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Are perceived barriers to physical activity related to depression, anxiety and stress among adolescents? The EHDLA study

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ABSTRACT

Objective The aim of this study was twofold: first, to examine the association between perceived barriers to physical activity (PA) practice and depression, anxiety and stress in a sample of Spanish adolescents; and second, to determine which barriers are specifically associated with depression, anxiety and stress.

Methods This cross-sectional study was conducted with 765 adolescents aged 12–17 (55.6% girls) in the *Valle of Ricote*, Murcia, Spain. Depression, anxiety and stress symptoms were assessed using the Depression, Anxiety and Stress Scale (DASS-21), with validated cut points employed to determine the presence of each of these mental conditions. The perception of barriers to PA was assessed using a validated questionnaire for the Spanish adolescent population.

Results The barrier 'Because I feel that my physical appearance is worse than that of others' was related to a higher likelihood of having depression (OR=2.41; 95% CI 1.35 to 4.28; p=0.003), anxiety (OR=2.65; 95% CI 1.51 to 4.71; p=0.001) and stress (OR=2.82; 95% CI 1.59 to 5.07; p<0.001). Similarly, the barrier 'Because nobody encourages me to engage in physical activity' was related to a higher likelihood of having depression (OR=1.92; 95% CI 1.08 to 3.43; p=0.026), anxiety (OR=1.97; 95% CI 1.11 to 3.50; p=0.021) and stress (OR=1.99; 95% CI 1.12 to 3.59; p=0.021).

Conclusion Perceived barriers to PA related to physical appearance and social support seem to be associated with a greater likelihood of depression, anxiety and stress among Spanish adolescents.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The relationship between perceived barriers to engaging in physical activity (PA) and the presence of depression, anxiety and stress has not been investigated in the adolescent population.
⇒ Gaining insight into the factors related to PA engagement and mental health might aid the design of more effective interventions.

WHAT THIS STUDY ADDS

⇒ Perceiving barriers related to physical appearance and perceiving a lack of social support seem to be associated with symptoms of depression, anxiety and stress in adolescents.
⇒ Promoting PA by reducing some specific barriers could be an important step in reducing symptoms of depression, anxiety and stress in adolescents.

INTRODUCTION

According to the WHO,[1] 970 million people worldwide had a mental disorder in 2019.[2] Depression and anxiety are the most prevalent mental disorders and main causes of disability, being considered among the top 10 causes of disability-adjusted life-years in youths aged 10–24 years.[3] Thus, the presence of mental health symptoms in adolescence, even when subclinical, predicts psychopathology in the future and can contribute to increased morbidity, mortality and disability.[4–6] Nevertheless, half of mental disorders develop before the age of 18.[6] This leads to a strong call for interventions aimed at promoting mental health in children and adolescents.[7 8]

Strategies focused on the improvement of some modifiable lifestyle factors, such as the practice of physical activity (PA),[9] have been proposed as potential contributors to the prevention or decrease of depression, anxiety and stress symptoms.[10] The importance of PA has been highlighted worldwide, as it provides multiple benefits related to health in children and adolescents, including their mental health.[11] The lifestyle acquired during childhood and adolescence can determine their future health and possibilities.[12] Investing in the health and well-being of adolescents not only yields current benefits but also has long-term advantages for the upcoming decades and the next generation.[12] Numerous studies indicate that active individuals during childhood and adolescence are likely to maintain an active lifestyle in adulthood, and active

adults, in turn, tend to encourage PA in their children.[13] However, approximately 81% of adolescents aged 11–17 years worldwide accumulate insufficient PA, with significant differences in prevalence according to sex, region and country.[14]

Different factors are thought to influence engagement in PA during adolescence. These factors encompass the existence of perceived barriers, an element that, according to an individual's perception, poses challenges in adopting a physically active lifestyle, either individually[15] or in combination.[16 17] In this line, systematic reviews have indicated an inverse association between the perception and number of certain barriers, such as the lack of social support or the self-perceived physical appearance, and levels of practised PA.[18–20] Additionally, low PA levels are considered a serious threat to the health and well-being of the population[3 21–23] and have been related to symptoms of depression, anxiety and stress in adolescents.[7–9]

The development and persistence of mental health issues are considered multifactorial, involving complex interactions between genetic and environmental factors.[24] Furthermore, different variables, including comorbidity and social or lifestyle factors, have been examined as potential protective or risk factors for mental health problems.[25] Scientific evidence indicates that participation in PA can support the current and future mental health of young people.[26 27] For example, findings from a systematic review and meta-analysis by Rodriguez-Ayllon *et al*[26] suggest that PA interventions can enhance adolescents' mental health. Furthermore, observational studies indicate that promoting PA and reducing sedentary behaviour may protect adolescents' mental health. Addressing the reduction of perceived barriers to practising PA is an important consideration alongside promoting other healthy behaviours, such as improving the quality of sleep, all of which can promote the reduction of depressive, anxiety and stress symptoms.[7–9 11] Therefore, gaining insight into the factors related to PA engagement and mental health might aid the design of more effective interventions. Nevertheless, the relationship between perceived barriers to engaging in PA and the presence of depression, anxiety and stress has not been investigated in the adolescent population.

