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The mediational role of positive youth development in the relationship between physical activity and health-related quality of life in adolescents from urban and rural environments

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ABSTRACT

The aim of this study was to analyse the role of the 5Cs of Positive Youth Development (PYD) in the relationship between physical activity (PA) and health-related quality of life (HRQoL), in a sample of adolescents enrolled at public secondary schools in both rural and urban environments in Huelva (Spain). The sample comprised 418 adolescents (Mean age = 14.40; SD = 1.20; 53% boys). A cross-sectional design was employed. PA (PAQ-A), Adherence to the Mediterranean Diet (KIDMED), PYD and HRQoL (KIDSCREEN-27) were assessed using self-report questionnaires. The results indicated that adolescents from rural environments were more physically active and achieved higher scores in PYD and HRQoL dimensions compared to those from urban environments. Mediation analyses demonstrated that the competence dimension of PYD positively mediated the relationship between PA and HRQoL. Consequently, this study highlights the importance of implementing PA interventions considering PYD and its positive impact on HRQoL.

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Physical activity; subjective well-being; positive youth development; adolescence; environment; mediation

Introduction

Adolescence is a life period between 10 and 19 years that occurs after childhood and before adulthood in which important changes (at physical, personal, social, academic and professional level) converge and could determine the decision-making which influences the consolidation and acquisition of healthy lifestyle habits (Oliva et al., 2017; World Health Organization [WHO], 2024). Within this developmental context, the promotion of the practice of Physical Activity (PA) is expected to have an adaptive impact in Positive Youth Development (PYD) and in Health-Related Quality of Life (HRQoL).

Physically inactive individuals do not meet the World Health Organization's (WHO) guidelines for health, which suggest at least 60 minutes of moderate physical activity per day, three days of vigorous physical weekly, and reduced sedentary behaviours (WHO, 2020). Non-compliance with these guidelines is linked to a higher risk of cardiovascular diseases, type 2 diabetes, and certain cancers (Lee et al., 2012; Stanaway et al., 2018). Eurobarometer data indicates that 62% of Europeans aged 15 or older rarely or never participating in sports or physical exercise (European Commission, 2022). Among adolescents, the global prevalence of physical inactivity decreased slightly between 2001 and 2016, with rates dropping from 80% to 78% for boys, while girls had higher inactivity rates

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(Guthold et al., 2020; WHO, 2020). Despite robust scientific evidence demonstrating the benefits of regular PA on adolescent psychological, physiological, cognitive and social well-being (Álvarez-Ibáñez & Fernández-Hawrylak, 2022; Contreras-Osorio et al., 2021; Rominger et al., 2022), recent studies in Andalusia and the HBSC study show alarmingly low rates of daily PA among adolescents (Moreno et al., 2020; Ruíz, 2022).

The PYD is a strength-based perspective of adolescent transition to adulthood, grounded in developmental systems theory (Lerner et al., 2011; Tomé et al., 2020). It emphasizes developmental assets that support a positive transition and psychological well-being. The PYD model identifies five core dimensions known as the 5Cs (Lerner et al., 2011, 2021): competence (efficacy in academic, social, and emotional areas), confidence (self-esteem, positive identity and self-efficacy), connection (quality of social relationships), character (respect for social and cultural norms, self-control, integrity and morality) and caring (empathy and sympathy). These 5Cs are associated with a life trajectory that encourages contributions to self, family, community, and society, leading to a sixth C, contribution (Lerner et al., 2005). The relationship between PYD and PA has been examined in sports contexts, suggesting that sport and PA can promote at least four of the 5Cs (i.e. competence, confidence, connection and character) (Vierimaa et al., 2018; Warner et al., 2019). Sport-based PYD programs can develop life skills and community engagement (Bates et al., 2021; Lerner, 2004). Furthermore, PYD has been linked to perceived quality of life and life satisfaction, which in turn is positively correlated with physical health (Branquinho et al., 2023; Park, 2004).

Positive development in the population would also mean improvements in health literacy, enabling individuals to improve personal and community health by adopting healthy lifestyles (WHO, 1998). Health-Related Quality of Life (HRQoL) refers to a subjective assessment of physical and psychological factors influencing overall life satisfaction (Rodríguez-Fernández et al., 2017). Existing evidence suggest a positive correlation between the amount of weekly PA and improved HRQoL in teenagers (Gopinath et al., 2012; Granger et al., 2017). Research among Spanish adolescents found that healthy lifestyle behaviours, especially PA, exert the most significant positive effect (Muros et al., 2017). A study of adolescents from Seville (Spain) also reported that physical activity correlated with higher QoL (Lima-Serrano et al., 2018). Similarly, Eddolls et al. (2018) observed that vigorous physical activity, cardiorespiratory fitness and BMI were linked to QoL in a sample of English adolescents.

The connection to nature has numerous health benefits, including promoting happiness, improving mental health and well-being among children and adolescents, and potentially enhancing academic performance (Browning & Rigolon, 2019; Norwood et al., 2019; Tillmann et al., 2018). Although there is limited evidence of a direct link between connection to nature and positive youth development, Bowers et al. (2021) found that exposure to nature was associated with overall PYD and competence. This suggests that nature-based experiences might play a role in fostering positive outcomes in youth.

While reviewing the scant international literature on adolescent health, it appears that certain variables, like HRQoL and PA, vary between rural and urban environments. Studies have found that adolescents in rural areas often have higher HRQoL and greater PA levels (Dollman et al., 2012; Hoekman et al., 2016; Jiménez, Arriscado, et al., 2022; Salcedo et al., 2005). However, whereas the scientific literature has independently studied, on one hand, the relationship of HRQoL with PA and PYD, and on the other hand, how PYD is benefited by sport practice and the relationship of this construct with life satisfaction, it will be novel to conduct research that comprehensively examines the differences between schooled adolescents in rural and urban environments, analysing their HRQoL and the PYD.

Considering that studies don't explicitly relate HRQoL and PYD, this study aimed to comprehensively examine the differences between adolescents attending school in rural and urban environments may be necessary, by analysing their lifestyles and some indicators of their physical, psychological and social health status. Based on this rationale and considering the gaps in the current literature, the aims of the present study were to analyse to what extent of the dimensions of

PYD influence the relationship between PA and HRQoL in adolescents, and to examine differential impact based on the area of residence, sex and/or age, including as covariates the adherence to Mediterranean Diet, sleeps habits and Body Mass Index (BMI).

