports showed better HRQoL outcomes in various domains, possibly due to their combination of individual competition and social interaction opportunities (Kumar, 2017). This suggests that the type of sport may play a role in shaping the holistic development of young athletes.

Overall, our study highlights the importance of considering both the benefits and potential challenges of competitive sports participation on adolescents' HRQoL. Interventions aimed at promoting physical activity should account for the diverse

experiences of young athletes and provide support that addresses both their physical and psychosocial well-being. Future research should explore longitudinal changes in HRQoL among athletes and investigate strategies to optimize the positive impacts of sports participation while mitigating any negative effects.

5 Limitations and Future Directions

One important limitation of this study is its cross-sectional design, which prevents establishing causal relationships between physical activity, competition level, type of sport, and HRQoL. As such, it remains unclear whether enhanced HRQoL leads to increased sports participation, or vice versa. Future research should consider using longitudinal designs or randomized controlled trials to better explore causal pathways among athletes and investigate strategies to optimize the positive impacts of sports participation while mitigating any negative effects.

6 Conclusions

In conclusion, this study provides valuable insights into the HRQoL of adolescents engaged in various levels of sports competition. While competitive sports participation generally enhances HRQoL, especially in terms of self-perception and social acceptance, it also presents challenges such as reduced autonomy and peer relationships at higher competition levels. Tailored interventions and balanced training programs are essential to support the overall well-being of young athletes, particularly during critical developmental stages. Promoting physical activity in a way that maximizes its benefits and minimizes its potential drawbacks is crucial for fostering healthy, well-rounded adolescents.

Declarations

Ethics Approval The study protocol was reviewed and approved by the Clinical Research Ethics Committee of Aragón (CEICA-PI/0339).

Competing interests The authors declare no competing interests.

References

Bassett, D. R., John, D., Conger, S. A., Fitzhugh, E. C., & Coe, D. P. (2015). Trends in physical activity and sedentary behaviours of united States youth. *Journal of Physical Activity and Health*, *12*(8), 1102–1111. https://doi.org/10.1123/jpah.2024-0050

Belz, J., Kleinert, J., Ohlert, J., Rau, T., & Allroggen, M. (2018). Risk for depression and psychological Well-Being in German National and state team Athletes—Associations with age, gender, and performance level. *Journal of Clinical Sport Psychology*, *12*(2), 160–178. https://doi.org/10.1123/JCSP.2016-0024

Bond, L., Clements, J., Bertalli, N., Evans-Whipp, T., McMorris, B. J., Patton, G. C., & Catalano, R. F. (2006). A comparison of self-reported puberty using the pubertal development scale and the sexual maturation scale in a school-based epidemiologic survey. *Journal of Adolescence*, *29*(5), 709–720. https://doi.org/10.1016/J.ADOLESCENCE.2005.10.001

Camacho-Miñano, M. J., LaVoi, N. M., & Barr-Anderson, D. J. (2011). Interventions to promote physical activity among young and adolescent girls: A systematic review. *Health Education Research*, *26*(6), 1025–1049. https://doi.org/10.1093/her/cyr040

Carskadon, M. A., & Acebo, C. (1993). A self-administered rating scale for pubertal development. *Journal of Adolescent Health*, *14*(3), 190–195. https://doi.org/10.1016/1054-139X(93)90004-9

Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: International survey. *Bmj*, *320*(7244), 1240–1243. https://doi.org/10.1136/BMJ.320.7244.1240

Davison, K. K., Werder, J. L., Trost, S. G., Baker, B. L., & Birch, L. L. (2017). Why are early maturing girls less active? Links between pubertal development, psychological well-being, and physical activity among girls at ages 11 and 13. *Social Science & Medicine*, *64*(12), 2391–2404. https://doi.org/10.1016/j.socscimed.2007.02.033