Despite extensive research on the benefits of PA on mental health,[26] there is limited knowledge about how specific perceived barriers are associated with mental health outcomes in this population. Therefore, there is a need to understand the relationship between perceived barriers to PA and mental health issues in adolescents. This study is novel as it is the first to investigate these associations in a sample of adolescents, providing insights that could contribute to the development of strategies aimed at promoting PA by mitigating barriers, thereby lowering the levels of depressive, anxiety and stress symptoms within this population. It is hypothesised that a higher number of perceived barriers to PA, such as concerns about physical appearance and lack of social support,

are positively associated with higher symptoms of depression, anxiety and stress in adolescents, independent of their PA levels. Therefore, the aim of the present study was twofold: first, to examine the association between perceived barriers to PA practice and depression, anxiety and stress in a sample of Spanish adolescents, and second, to determine which barriers are specifically associated with depression, anxiety and stress

MATERIAL AND METHODS
Population and study design
This cross-sectional study includes data from the Eating Healthy and Daily Life Activities (EHDLA) study, where adolescents from three secondary schools from the *Valle de Ricote* (Region of Murcia, Spain) were assessed. The methodology of the EHDLA study has been previously published.[28] Regarding participation, the parents or legal guardians of the adolescents were provided with a written informed consent form to be signed previously. The adolescents were also asked about their willingness to participate in the study. The entire data collection process was carried out during physical education classes. The inclusion criteria for the study were as follows: aged between 12 and 17 years old and registered and/or lived in the *Valle de Ricote*. Regarding exclusion criteria, adolescents are exempt from physical education at school and pathology that contraindicates PA or demands special attention and pharmacological treatment.

Procedures
Perceived barriers to PA practice (independent variables)
A scale of perceived barriers to PA in adolescents, previously validated among the Spanish population, was applied[29] to assess perceived barriers to PA in adolescents. The scale is composed of twelve items that are included in four distinct dimensions: barriers due to incompatibility with other tasks (two items), self-concept barriers (four items), motivational barriers (four items) and social barriers (two items). Each item is scored with a 5-point Likert-type response scale, from 1 (strongly disagree) to 5 (strongly agree).[29] For further analyses, we categorised the items as 'agree' (4 or 5 points on a Likert scale) or 'not agree' (1, 2 and 3 points on a Likert scale). In addition, we determined the number of perceived barriers to PA (ie, items with 'agree' responses).

Depression, anxiety and stress (dependent variables)
Depressive, anxiety and stress symptoms were evaluated by the *Depression, Anxiety and Stress* Scale (DASS-21),[30] which includes 21 items scored on a 4-point Likert-type scale. The score of each item ranges from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time) and is divided uniformly into three subscales: depression, anxiety and stress. The depression subscale assesses symptoms like inertia, anhedonia, dysphoria, lack of interest/involvement, self-depreciation, devaluation of life and discouragement. The anxiety subscale evaluates the excitation of the autonomous nervous

system, musculoskeletal effects, situational anxiety and subjective anxiety experiences. Finally, the stress subscale assesses difficulty in relaxing, such as nervous excitation, easy perturbation/agitation, irritability/exaggerated reaction and impatience. The Spanish version, which has adequate reliability, was used in this study.[31] The cut-off points established for the presence of depression, anxiety and stress were ≥6 points, ≥6 points and ≥5 points, respectively, due to the adequate sensitivity and specificity that these cut-off points have shown in adolescents.[32] It is important to mention that higher scores represent more severe symptoms on the DASS-21.

Covariates

Sex and age were self-reported. Socioeconomic status (SES) was assessed using the Family Affluence Scale-III,[33] which has a final score that ranges from 0 to 13 points. The body weight of the adolescents was measured using an electronic scale (with an accuracy of 0.1 kg) (Tanita BC-545, Tokyo, Japan), while a portable height rod determined height with an accuracy of 0.1 cm (Leicester Tanita HR 001, Tokyo, Japan). The body mass index (BMI) was calculated by dividing body weight (in kg) and height (in square metres). PA and sedentary behaviour were assessed using the Spanish version of the Youth Activity Profile.[34] The Youth Activity Profile is a 15-item self-administered 7-day (previous week) recall questionnaire appropriate for young people aged 8 and 17 years.[35] The items use a 5-point Likert scale and are separated into three sections: activity at school, activity out of school and sedentary habits.[36] Sleep duration was evaluated by asking respondents for weekdays and weekends separately: 'What time does your child usually go to bed?' and 'What time does your child usually get up?'. The average daily sleep duration was calculated for each adolescent, considering the average nighttime sleep duration on weekdays and weekends.[36]