Materials and methods

Participants

The sample comprised 418 adolescents aged between 12 and 17 (Mean age = 14.4; SD = 1.20; 53% boys). 93.5% of the participants had Spanish origin and 87% indicated that their parents also had Spanish nationality. High Schools were selected by convenience and participant selection occurred through clusters according to the academic year, from first to fourth year of Secondary School. To maintain a confidence level of 95% and a margin of error of 5%, a total of 138 subjects were estimated by G*Power. 42.2% of the sample was enrolled at a high school located in an urban environment.

In this study, the municipalities of Valverde del Camino and San Juan del Puerto were considered rural as they fulfilled the requirements of the «Ley 45/2007 de Desarrollo Sostenible del Medio Rural».

Study design and data collection procedure

A cross-sectional design was followed, by administering a self-report instrument in public Secondary Education centres located in Huelva (Spain), in an urban environment (City of Huelva) and two rural towns (Valverde del Camino and San Juan del Puerto). This instrument was anonymously and individually filled in by the sample between March and May 2023. A member of the research team contacted the management teams and the teachers in charge of the Physical Education area to inform them of the procedure and purpose of the study. After receiving the acceptance of the educational centre, a class group was randomly chosen in each academic year (1st to 4th years of Secondary Compulsory Education). Students in the selected groups received the written informed consent to obtain their approval to participate from their parents. Subsequently, the field work was carried out by administering the paper-based questionnaire during school hours, in a classroom or in the sports hall, receiving a brief overall explanation of the procedure and using a total of 30 minutes per group. Once the field work was completed, the data was recorded for later data analysis.

Measures

Ad Hoc questions

Some sociodemographic variables were assessed (i.e. date of birth, sex, nationality, educational level of the parents and their employment category). Concerning the anthropometric characteristics, estimated height and weight were asked to subsequently calculate the BMI (kg/height [m²]) and make the classification by the ranges established by the WHO (2010). In relation to some lifestyle habits, some questions from Health Behaviour in School-Aged Children (HBSC) questionnaire were included to measure the sleep pattern during the week and on weekends or holidays asking about the number of hours and to assess the frequency of energy drinks' consumption indicating never consume or daily, weekly, monthly or yearly consumption (Moreno et al., 2018).

Physical activity

To assess the level of PA, the Physical Activity Questionnaire for Adolescents (PAQ-A) validated in Spanish by Martínez-Gómez et al. (2009) was used. This questionnaire evaluates adolescents' PA over the past seven days, encompassing their leisure time, physical education classes, various times of the day (lunch, afternoon and evening), and weekends or holidays (if he/she is active or not, the quantity is not measured). The questionnaire is composed of nine questions that measure different

aspects of PA using a 5-point Likert scale, with 1 being low PA and 5 being very high PA. The last two questions assess what level of PA best represents what is done during the week and the respective daily frequency. The ninth item is used to rule out situations that would interfere with PA. The final score is obtained by calculating the arithmetic average of the first eight questions. The PA pattern was categorized using a cut-off point of 2.75, distinguishing between 'active' and 'non-active' adolescents (Benítez-Porres, 2016). The questionnaire presents good validity and reliability, showing an intraclass correlation coefficient of 0.97 and an internal consistency of Cronbach's $\alpha = 0.93$ (Wyszyńska et al., 2019).

Adherence to the Mediterranean Diet

The Mediterranean Diet Quality Index or KIDMED questionnaire was used, which is composed of 16 self-reported dichotomic items (yes or no), related to Mediterranean dietary patterns. Items with a negative connotation towards the diet were scored with -1 , and positive ones were scored with $+1$. The final score was obtained by adding all the values and the results were categorized: ≥ 8 = optimal adherence to the diet, 4–7 points = need to improve adherence to the Mediterranean diet, ≤ 3 = low quality of the diet. The questionnaire has Cronbach's $\alpha = 0.79$ (Altavilla et al., 2020).

Positive youth development

To measure PYD, the short version developed by Geldhof et al. (2014) and adapted to Spanish by Gomez-Baya et al. (2019) was administered. This questionnaire consists of 34 items, which measure the 5Cs: competence, confidence, character, connection, and caring. The indicators are evaluated following a 5-point Likert scale (from strongly disagree/not at all important/never or almost never; to strongly agree/very important/always). The overall score was calculated by averaging the five dimensions of 5Cs. The questionnaire has notable internal consistency reliability, with Cronbach's $\alpha = 0.90$ (Gomez-Baya et al., 2022).

Health-related quality of life

HRQoL was assessed using the KIDSCREEN-27 instrument, which is validated for the adolescent population (Aymerich et al., 2005). This scale contains 27 items to assess five dimensions: physical well-being (5 items), psychological well-being (7 items), autonomy and parental relationship (7 items), peers and social support (4 items), and school environment (4 items). The items were scored with 0, 25, 50, 75 and 100 points (the higher the score, the higher quality of life). An overall global score was calculated with the average score of the five dimensions. The questionnaire has good reliability, with values of Cronbach's α greater than 0.70 in the respective five dimensions (Ravens-Sieberer et al., 2007).