Eime, R. M., Young, J. A., Harvey, J. T., Charity, M. J., & Payne, W. R. (2013). A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. *International Journal of Behavioural Nutrition and Physical Activity*, *10*, 1–21. https://doi.org/10.1186/1479-5868-10-98

Freire, T., & Ferreira, G. (2018). Health-related quality of life of adolescents: Relations with positive and negative psychological dimensions. *International Journal of Adolescence and Youth*, *23*(1), 11–24. https://doi.org/10.1080/02673843.2016.1262268

Karimi, M., & Brazier, J. (2016). Health, health-related quality of life, and quality of life: What is the difference? *Pharmacoeconomics*, *34*(7), 645–649. https://doi.org/10.1007/s40273-016-0389-9

Kipp, L. E. (2012). *Social influences and psychological and physical well-being among female adolescent gymnasts*. University of Minnesota.

Knox, B., Azurah, A. G. N., & Grover, S. R. (2015). Quality of life and menstruation in adolescents. *Current Opinion in Obstetrics & Gynecology*, *27*(5), 309–314. https://doi.org/10.1097/GCO.00000000 00000199

Kumar, S. (2017). A study of mental health and emotional maturity between racquet players. *International Journal of Physiology Nutrition and Physical Education*, *2*(2), 2058–2061.

Marker, A. M., Steele, R. G., & Noser, A. E. (2018). Physical activity and health-related quality of life in children and adolescents: A systematic review and meta-analysis. *Health Psychology*, *37*(10), 893. https://doi.org/10.1037/hea0000653

Martínez-Gómez, D., Martínez-De-Haro, V., Pozo, T., Welk, G. J., Villagra, A., Calle, M. E., Marcos, A., & Veiga, O. L. (2009). [Reliability and validity of the PAQ-A questionnaire to assess physical activity in Spanish adolescents]. *Revista Española De Salud Publica*, *83*(3), 427–439. https://doi.org/10.159 0/S1135-57272009000300008

McMahon, E. M., Corcoran, P., O'Regan, G., Keeley, H., Cannon, M., Carli, V., & Wasserman, D. (2017). Physical activity in European adolescents and associations with anxiety, depression and well-being. *European Child & Adolescent Psychiatry*, *26*, 111–122. https://doi.org/10.1007/S00787-016-0875-9

Michel, G., Bisegger, C., Fuhr, D. C., Abel, T., & KIDSCREEN group. (2009). Age and gender differences in health-related quality of life of children and adolescents in europe: A multilevel analysis. *Quality Life Research*, *18*(9), 1147–1157. https://doi.org/10.1007/s11136-009-9538-3

Moreno-Maldonado, C., Ramos, P., Moreno, C., & Rivera, F. (2019). Direct and indirect influences of objective socioeconomic position on adolescent health: The mediating roles of subjective socioeconomic status and lifestyles. *International Journal of Environmental Research and Public Health*, *16*(9), 1637. https://doi.org/10.3390/IJERPH16091637

Morssinkhof, M. W. L., van Wylick, D. W., Priester-Vink, S., van der Werf, Y. D., den Heijer, M., van den Heuvel, O. A., & Broekman, B. F. P (2020). Associations between sex hormones, sleep problems and depression: A systematic review. *Neuroscience and Biobehavioral Reviews*, *118*, 669–680. https://doi.org/10.1016/j.neubiorev.2020.08.006

Petersen, A. C., Crockett, L., Richards, M., & Boxer, A. (1988). A self-report measure of pubertal status: Reliability, validity, and initial norms. *Journal of Youth and Adolesccence*, *17*, 117–133. https://doi.org/10.1007/BF01537962

Prochaska, J. J., Sallis, J. F., & Long, B. (2001). A physical activity screening measure for use with adolescents in primary care. *Archives of Pediatrics & Adolescent Medicine*, *155*(5), 554–559. https://doi.org/10.1001/ARCHPEDI.155.5.554