Statistical analysis

For categorical variables, the descriptive data are presented as the number (n) and the percentage (%) of observations. For continuous variables, descriptive data were presented as median and IQR values since visual methods (ie, density and quantile-quantile plots) and the Shapiro-Wilk test showed a non-normal distribution of the variables. To assess the potential moderating effect of sex on the relationship between barriers to PA and depression, anxiety or stress, an interaction term was included in the generalised logistic regression model. The results indicated a non-significant interaction between barriers to PA and sex (depression: p=0.397; anxiety: p=0.757; stress: p=0.826), suggesting that the association of barriers with depression, anxiety or stress do not differ between sexes. Therefore, both sexes were examined jointly. To examine the association between the number of perceived barriers for PA and the number of depression, anxiety, or stress symptoms among adolescents without any parametric assumptions on the nature

of the relationship, generalised additive models (GAMs) were applied. The GAM is a flexible model that can capture non-linear connections in data without requiring a predefined mathematical structure. GAMs were chosen for their flexibility in capturing complex non-linear relationships through smooth functions, which adaptively fit the data without requiring prespecified knot placement. Restricted maximum likelihood for smoothness selection was applied,[37] with a shrinkage approach employed as a function of thin plate regression spline smoothers.[38] To quantify the degree of non-linearity of the curve, we used the effective df (edf) of the GAM. To determine the OR and its 95% CI of the association of barriers to PA status (ie, low, medium and high) or each specific barrier to PA with depression, anxiety or stress status, we carried out binary logistic regression analyses. Furthermore, we applied a correction for multiple comparisons using the false discovery rate p value method developed by Benjamini and Hochberg.[39] In addition, we computed prediction margins and average marginal effects of the relationship between barriers to PA (ie, for each additional barrier, based on the status of barriers) and levels of depression, anxiety and stress (ie, for each additional symptom, based on the status of depression, anxiety and stress). Models were adjusted for sex, age, SES, BMI, overall sleep duration, PA and sedentary behaviour. All statistical analyses were conducted with the statistical software R (V.4.3.2) (R Core Team, Vienna, Austria) and RStudio (2023.09.1+494) (Posit, Boston, MA, USA). Statistical significance was set up with a p value <0.05.

RESULTS

Table 1 shows the main characteristics of the study participants. A total of 31.2% of adolescents were classified as having depression, 34.9% as having anxiety and 40.3% as having stress. Online supplemental table S1 shows the perceived barriers to the practice of PA in adolescents. The barriers most declared by adolescents were 'Because I have a lot of homework' (42.6%) and 'Because I am afraid of making a fool of myself' (19.1%). The least frequently declared barriers were 'Because I consider that I already do enough physical activity in my physical education classes' (7.8%) and 'Because nobody encourages me to engage in physical activity' (9.9%).

Figure 1 presents smoothed functions from GAMs for the number of barriers for PA and as a function of depression, anxiety or stress score. Examining the figure, edf and approximate significance of the smooth terms, we observed a nonlinear relationship between the number of barriers to PA and depressive symptoms (F=5.43; edf=1.89; p<0.001), anxiety symptoms (F=5.08; edf=2.28; p<0.001) and stress symptoms (F=4.42; edf=2.29; p<0.001). The predictive margins for each additional symptom of depression, anxiety or stress are shown in online supplemental figure S1. For each additional barrier to PA, the probability of having one more symptom of depression, anxiety and stress was 61.8% (95% CI 39.9% to 83.7%,

Table 1 Descriptive data of the study participants (n=765)

Variables		Perceived barriers to physical activity		
		Low n=548; 71.6%	Medium n=171; 22.4%	High n=46; 6.0%
Age (years)	Mean (SD)	13.9 (1.5)	14.3 (1.6)	14.0 (1.5)
Sex	Boys, n (%)	273 (49.8)	50 (29.2)	17 (37.0)
	Girls, n (%)	275 (50.2)	121 (70.8)	29 (63.0)
Socioeconomic status (FAS-III score)	Mean (SD)	8.2 (2.1)	8.0 (2.0)	7.7 (2.4)
Physical activity (YAP-S score)	Mean (SD)	2.7 (0.7)	2.5 (0.6)	2.6 (0.8)
Sedentary behaviours (YAP-S score)	Mean (SD)	2.6 (0.6)	2.6 (0.6)	2.9 (0.7)
Overall sleep duration (minutes)	Mean (SD)	497.3 (53.4)	481.3 (58.8)	476.5 (64.0)
Body mass index (kg/m^2)	Mean (SD)	22.5 (4.7)	23.5 (5.1)	24.6 (5.3)
Excess weight status	No, n (%)	417 (76.1)	121 (70.8)	29 (63.0)
	Yes, n (%)	131 (23.9)	50 (29.2)	17 (37.0)
DASS-21				
Depression symptoms (score)	Mean (SD)	3.7 (4.5)	6.7 (6.4)	7.4 (6.2)
Depression (status)*	No, n (%)	410 (74.8)	94 (55.0)	22 (47.8)
	Yes, n (%)	138 (25.2)	77 (45.0)	24 (52.2)
Anxiety symptoms (score)	Mean (SD)	3.4 (4.0)	6.2 (5.6)	6.5 (5.4)
Anxiety (status)†	No, n (%)	394 (71.9)	83 (48.5)	21 (45.7)
	Yes, n (%)	154 (28.1)	88 (51.5)	25 (54.3)
Stress symptoms (score)	Mean (SD)	4.5 (4.4)	7.4 (5.4)	7.1 (5.2)
Stress (status)‡	No, n (%)	371 (67.7)	69 (40.4)	17 (37.0)
	Yes, n (%)	177 (32.3)	102 (59.6)	29 (63.0)