Data analysis

The data were analysed using SPSS 27.0 for Windows (SPSS Inc. Chicago, IL, U.S.A.). Differences by rural vs. urban environment were carried out using Student's T test for the quantitative variables of the study (i.e. PA, BMI, sleep pattern, adherence to the Mediterranean Diet, PYD dimensions and HRQoL dimensions). The χ^2 test was used to examine differences by environment in the categorical variables (i.e. such as being active or not, and the quality of adherence to Mediterranean Diet). The sample size calculation was performed to evaluate the influence of PYD in the relationship between PA and HRQoL by using G*Power software (version 3.1.9.7, Universität Kiel, Germany). A priori power analysis indicated that a total of at least 138 participants were required. This calculation was based on a moderate effect size (effect size $d = 0.15$), an alpha level of 0.05, and a beta value of 0.95 for an F test calculating the linear multiple regression: fixed model, R^2 deviation from zero (Faul et al., 2007). The effect size was indicated to show the statistically significant differences in the 95% confidence interval (Cohen's d [<0.199 negligible; 0.20–0.499 small; 0.50–0.799 medium; ≥ 0.80 large] for the Student T test; Cramer's V [0–0.10 negligible; 0.11–0.30 small; 0.31–0.50 medium; 0.51–1 large] for

the χ^2 test). Second, Pearson correlation analysis was performed to determine the associations between PA and all the study variables, controlling by environment (rural/urban). Third, a multiple mediation analysis was performed using PROCESS macro (Hayes, 2017) with a bootstrap threshold of 10,000. This model tested the mediation of the 5Cs of PYD in the relationship between PA and HRQoL. The mediation model was performed both unadjusted (model 1) and adjusted (model 2) to control the confounding variables age (in years), sex (boy/girl), adherence to Mediterranean Diet, sleep habit (in hours) and BMI. Based on mediational analyses, a structural equation model was tested, applying the statistical program EQS 6.1. This path model was designed following indications by Byrne (2013), using Lagrange multipliers and Wald tests. The overall fit of the model was examined by calculating χ^2 , CFI, SRMR, RMSEA and 90% Confidence Interval of RMSEA.

Results

Table 1 shows the results of the differences by environment in the anthropometric characteristics, PA, sleep habits, adherence to the Mediterranean Diet, PYD and HRQoL. Significantly higher values were observed in rural environment than in urban environment in the study variables. Significant differences were observed in overall PA, being less active the students from the urban environment (49.7%) than those from the rural environment (60%). Regarding the Mediterranean Diet, students from urban environments attained higher total scores than their rural counterparts. Higher scores in the overall PYD, as well as in the dimensions of competence and connection were obtained by students from the rural environment. Additionally, significant differences emerged in global HRQoL and its dimensions, with higher mean scores in the rural environment. Upon examining differences based on age and sex, significant differences appeared in all variables. Age-related variations were noted in energy drinks consumption, while sex disparities were evident in breakfast habits.

Table 2 described the comparative analysis between practicing or not practicing PA by all the study variables. Active students obtained a higher total score in adherence to the Mediterranean Diet, with higher percentages in medium (54.8%) and high (30.3%) diet quality. Moreover, active students showed higher means in the overall PYD and four Cs (excepting caring), with medium effect sizes. In addition, active students presented higher scores in global HRQoL and four dimensions (excluding peers and social support), with large effect sizes.

Table 3 shows a bivariate correlation matrix illustrating the associations between PA at different times of the day and frequency and with anthropometric characteristics, sleep habits, adherence to the Mediterranean Diet, PYD, and HRQoL, categorized by environment (rural/urban). In rural environment, PA was associated with age, sex and anthropometric characteristics, while in the urban environment, a significant relationship was only observed with age. Additionally, adherence to the Mediterranean Diet was significantly correlated with the global PA in both environments. Results indicated positive correlations between four PYD dimensions and PA in the rural environment, excluding PA performed at lunchtime, which presented a negative correlation. In the urban environment, significant associations were observed only in the Competence dimension. Finally, regarding the interrelations between HRQoL and PA in the rural environment, all HRQoL dimensions were positively associated, except for the dimension of peers and social support. In urban environment, results pointed out that HRQoL dimensions of psychological well-being and school environment were associated with PA during PE classes. In both environments, the dimension of physical well-being and the overall HRQoL were positively correlated with PA, except for PA performed at lunchtime, where the relationships were negative.

Figures 1 and Figure 2 show the results of the multiple mediation analysis. This analysis represents the mediation of the PYD dimensions in the relationship between the influence of PA on the global HRQoL, comparing rural and urban environments. In model 1, an unadjusted model was described (Figure 1a,b), showing significant direct and total effects (c and c') by PA on the global HRQoL score. After including the mediations, only in the rural environment, PA was related to the character dimension. In both environments, the dimensions of confidence and connection showed positive



Table 1. Differences in physical activity practice, sleep habits, adherence to the Mediterranean Diet, positive youth development and health-related quality of life, by the environment (rural/urban), age and sex.