Purcell, R., Pilkington, V., Carberry, S., Reid, D., Gwyther, K., Hall, K., & Rice, S. (2022). An evidence-informed framework to promote mental wellbeing in elite sport. *Frontiers in Psychology*, *13*, 780359. https://doi.org/10.3389/fpsyg.2022.780359

Ravens-Sieberer, U., Gosch, A., Abel, T., Auquier, P., Bellach, B. M., Bruil, J., & Rajmil, L. (2001). Quality of life in children and adolescents: A European public health perspective. *Sozial Und Praventivmedizin*, *46*(5), 294–302. https://doi.org/10.1007/BF01321080

Ravens-Sieberer, U., Gosch, A., Rajmil, L., Erhart, M., Bruil, J., Duer, W., & Kilroe, J. (2005). KIDSCREEN-52 quality-of-life measure for children and adolescents. *Expert Review of Pharmacoeconomics & Outcomes Research*, *5*(3), 353–364. https://doi.org/10.1586/14737167.5.3.353

Rees, R., Kavanagh, J., Harden, A., Shepherd, J., Brunton, G., Oliver, S., & Oakley, A. (2006). Young people and physical activity: A systematic review matching their views to effective interventions. *Health Education Research*, *21*(6), 806–825. https://doi.org/10.1093/her/cyl120

Roberts, C., Freeman, J., Samdal, O., Schnohr, C. W., De Looze, M. E., Gabhainn, N., & International HBSC Study Group. (2009). The health behaviour in School-aged children (HBSC) study: Methodological developments and current tensions. *International Journal of Public Health*, *54*, 140–150. https://doi.org/10.1007/S00038-009-5405-9

Russell, S., Jenkins, D., Rynne, S., Halson, S. L., & Kelly, V. (2019). What is mental fatigue in elite sport? Perceptions from athletes and staff. *European Journal of Sport Science*, *19*(10), 1367–1376. https://doi.org/10.1080/17461391.2019.1606261

Sitko, S., Francín-Gallego, M., Pano-Rodríguez, A., Oviedo-Caro, M. A., Mayolas-Pi, C., & Legaz-Arrese, A. (2024). Sport practice and depression during adolescence: Special emphasis on performance level and sport discipline. *Journal of Science Medicine in Sport*, *15*(24), 1440–2440. https://doi.org/10.1016/j.jsams.2024.07.009

Spencer, M. R., & Gastin, P. B. (2001). Energy system contribution during 200- to 1500-m running in highly trained athletes. *Medicine and Science in Sports and Exercise*, *33*(1), 157–162. https://doi.org/10.1097/00005768-200101000-00024

Spencer, M., Bishop, D., Dawson, B., Goodman, C., & Duffield, R. (2006). Metabolism and performance in repeated cycle sprints: Active versus passive recovery. *Medicine and Science in Sports and Exercise*, *38*(8), 1492–1499. https://doi.org/10.1249/01.MSS.0000228944.62776.A7

Viner, R. M., Ross, D., Hardy, R., Kuh, D., Power, C., Johnson, A., Wellings, K., McCambridge, J., Cole, T. J., Kelly, Y., & Batty, G. D. (2015). Life course epidemiology: Recognising the importance of adolescence. *Journal of Epidemiology and Community Health*, *69*(8), 719–720. https://doi.org/10.1136/jech-2014-205300

Wu, X. Y., Han, L. H., Zhang, J. H., Luo, S., Hu, J. W., & Sun, K. (2017). The influence of physical activity, sedentary behavior on health-related quality of life among the general population of children and adolescents: A systematic review. *PloS One*, *12*(11), e0187668. https://doi.org/10.1371/journal.pone.0187668

Zhou, J., Heim, D., & O'Brien, K. (2015). Alcohol consumption, athlete identity, and happiness among student sportspeople as a function of Sport-Type. *Alcohol and Alcoholism*, *50*(5), 617–623. https://doi.org/10.1093/ALCALC/AGV030

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