Data are expressed as the mean (SD) or count (percentages).
*Cut-off point for depression symptoms ≥6 points.
†Cut-off point for anxiety symptoms ≥6 points.
‡Cut-off point for stress symptoms ≥5 points.
DASS-21, Depression, Anxiety and Stress Scale-21; FAS-III, Family Affluence Scale-III; YAP-S, Spanish Youth Active Profile.

p<0.001), 52.7% (95% CI 31.0% to 74.5%, p<0.001) and 56.2% (95% CI 33.8% to 78.6%, p<0.001), respectively.

Figure 2 displays the adjusted ORs of having depression, anxiety and stress in adolescents according to their perceived barriers to PA status. Compared with those with low perceived barriers to PA, adolescents with medium or high barriers to PA had higher probabilities of having depression (medium perceived barriers to PA: OR=1.97; 95% CI 1.35 to 2.88; p<0.001; high perceived barriers to PA: OR=2.62; 95% CI 1.36 to 5.05; p=0.004), anxiety (medium perceived barriers to PA: OR=2.29; 95% CI 1.58 to 3.32; p<0.001; high perceived barriers to PA: OR=2.55; 95% CI 1.34 to 4.89; p=0.004) and stress (medium perceived barriers to PA: OR=2.62; 95% CI 1.81 to 3.82; p<0.001; high perceived barriers to PA: OR=3.31; 95% CI 1.72 to 6.52; p<0.001). Additionally, online supplemental figure S2 displays the predictive margins for having depression, anxiety or stress for each additional perceived barrier to PA. Thus, the probability of having depression, anxiety and stress was 3.2% (95% CI 2.0% to 4.5%, p<0.001), 3.7% (95% CI 2.4% to 5.1%, p<0.001) and 4.1% (95% CI 2.7% to 5.4%, p<0.001), respectively.

Table 2 shows the results of the logistic regression analyses examining the relationship between perceived barriers to PA and symptoms of depression, anxiety and stress in adolescents before and after adjusting for age, sex, SES, BMI, PA, sedentary behaviour and overall sleep duration. Barrier 8, 'Because I feel that my physical appearance is worse than that of others', was related to a higher likelihood of having depression (OR=2.41; 95% CI 1.35 to 4.28; p=0.003), anxiety (OR=2.65; 95% CI 1.51 to 4.71; p=0.001) and stress symptoms (OR=2.82; 95% CI 1.59 to 5.07; p<0.001). Similarly, barrier 9, 'Because nobody encourages me to engage in physical activity', was related to a higher likelihood of having depression (OR=1.92; 95% CI 1.08 to 3.43; p=0.026), anxiety (OR=1.97; 95% CI 1.11 to 3.50; p=0.021) and stress symptoms (OR=1.99; 95% CI 1.12 to 3.59; p=0.021).