	Total (n = 418)		Rural (n = 185)		Urban (n = 233)		Environment		Age		Sex	
	Mean ± SD		Mean ± SD		Mean ± SD		p-value (ES)	p-value (ES)	p-value (ES)	p-value (ES)		
Anthropometric characteristics												
Weight (kg)	53.9 ± 11.4		53.3 ± 11.0		54.8 ± 11.8		.199 (11.4)		<.001 (10.9)		<.001 (11.0)	
Height (m)	1.64 ± 0.10		1.64 ± 0.10		1.64 ± 0.109		.444 (0.10)		<.001 (0.10)		<.001 (0.10)	
BMI (kg/m ²)	20.2 ± 4.93		19.9 ± 3.71		20.6 ± 6.24		.200 (4.93)		.141 (4.95)		.328 (4.96)	
PA (PAQ-A)												
Active/Not active	44.5 / 55.5		60 / 40		49.7 / 50.3		.037 (0.10)		.004 (0.14)		<.001 (0.23)	
PA in free time	1.53 ± 0.51		1.54 ± 0.55		1.51 ± 0.47		.566 (0.51)		<.001 (0.51)		.005 (0.51)	
PA in classes of PE	4.00 ± 1.07		4.08 ± 0.96		3.81 ± 1.18		.010 (1.06)		.037 (1.06)		.012 (1.06)	
PA at lunch time	3.60 ± 1.18		3.49 ± 1.24		3.72 ± 1.10		.045 (1.18)		.037 (1.18)		<.001 (1.17)	
PA after high school(15 h-18 h)	2.96 ± 1.40		3.09 ± 1.40		2.80 ± 1.40		.039 (1.40)		<.001 (1.39)		<.001 (1.38)	
PA in the evening (18 h-22 h)	2.93 ± 1.37		3.01 ± 1.37		2.82 ± 1.37		.166 (1.37)		.048 (1.36)		<.001 (1.35)	
PA in the last weekend	2.77 ± 1.32		2.86 ± 1.37		2.65 ± 1.25		.107 (1.32)		<.001 (1.29)		<.001 (1.31)	
PA in the last week	2.59 ± 1.35		2.75 ± 1.34		2.39 ± 1.34		.007 (1.34)		.085 (1.34)		<.001 (1.34)	
PA according to days of the week	2.84 ± 0.94		2.90 ± 0.97		2.76 ± 0.91		.119 (0.94)		<.001 (0.93)		<.001 (0.91)	
Global PA	2.90 ± 0.68		2.97 ± 0.65		2.81 ± 0.70		.017 (0.67)		<.001 (0.67)		<.001 (0.66)	
Sleep habits												
Global sleep hours (h)	8.30 ± 1.40		8.40 ± 1.58		8.20 ± 1.52		.087 (1.55)		.002 (1.52)		.785 (1.56)	
During the week (h)	9.20 ± 2.48		7.50 ± 1.36		7.40 ± 1.44		.272 (1.40)		<.001 (2.44)		.127 (2.48)	
At the weekend (h)	7.50 ± 1.56		9.40 ± 2.42		8.90 ± 2.54		.095 (2.48)		.151 (1.37)		<.001 (1.36)	
Mediterranean Diet (KIDMED)												
Score (0-12)	5.58 ± 2.62		5.35 ± 2.56		5.87 ± 2.68		.044 (2.61)		.081 (2.61)		.311 (2.58)	
Quality (%) (low/medium/high)	20.6 / 54.7 / 24.7		21.5 / 56.1 / 22.4		19.4 / 52.8 / 27.8		.449 (0.06)		.078 (0.11)		.466 (0.06)	
Usual consumption of fast food (% Yes)	28.8		28.3		29.5		.792 (0.01)		.160 (0.07)		.976 (0.00)	
Not breakfast (% Yes)	27.6		26.7		28.8		.638 (0.02)		.128 (0.08)		<.001 (0.18)	
Usual consumption of pastries at breakfast (% Yes)	21.9		22.0		21.7		.952 (0.00)		.212 (0.06)		.517 (0.03)	
Consumption of energy drinks (% Yes)	46.9		51.5		41.1		.034 (0.10)		.002 (0.16)		.307 (0.05)	
PYD												
Character	3.67 ± 0.58		3.66 ± 0.59		3.69 ± 0.57		.675 (0.58)		.269 (0.57)		.256 (0.58)	
Competence	3.32 ± 0.75		3.39 ± 0.70		3.23 ± 0.80		.033 (0.75)		.046 (0.74)		<.001 (0.72)	
Confidence	3.66 ± 0.76		3.69 ± 0.75		3.62 ± 0.78		.333 (0.76)		.028 (0.75)		<.001 (0.73)	
Caring	3.74 ± 0.84		3.77 ± 0.79		3.71 ± 0.89		.481 (0.84)		.360 (0.82)		<.001 (0.82)	
Connection	3.69 ± 0.66		3.84 ± 0.64		3.51 ± 0.63		<.001 (0.63)		.008 (0.65)		.579 (0.66)	
Global PYD	3.62 ± 0.51		3.67 ± 0.52		3.55 ± 0.48		.025 (0.50)		.008 (0.49)		.008 (0.51)	
HRQoL (KIDSCREEN-27)												
Physical Well-Being	57.8 ± 16.7		59.8 ± 15.9		55.3 ± 17.3		.008 (16.5)		<.001 (16.2)		<.001 (15.9)	
Psychological Well-Being	67.5 ± 21.0		70.0 ± 19.2		61.4 ± 22.8		.010 (20.9)		.151 (20.9)		<.001 (20.6)	
Autonomy and Parent Relation	73.2 ± 18.6		75.7 ± 17.6		70.2 ± 19.3		.003 (18.4)		.112 (18.4)		.021 (18.6)	

(Continued)

Table 1. (Continued).

	Total (n = 418)		Rural (n = 185)		Urban (n = 233)		Environment		Age		Sex	
	Mean	± SD	Mean	± SD	Mean	± SD	p-value	(ES)	p-value	(ES)	p-value	(ES)
Peers and Social Support	82.1	± 19.3	84.9	± 17.2	78.7	± 21.2	<.001	(19.1)	.766	(19.2)	.257	(19.3)
School Environment	64.8	± 21.9	59.8	± 15.9	55.3	± 17.3	.071	(21.8)	<.001	(21.2)	.202	(22.0)
Global HRQoL	69.5	± 13.7	71.8	± 12.9	66.8	± 14.2	<.001	(13.5)	<.001	(13.4)	<.001	(13.5)

SD: Standard Deviation; ES: Effect Size; Kg: kilograms; m: metres; m²: square metres; BMI: Body Mass Index; h: hours; PYD: Positive Youth Development; HRQoL: Health-Related Quality of Life.

Table 2. Differences in sleep habits, adherence to the Mediterranean Diet, positive youth development and health-related quality of life comparing the active and not active group.

	Total (n = 411)	Active (n = 228)	Not active (n = 183)	p-value (ES)
	Mean ± SD	Mean ± SD	Mean ± SD	
Anthropometric characteristics				
Weight (kg)	53.9 ± 11.4	54.3 ± 12.1	53.4 ± 10.5	.437 (11.4)
Height (m)	1.64 ± 0.10	1.65 ± 0.11	1.64 ± 0.09	.019 (0.10)
BMI (kg/m ²)	20.2 ± 4.95	20.1 ± 5.73	20.3 ± 3.67	.738 (4.95)
Sleep habits				
Global sleep hours (h)	8.32 ± 1.51	8.36 ± 1.48	8.27 ± 1.55	.557 (1.51)
During the week (h)	7.48 ± 1.38	7.56 ± 1.30	7.37 ± 1.46	.168 (1.37)
At the weekend (h)	9.15 ± 2.36	9.16 ± 2.28	9.13 ± 2.46	.920 (2.36)
Mediterranean Diet (KIDMED)				
Score (0–12)	5.55 ± 2.62	6.07 ± 2.55	4.92 ± 2.56	<.001 (2.56)
Quality (%) (low/medium/high)	20.7 / 54.6 / 24.7	14.9 / 54.8 / 30.3	27.8 / 54.4 / 17.8	<.001 (0.19)
Usual consumption of fast food (% Yes)	28.9	26.4	31.9	.228 (0.06)
Not breakfast (% Yes)	27.6	26.3	29.3	.505 (0.03)
Usual consumption of pastries at breakfast (% Yes)	22.2	21.6	23.1	.719 (0.02)
Consumption of energy drinks (% Yes)	46.5	50.0	42.1	.109 (0.08)
PYD				
Character	3.67 ± 0.58	3.80 ± 0.51	3.53 ± 0.62	<.001 (0.56)
Competence	3.32 ± 0.75	3.55 ± 0.68	3.04 ± 0.73	<.001 (0.70)
Confidence	3.66 ± 0.75	3.80 ± 0.72	3.48 ± 0.76	<.001 (0.74)
Caring	3.74 ± 0.84	3.79 ± 0.80	3.68 ± 0.88	.189 (0.84)
Connection	3.70 ± 0.65	3.82 ± 0.62	3.55 ± 0.66	<.001 (0.64)
Global PYD	3.62 ± 0.50	3.77 ± 0.44	3.45 ± 0.52	<.001 (0.48)
HRQoL (KIDSCREEN-27)				
Physical Well-Being	57.9 ± 16.7	66.0 ± 13.2	47.7 ± 15.0	<.001 (14.0)
Psychological Well-Being	67.6 ± 21.0	70.7 ± 19.4	63.7 ± 22.2	<.001 (20.7)
Autonomy and Parent Relation	73.4 ± 18.5	77.0 ± 15.9	59.0 ± 20.6	<.001 (18.1)
Peers and Social Support	82.2 ± 19.3	83.8 ± 19.4	80.2 ± 19.0	.061 (19.2)
School Environment	64.9 ± 21.9	67.8 ± 21.8	61.2 ± 21.5	.002 (21.6)
Global HRQoL	69.5 ± 13.7	73.4 ± 12.3	64.7 ± 12.3	<.001 (13.0)

SD: Standard Deviation; ES: Effect Size; Kg: kilograms; m: metres; m²: square metres; BMI: Body Mass Index; h: hours; PYD: Positive Youth Development; HRQoL: Health-Related Quality of Life.

relationships with global HRQoL. Finally, the competence dimension showed an indirect effect in the relationship between PA and its positive impact on HRQoL.

In model 2 (Figure 2a,b), after adjusting by age, sex, adherence to Mediterranean Diet, sleep habits and BMI, the total effect of PA (c) on the global HRQoL score and the direct effect (c') remained significant in both environments. In rural environment, the relationship between global PA and the character and competence dimensions of PYD was also observed, as in the unadjusted model. In rural environment, positive relationships between the dimensions of competence, confidence and connection with the global HRQoL were preserved. Only in rural environment, the competence dimension remained an indirect effect in the relationship between PA and its positive impact on HRQoL. In urban environment, the competence dimension was related to global PA and just character and connection were linked to HRQoL.

After the mediational analyses, a structural equation model was tested. Figure 3 represents the mediation by PYD dimension of competence, in the relationship between PA and HRQoL, controlling for sex, age, adherence to Mediterranean Diet, sleep habits, BMI and environment. The model showed good data fit, $\chi^2(21) = 21.46$, $p = .431$, CFI = .998, SRMR = .041, RMSEA = .009, 90% CI RMSEA = .001, .050. The results indicated that higher rates of PA had a positive effect on HRQoL, directly and through a positive effect on the dimension of competence. The model reached an explained variance for HRQoL of $R^2 = .371$. As well, some significant effects on HRQoL were observed by sleep and environment. Moreover, sex, age and adherence to Mediterranean Diet had effects on PA, and sex, sleep and BMI were related to competence.

Table 3. Correlations between physical activity practice and age, sex, anthropometric characteristics, sleep habits, adherence to the Mediterranean Diet, positive youth development, and health-related quality of life, comparing the different environments (rural/urban).

	Age	Sex	Weight (kg)	Height (m)	BMI (kg/m ²)	Global sleep hours (h)	KIDMED (0-12)	PVD Cha	PVD Com	PVD Conf	PVD Ca	PVD Conn	PVD Global	HRQoL Phys	HRQoL Psy	HRQoL APR	HRQoL PSS	HRQoL SE	Global HRQoL	
RURAL ENVIRONMENT																				
Active/Not active	-.155*	-.351**	-.012	.119	-.090	-.022	.259**	.308**	.377**	.306**	.107	.176**	.358**	.578**	.189**	.215**	.047	.203**	.326**	
PA in free time	-.202**	-.143*	-.173**	.008	-.193**	.028	.103	.158*	.242**	.143*	.033	.001	.161*	.397**	.097	.117	.040	.143*	.174*	
PA in PE classes	-.051	-.103	-.117	.015	-.151*	.055	.120	.231**	.318**	.234**	.064	.193**	.311**	.376**	.123	.222**	.129	.199**	.263**	
PA at lunch time	.113	.217**	-.035	.062	-.119	-.036	-.071	-.159*	-.312**	-.209**	.025	-.095	-.225**	-.312**	-.178**	-.146*	-.010	-.078	-.225**	
PA after high school (15 h-18 h)	-.140*	-.297**	-.007	.052	-.036	-.001	.147*	.241**	.251**	.268**	.037	.126	.266**	.422**	.114	.220**	-.027	.148*	.217**	
PA in the evening (18 h-22 h)	-.117	-.300**	.013	.142*	-.096	-.062	.185**	.286**	.337**	.257**	.135*	.190**	.354**	.540**	.131	.219**	.043	.228**	.286**	
PA in the last weekend	-.259**	-.239**	-.142*	-.093	-.092	.005	.135*	.175**	.265**	.197**	.064	.134*	.261**	.408**	.145*	.222**	.063	.195**	.310**	
PA in the last week	-.090	-.256**	.011	.085	-.027	-.058	.319**	.217**	.319**	.212**	.019	.097	.240**	.421**	.162*	.162*	.033	.215**	.274**	
PA according to days of the week	-.226**	-.381**	-.095	-.037	-.090	.002	.205**	.315**	.440**	.334**	.127	.197**	.404**	.548**	.242**	.261**	.055	.296**	.404**	
Global PA	-.209**	-.334**	-.098	.062	-.159*	-.020	.262**	.321**	.399**	.316**	.113	.193**	.384**	.602**	.172*	.287**	.069	.288**	.370**	
URBAN ENVIRONMENT																				
Active/Not active	-.112	-.074	.115	.127	.050	.073	.194**	.143	.278**	.077	.015	.187*	.228**	.494**	.117	.187*	.112	.054	.283**	
PA in free time	-.176*	-.134	.036	-.130	.166*	.046	.060	-.104	.091	.037	-.043	.021	.056	.342**	-.025	-.043	.065	-.003	.124	
PA in PE classes	-.017	-.145	.029	.090	-.013	.036	.155*	.163*	.364**	.248**	-.034	.163*	.266**	.227**	.178*	.179*	.124	.166*	.238**	
PA at lunch time	.065	.077	.066	.004	.065	.069	-.076	.018	-.088	-.135	-.023	-.086	-.068	-.212**	-.095	-.141	-.153*	-.028	-.217**	
PA after high school (15 h-18 h)	-.188*	-.050	-.030	.010	.032	.009	.094	.080	.161*	-.016	.039	.047	.128	.436**	.001	.093	.106	.034	.177*	