DISCUSSION
Main findings and comparison with previous studies
Overall, the present study is the first to examine the association between the perception of barriers to PA practice and depression, anxiety and stress symptoms. Compared
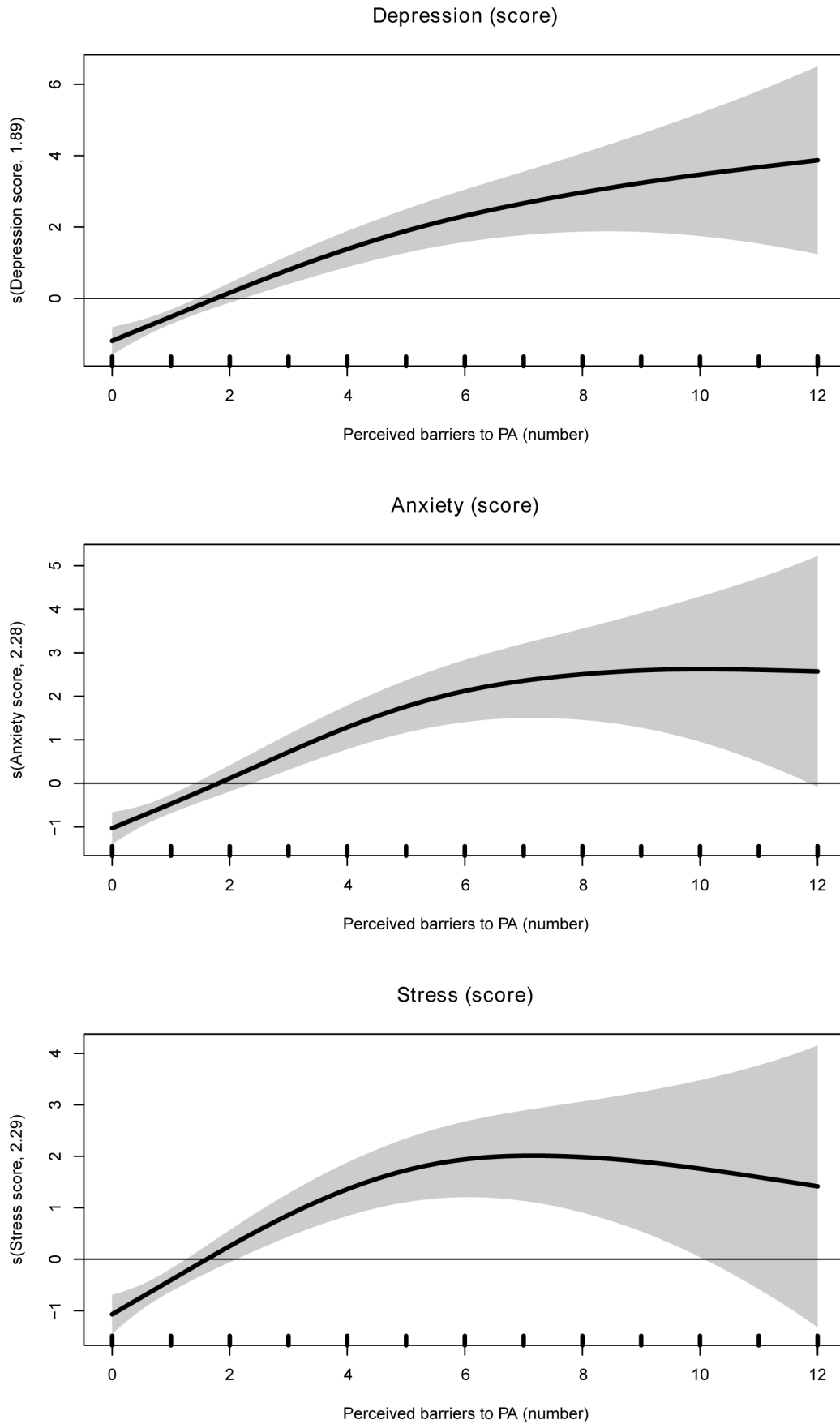
Figure 1 Curvilinear associations between the number of barriers to physical activity (PA) and the number of depression, anxiety or stress symptoms among adolescents. Adjusted for age, sex, socioeconomic status, body mass index, PA, sedentary behaviour and overall sleep duration.
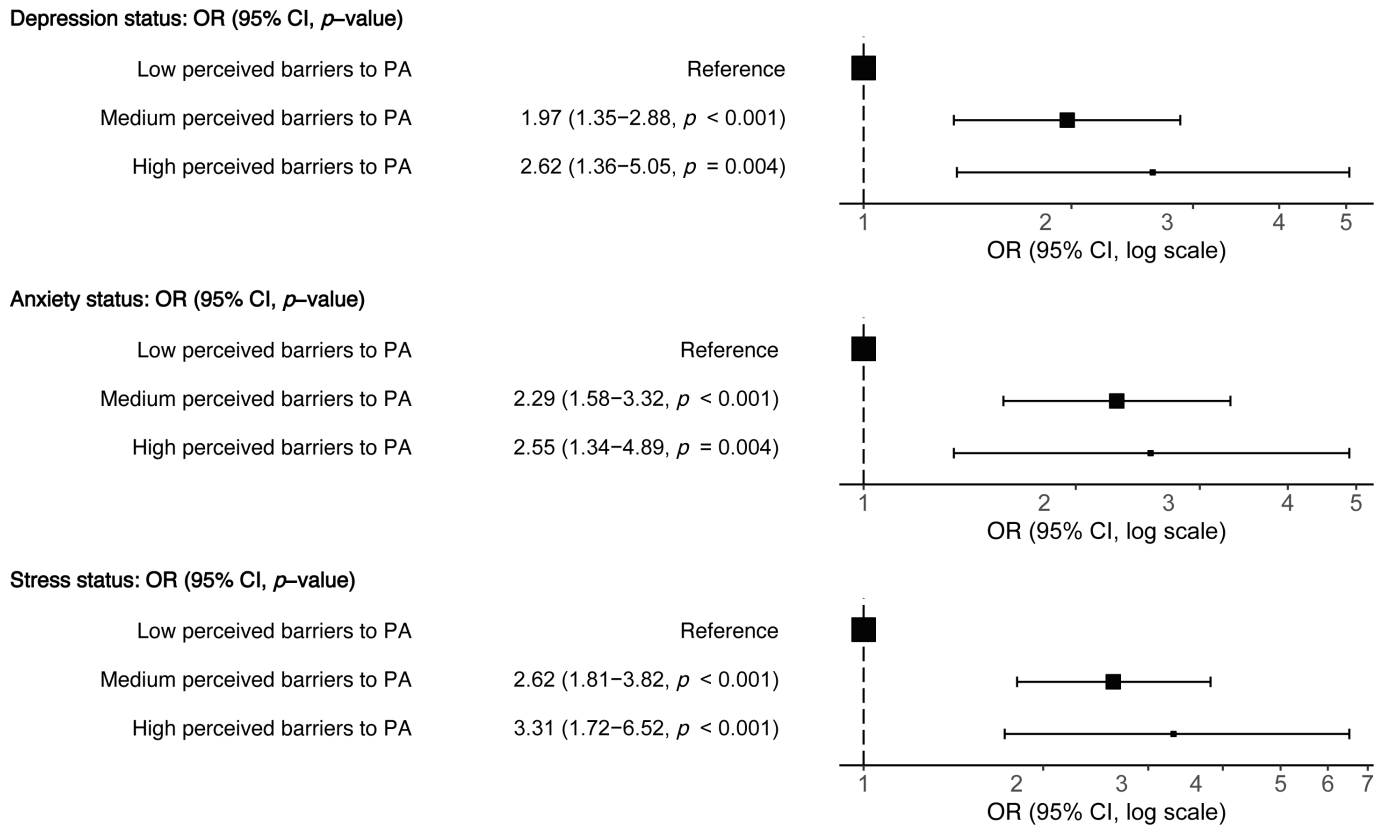
Figure 2 Adjusted ORs and 95% CIs of having depression, anxiety and stress symptoms according to barriers to physical activity (PA) status among adolescents. Adjusted for age, sex, socioeconomic status, body mass index, PA, sedentary behaviour and overall sleep duration.