(Continued)

Table 3. (Continued).

	Age	Sex	Weight (kg)	Height (m)	BMI (kg/m ²)	Global sleep hours (h)	KIDMED (0-12)	PYD Cha	PYD Com	PYD Conf	PYD Ca	PYD Conn	PYD Global	HRQoL Phys	HRQoL Psy	HRQoL APR	HRQoL PSS	HRQoL SE	Global HRQoL
PA in the evening (18 h-22 h)	-.060	-.095	.145	.046	.139	.049	.113	.048	.239**	.026	-.094	.092	.139	.411**	.143	.119	.164*	.011	.254**
PA in the last weekend	-.140	-.080	.019	.046	-.060	-.008	.159*	.057	.243**	.093	.046	.221**	.157*	.405**	.126	.157*	.244**	.095	.316**
PA in the last week	-.051	-.072	.104	.066	.110	.010	.198**	.117	.282-**	.162*	-.005	.115	.228**	.471**	.116	.182*	.166*	.070	.255**
PA according to days of the week	-.131	-.142	.141	.045	.139	.090	.203**	.083	.271**	.089	-.048	.104	.180*	.465**	.122	.182*	.157*	.068	.312**
Global PA	-.132	-.121	.101	.054	.101	.057	.178*	.104	.327**	.102	-.042	.140	.234**	.522**	.117	.156*	.185*	.073	.298**

Kg: kilograms; m: metres; m²: square metres; BMI: Body Mass Index; h: hours; PYD Cha: Character; PYD Com: Competence; PYD Conf: Confidence; PYD Ca: Caring; PYD Conn: Connection; HRQoL Phys: Physical Well-being; HRQoL Psy: Psychological Well-being; HRQoL APR: Autonomy and Parent Relation; HRQoL PSS: Peers and Social Support; HRQoL SE: School Environment; PA: Physical Activity; PE: Physical Education.

**The correlation is significant at the .01 level (bilateral). * . Correlation is significant at the .05 level (bilateral).

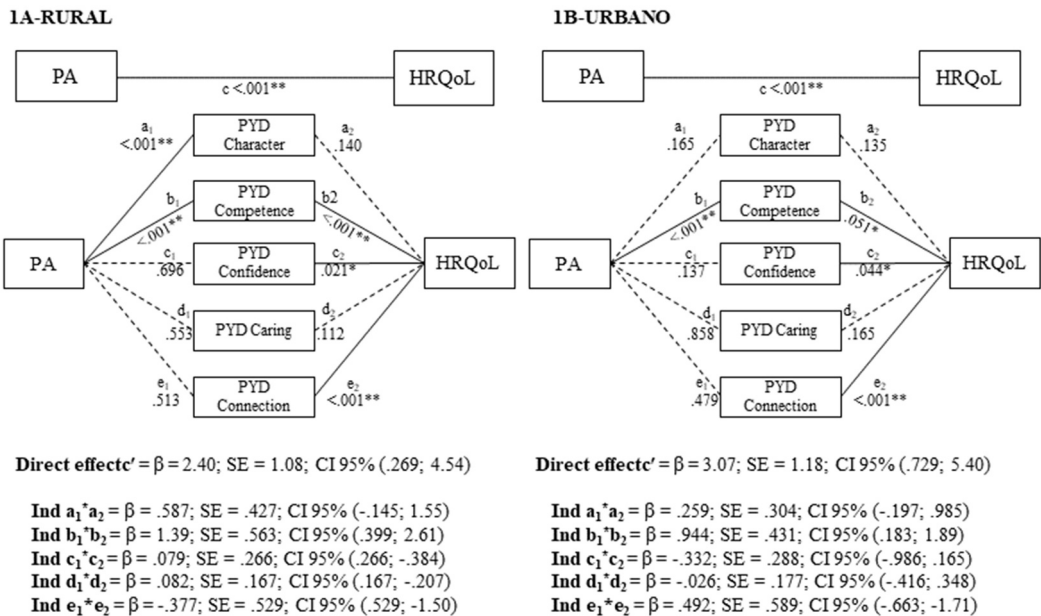


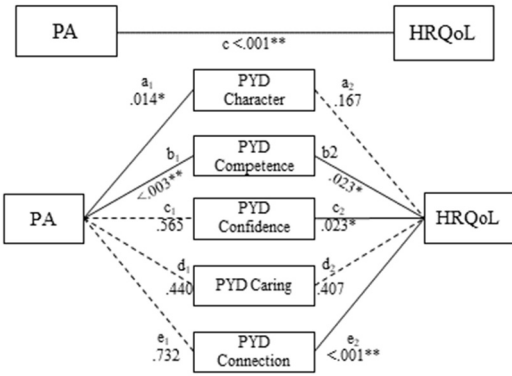
Figure 1. Unadjusted multiple mediation analysis of PYD in the relationship between global physical activity practice and health-related quality of life. Note. * $p < .05$, ** $p < .01$; β : unstandardized regression coefficients. SE: standard error. CI: confidence interval; if zero was not included in the 95% CI of the estimate, the indirect effect (Ind) is statistically significant.