with adolescents with low perceived barriers to PA (ie, from 0 to 1 barrier), those with two more barriers showed a greater number of depression, anxiety and stress symptoms, as well as a higher likelihood of having depression, anxiety and stress. Specifically, the barriers related to physical appearance and lack of encouragement were associated with higher odds of depression, anxiety and stress after adjusting for several covariates (ie, sociodemographic, socioeconomic, anthropometric and lifestyle variables). Previous studies have identified associations between PA and physical appearance,[40–42] as well as lack of encouragement,[43 44] which may support the present study's findings. For instance, regarding barriers related to physical appearance, the systematic review by Gualdi-Russo et al[40] showed that PA involvement is related to lower concerns about body image perception and enhances body satisfaction (ie, as PA increases, body image dissatisfaction decreases). In relation to barriers linked to lack of encouragement, the systematic review by Mendonça et al[43] indicated that participants who received more overall social support and support from parents, friends and family exhibited higher levels of PA. Furthermore, a study with Brazilian adolescents found that social support from parents and friends was associated with higher moderate to vigorous PA levels. Several factors could explain our findings, such as the relationship between self-perception of physical appearance and mental health symptoms like depression, anxiety and stress; the impact

of social support on these mental health issues; and the influence of PA on depression, anxiety and stress.

First, adolescents who do not conform to societal beauty standards or have different body shapes and sizes (ie, obesity) may experience stigma and discrimination, which can be detrimental to their mental well-being.[42 45] In the same line, adolescents who are dissatisfied with their physical appearance may experience negative body image self-perception, low self-esteem and lower body confidence.[40] On the other hand, comparing themselves to others who may appear to be more physically fit or athletic may further contribute to negative emotions. These feelings and the fear of judgement or scrutiny from others can lead to reluctance to engage in PA,[42 45] especially in public settings.[40] Similarly, negative comments, bullying or feeling judged due to their appearance can significantly impact self-esteem, self-worth and overall psychological health.[41] This, in turn, can create a barrier to engaging in PA, as it may be associated with potential exposure to such negative experiences.[19] A systematic review reported a significantly elevated prevalence of depression and anxiety symptoms in children/adolescents with overweight/obesity in contrast to those without.[42] Given the association between inadequate PA and an energy imbalance, it is reasonable to suggest that weight gain and its potential adverse effects on mental health might serve as a mediator in the association between barriers to PA and heightened symptoms of

Table 2 ORs and 95% CIs of having depression, anxiety and stress symptoms according to specific barriers to physical activity among adolescents (N=765)

Barriers	Depression	
	OR (95% CI, p value) (univariable)	OR (95% CI, p value) (multivariable)
Because I have a lot of homework	1.22 (0.90 to 1.67, p=0.199)	0.83 (0.58 to 1.20, p=0.330)
Because training days don't work well for me	0.95 (0.63 to 1.40, p=0.784)	0.83 (0.51 to 1.31, p=0.430)
Because my friends don't engage in physical activity	1.37 (0.84 to 2.20, p=0.203)	0.81 (0.44 to 1.44, p=0.475)
Because I don't have enough physical fitness	**2.65 (1.74 to 4.05, p<0.001)**	1.12 (0.64 to 1.94, p=0.700)
Because I'm not interested in physical activity	**1.65 (1.01 to 2.67, p=0.041)**	1.37 (0.71 to 2.60, p=0.343)
Because I feel embarrassed about my body when I engage in physical activity	**4.22 (2.88 to 6.22, p<0.001)**	1.67 (0.93 to 2.97, p=0.085)
Because I don't enjoy physical activity	1.22 (0.77 to 1.91, p=0.389)	0.67 (0.35 to 1.27, p=0.228)
Because I feel that my physical appearance is worse than that of others	**4.37 (3.00 to 6.42, p<0.001)**	**2.41 (1.35 to 4.28, p=0.003)**
Because nobody encourages me to engage in physical activity	**2.90 (1.80 to 4.72, p<0.001)**	**1.92 (1.08 to 3.43, p=0.026)**
Because there are no physical activities that I enjoy	**1.87 (1.22 to 2.86, p=0.004)**	1.26 (0.72 to 2.19, p=0.417)
Because I am afraid of making a fool of myself	**3.26 (2.25 to 4.74, p<0.001)**	1.04 (0.60 to 1.78, p=0.892)
Because I consider that I already do enough physical activity in my physical education classes	1.20 (0.68 to 2.07, p=0.513)	0.95 (0.47 to 1.87, p=0.895)
	Anxiety	
	OR (95% CI, p value) (univariable)	OR (95% CI, p value) (multivariable)
Because I have a lot of homework	1.24 (0.92 to 1.68, p=0.158)	0.83 (0.58 to 1.18, p=0.296)
Because training days don't work well for me	1.23 (0.84 to 1.78, p=0.289)	1.14 (0.73 to 1.77, p=0.554)
Because my friends don't engage in physical activity	1.20 (0.74 to 1.93, p=0.446)	0.65 (0.36 to 1.16, p=0.150)
Because I don't have enough physical fitness	**2.99 (1.97 to 4.58, p<0.001)**	1.45 (0.84 to 2.51, p=0.179)
Because I'm not interested in physical activity	**1.74 (1.08 to 2.79, p=0.023)**	1.33 (0.71 to 2.50, p=0.370)
Because I feel embarrassed about my body when I engage in physical activity.	**3.77 (2.58 to 5.56, p<0.001)**	1.40 (0.78 to 2.49, p=0.251)
Because I don't enjoy physical activity	1.38 (0.88 to 2.13, p=0.154)	0.80 (0.43 to 1.47, p=0.475)
Because I feel that my physical appearance is worse than that of others	**4.20 (2.88 to 6.18, p<0.001)**	**2.65 (1.51 to 4.71, p=0.001)**
Because nobody encourages me to engage in physical activity	**2.87 (1.78 to 4.69, p<0.001)**	**1.97 (1.11 to 3.50, p=0.021)**
Because there are no physical activities that I enjoy	**2.12 (1.39 to 3.23, p<0.001)**	1.38 (0.80 to 2.37, p=0.244)
Because I am afraid of making a fool of myself	**2.80 (1.94 to 4.06, p<0.001)**	0.83 (0.47 to 1.41, p=0.490)
Because I consider that I already do enough physical activity in my physical education classes	1.27 (0.73 to 2.16, p=0.389)	0.87 (0.44 to 1.67, p=0.676)
	Stress	
	OR (95% CI, p value) (univariable)	OR (95% CI, p value) (multivariable)
Because I have a lot of homework	1.48 (1.11 to 1.99, p=0.008)	1.05 (0.75 to 1.48, p=0.769)
Because training days don't work well for me	1.15 (0.79 to 1.66, p=0.468)	0.92 (0.60 to 1.42, p=0.722)
Because my friends don't engage in physical activity	1.56 (0.98 to 2.48, p=0.062)	0.97 (0.55 to 1.70, p=0.918)
Because I don't have enough physical fitness	**2.87 (1.88 to 4.43, p<0.001)**	1.36 (0.78 to 2.37, p=0.284)
Because I'm not interested in physical activity	**1.80 (1.12 to 2.89, p=0.015)**	1.40 (0.75 to 2.62, p=0.294)
Because I feel embarrassed about my body when I engage in physical activity	**3.38 (2.31 to 5.00, p<0.001)**	1.05 (0.58 to 1.87, p=0.878)