Discussion

The aim of this study was to analyse the mediational role of the 5Cs of PYD in the relationship between PA and HRQoL in an adolescent sample, considering differences by area of residence, age and sex. While previous research has explored the associations of various health-protective behaviours (PA, adherence to the Mediterranean Diet, sedentary time) with HRQoL (Granger et al., 2017; Hawks et al., 2022), less evidence has been collected concerning PYD (McDavid et al., 2019). Moreover, to date, no research has jointly analysed the relationship between both PA, HRQoL and PYD. Furthermore, the potential mediation of the 5Cs of PYD in the interrelationship between PA and HRQoL in adolescents attending schools from different environments is also a novel contribution.

This study reveals that adolescents in rural environments exhibited superior levels of PA, PYD and HRQoL, with significant differences by age and sex. The competence dimension of PYD emerged as a key mediator in the PA-HRQoL relationship in both rural and urban environments. Rural adolescents showed a healthier lifestyle, being more physically active and presenting higher scores in PYD and HRQoL, aligning with previous literature (Jiménez et al., 2022; Warner et al., 2019). These environmental differences may be attributed to the increased opportunities for an active life in rural contexts (Torres-Luque et al., 2014). Conversely, Franco et al. (2020) concluded that, in both rural and urban environments, there is an increase in sedentary time during the transition to Secondary Education. In this study, sleep habits were generally within the recommended ranges (between 8–10 hours), offering potential cognitive and health-related advantages (Dutil et al., 2022; Mason et al., 2021), with some age and sex differences but no discernible environment distinctions, as concluded by Jiménez et al. (2021).

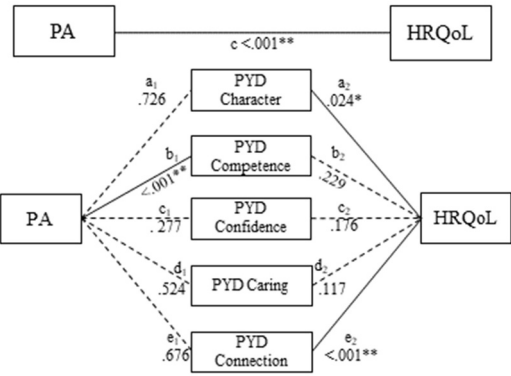
2A-RURAL



Direct effects' = $\beta = 2.65$; SE = 1.18; CL 95% (.312; 4.99)

- Ind $a_1^*a_2 = \beta = .249$; SE = .313; CI 95% (-.284; .979)
- Ind $b_1^*b_2 = \beta = .781$; SE = .445; CI 95% (.052; 1.762)
- Ind $c_1^*c_2 = \beta = -.138$; SE = .303; CI 95% (-.772; .469)
- Ind $d_1^*d_2 = \beta = .067$; SE = .149; CI 95% (-.186; .438)
- Ind $e_1^*e_2 = \beta = -.213$; SE = .599; CI 95% (-1.46; .909)

2B-URBANO



Direct effects' = $\beta = 4.19$; SE = 1.36; CL 95% (1.49; 6.88)

- Ind $a_1^*a_2 = \beta = .134$; SE = .402; CI 95% (-.383; 1.09)
- Ind $b_1^*b_2 = \beta = .633$; SE = .452; CI 95% (-.574; 1.59)
- Ind $c_1^*c_2 = \beta = -.205$; SE = .269; CI 95% (-.207; .281)
- Ind $d_1^*d_2 = \beta = -.137$; SE = .278; CI 95% (-.808; .392)
- Ind $e_1^*e_2 = \beta = .344$; SE = .804; CI 95% (-1.28; 1.92)

*Models adjusted by: age, sex, Mediterranean diet (KIDMED), sleep habits and BMI.

Figure 2. Multiple mediation analysis of the role of PYD in the relationship between global physical activity practice and health-related quality of life adjusted by age, sex, adherence to Mediterranean Diet, sleep habits and BMI. Note. * $p < .05$, ** $p < .01$; β : unstandardized regression coefficients. SE: standard error. CI: confidence interval; if zero was not included in the 95% CI of the estimate, the indirect effect (Ind) is statistically significant.

In PYD, rural students reported more competence, possibly due to closer social relationships and a stronger connection to the natural environment, linked to both PYD and psychological well-being (Bowers et al., 2021; Tomé et al., 2020). Connection also showed a positive association with increased time spent in nature in rural communities in South Carolina (Bowers et al., 2021). Concerning HRQoL, our results align with Jiménez et al. (2021), rural students showing higher HRQoL. Age differences may be explained by declining healthy behaviours across adolescence, consistent with previous literature (Grao-Cruces et al., 2013; Moreno et al., 2020). Sex differences suggest a specific decrease in PA among females during adolescence (Guthold et al., 2020; Moreno et al., 2020), with PYD dimensions potentially exerting a greater influence on girls' mental health (Tomé et al., 2021).

Furthermore, the outcomes in study variables between active or not active students showed some significant differences. Thus, the active students reported better adherence to the Mediterranean Diet, aligning with the findings of García (2019). The promotion of PYD through interventions involving PA has been just recently studied (Vierimaa et al., 2018; Warner et al., 2019), yielding promising results that require further research (Whitley et al., 2019). Lastly, various studies have also shown the association between PA and the improvement of HRQoL (Jiménez et al., 2021; Muros et al., 2017).