Table 2 Continued

	Stress	
	OR (95% CI, p value) (univariable)	**OR (95% CI, p value) (multivariable)**
Because I don't enjoy physical activity	1.42 (0.92 to 2.20, p=0.109)	0.89 (0.48 to 1.62, p=0.707)
Because I feel that my physical appearance is worse than that of others	**4.21 (2.86 to 6.27, p<0.001)**	**2.82 (1.59 to 5.07, p<0.001)**
Because nobody encourages me to engage in physical activity	**2.83 (1.74 to 4.67, p<0.001)**	**1.99 (1.12 to 3.59, p=0.021)**
Because there are no physical activities that I enjoy	**2.22 (1.46 to 3.40, p<0.001)**	1.55 (0.91 to 2.67, p=0.109)
Because I am afraid of making a fool of myself	**2.96 (2.04 to 4.31, p<0.001)**	0.95 (0.55 to 1.62, p=0.861)
Because I consider that I already do enough physical activity in my physical education classes	0.92 (0.53 to 1.56, p=0.751)	0.55 (0.28 to 1.07, p=0.085)

Adjusted for age, sex, socioeconomic status, body mass index, physical activity, sedentary behaviour and overall sleep duration. Bold indicates a p value < 0.05.

depression, anxiety and stress. Future prospective studies are necessary to explore this potential pathway.

On the other hand, social support has been cross-sectionally and longitudinally associated with the practice of PA in adolescents.[43] Otherwise, having social support that encourages and participates in PA can positively influence mental health outcomes.[43 46] However, when individuals perceive a lack of support or encouragement from their friends, family or community, it can undermine their motivation and confidence to engage in physical activities.[43 46] Furthermore, the absence of a supportive environment can increase feelings of loneliness and isolation, which are risk factors for depression, anxiety and stress.[10 27 47 48] Therefore, increasing parents' and friends' encouragement to higher practice of PA among adolescents can be essential.[44] For instance, de Camargo et al[44] showed that Brazilian adolescents who received social support from parents or friends had greater odds of engaging in PA and meeting the PA WHO recommendations.[49] Additionally, the literature has shown that doing PA together,[44] watching other adolescents doing it,[43] talking about PA with other adolescents, praising[46] and providing support for active commuting[50] can contribute to adolescents being physically active.

Additionally, regular PA is an effective coping mechanism for managing and reducing symptoms of stress, anxiety and depression.[10 27 47 48] When individuals face barriers to PA related to physical appearance or lack of social support, they may lose out on the benefits of exercise as a coping strategy.[10 27 47 48] And, without these beneficial effects, they may struggle to find alternative healthy ways to manage their mental health, leading to a higher likelihood of experiencing symptoms of depression, anxiety and stress.[10 27 47 48] An overview of systematic reviews, which included the results of 97 reviews (1039 trials and 128 119 participants), synthesised the evidence on the effects of PA interventions on symptoms of depression, anxiety and psychological distress and showed that PA can be effective in reducing mild-to-moderate

symptoms of depression, anxiety and psychological distress compared with usual care.[47] In the present study, some barriers related to PA (self-perceived physical appearance and lack of social support) were associated with an increased likelihood of depression, anxiety and stress. These barriers may lead to a lower level of PA in adolescents, which could lead to greater symptoms of depression, anxiety and stress. Understanding perceived barriers to PA practice may contribute to developing strategies to promote PA for this population,[19] and improve their mental health.[47]

This study was not without limitations. First, the cross-sectional study does not establish cause-and-effect associations. Although the causal relationship between healthy behaviours (eg, PA, adequate sleep and low perceived barriers to PA) and mental health problems remains unclear, evidence suggests a significant association between these variables. Furthermore, the self-report questionnaires used in this study may lead to social desirability and recall bias. On the other hand, this study has some strengths that must be recognised. For instance, this is the first study to examine the relationship between perceived barriers to PA and depression, anxiety and stress symptoms in a sample of Spanish adolescents. Moreover, the analyses presented were adjusted for numerous covariates that could influence the results obtained, providing greater robustness to the findings. However, residual confusion is still possible. Despite these limitations, the implications of this study for adolescent health and exercise programmes are significant, suggesting that interventions should focus on addressing perceived barriers to PA. Potential intervention designs could include programmes that enhance social support from family and peers, which is related to PA levels and mental health outcomes. Additionally, efforts to improve adolescents' body image and self-esteem could reduce the impact of physical appearance-related barriers. Future steps could involve developing comprehensive school-based programmes incorporating these elements,

promoting an environment that supports regular PA and concurrently addresses mental health.

CONCLUSIONS

The results showed that perceiving barriers related to physical appearance and perceiving a lack of social support seem to be associated with symptoms of depression, anxiety and stress in adolescents. One of the most relevant practical applications of this study is that promoting PA by reducing some specific barriers could be an important step in reducing symptoms of depression, anxiety and stress in adolescents.

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