To date, no study has examined the relationship between PYD and HRQoL comparing different contexts (i.e. rural vs. urban). In our study, we found that PA was associated with the anthropometric characteristics, adherence to the Mediterranean Diet, PYD and HRQoL, differently in urban or rural contexts. Higher PA levels, regardless of the environment, positively influenced adherence to the Mediterranean Diet and exhibited positive effects on PYD and HRQoL, including their different dimensions. A Spanish study had positive associations between adherence to the Mediterranean Diet and commitment to PA, mediating an enhanced HRQoL through increased psychological wellbeing (Knox & Muros, 2017). Similarly, PA itself has shown bidirectional

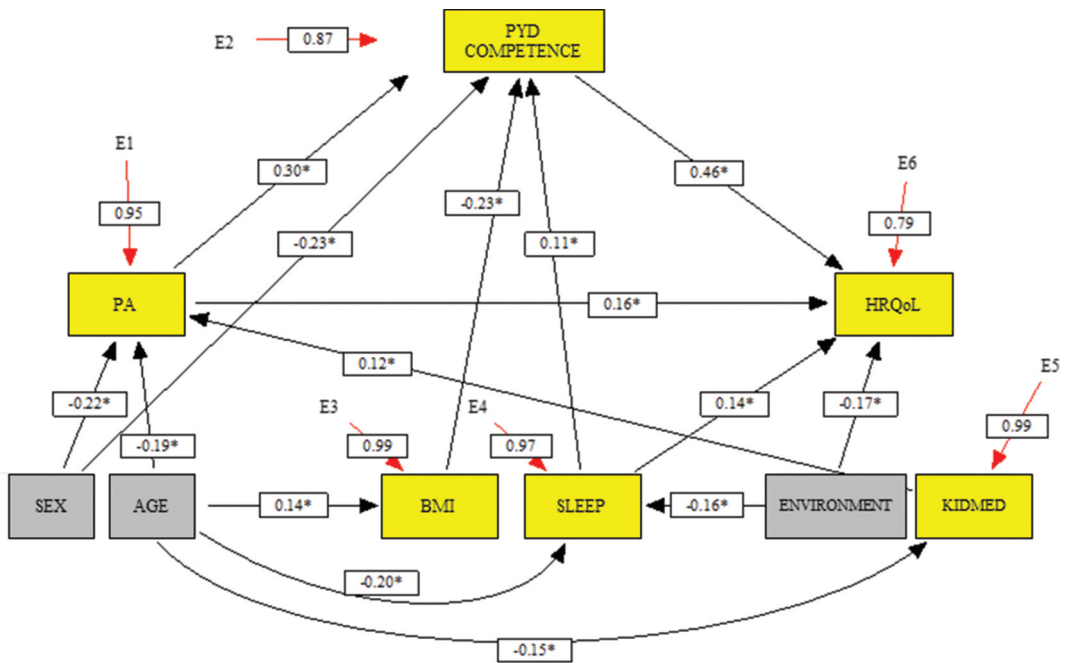


Figure 3. Structural equation model of the mediation by competence in the relationship between physical activity and health-related quality of life.

associations with improved HRQoL (Pastor et al., 2022). Notably, in PYD studies from sports perspective, the dimensions of character and caring are often combined due to conceptual similarities (Côté et al., 2010; Vierimaa et al., 2018), potentially explaining the absence of significant associations with caring dimension in our study. Furthermore, the correlations between PA and the dimensions of physical well-being in rural and urban environments, as well as PA and psychological well-being in rural environment, may signify the positive impact of PA on the holistic development of our adolescents, as extensively documented in the literature (Pastor et al., 2022).

In the mediational analysis and in the structural equation model, several key findings emerged. Firstly, a positive impact of PA on HRQoL was confirmed in both rural and urban environments, consistent with previous research (Omouro et al., 2022; Villafaina et al., 2021; WHO, 2020). However, the mediation of the PYD dimension of competence had a unique effect: it positively influenced HRQoL, but only in the rural environment. Competence, which includes the skills and knowledge needed to effectively navigate social and cultural settings, also encompasses health care (Oliva et al., 2010). This finding aligns with research suggesting that contact with nature, more readily available in rural environments, is related to greater well-being (Dong & Geng, 2023; Pasca & Aragonés, 2021). Moreover, Tomé et al. (2021) highlighted competence as having the strongest association with well-being and O'Connor et al. (2020) that linked competence to more enjoyment and adherence to youth sports. Keep in mind developmental assets in PYD (Oliva et al., 2011), where internal assets refer to the psychological or behavioural skills that, when nurtured, enhance decision-making and responsible actions, fostering competence and subsequent well-being. Although the connection between PYD and PA is still little explored, PYD programs centred on PA (Weiss, 2020) and sports (Warner et al., 2019) that focus on competence, physical health literacy and socioemotional skills, could provide the fulfilment of many development assets.

Relative to environments, some studies have shown that the urban environment may have a more favourable design to increase the practice of physical activity and health outcomes. The strategies

include the provision of safe roads in relation to traffic reduction, easy access to recreational facilities and providing safe routes to school environments (Audrey & Batista-Ferrer, 2015; Ding et al., 2011). Another possibility would be the effects of 'Green city' that could support adolescent health and well-being (Roe & Aspinall, 2012).

Limitations, strengths, and future perspectives

Some limitations in this study should be acknowledged. First, the cross-sectional precludes establishing causal relationships. Second, self-reports may produce some biases related to inaccuracy, social desirability, and misinterpretation of questions. However, the questionnaires used in this work have been widely validated in previous research. Third, it would be interesting to replicate the study with a more heterogeneous sample, encompassing high schools from different socioeconomic contexts and ownership types (public and private educational centres). As a strength, as far as we know, this is the first study that analyzes the relationships between PA, HRQoL and PYD using a mediation analysis and considering the differences between rural-urban environments. Covariates such as age, sex, adherence to the Mediterranean Diet, sleep habits and BMI were included to improve the robustness of the results.

After this cross-sectional research with self-report data, future research should extend its scope by employing longitudinal data and objective PA measures in a larger, more heterogeneous adolescent cohort. As a practical implication, these findings encourage physical exercise and sport participation, aiming to increase PA frequency, duration and intensity to reach greater HRQoL.

Conclusion

To sum up, this research found that adolescents attending Secondary Education in the rural environment of Huelva showed higher scores in health-related variables, such as PA, adherence to the Mediterranean Diet, PYD and HRQoL. Likewise, this study concluded that the competence dimension of PYD had a mediating role in the relationship between PA and HRQoL. Finally, the findings invite the promotion of PYD programs involving PA in order to improve adolescents' HRQoL.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

Database of this study is available upon request from the corresponding author. The data is not public due to ethical or privacy restrictions.

Ethical statement

All procedures performed in studies with human participants were approved by the Ethics Committee of the University of Huelva (Spain) (0735-N-23) and were in accordance with the 1964 Helsinki Declaration and its later amendments. Both the participating students and their parents or legal guardians were previously informed and gave their informed consent.

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