

CAN SELF-ESTEEM MEDIATE THE ASSOCIATION BETWEEN SOCIAL SUPPORT AND DIFFERENT LEVELS OF PHYSICAL ACTIVITY IN ADOLESCENTS?

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Abstract:

The aim was to analyze the mediation role of self-esteem in the interaction between social support from the best friend, friends, and parents, and physical activity (PA). Participants were N=444 adolescents of both genders (male= 205), aged between 12-18 years (M= 16.02; SD= 1.57). Structural equation modeling, serial mediation and multigroup analysis were used to test the proposed hypothesis. Self-reported instruments were used to collect both PA social support and self-esteem. Self-esteem mediates partially the interaction between different social supports and vigorous PA, independently of adolescent sex. Interestingly, self-esteem was fully mediating the interaction between parents' social support and vigorous PA in female adolescents. In contrast, self-esteem revealed no mediation in the interaction between social support and light and moderate PA. In conclusion, self-esteem mediates the relationship between social support and vigorous PA, the strength of mediation is higher in girls than in boys, in both genders the mediation is higher when the social support has come from parents.

Key words: *friends, parents, vigorous physical activity, best friends, self-worth, youth*

Introduction

Physical activity (PA) participation is of utmost importance since it represents a healthy way to reduce chronic diseases and mortality (WHO, 2018). The evidence on the health benefits of PA is considerable, overwhelming, and irrefutable. The benefits are not only evident in the prevention of physical diseases (Warburton & Bredin, 2017) but also in the area of mental health and well-being (Fox, 1999; Pascoe, et al., 2020), and even in social relationships (Di Bartolomeo & Papa, 2019). Despite this evidence, PA levels of the adolescent world population are low. For instance, in 2016, 81% of students aged 11–17 years, according to the current WHO recommendation (WHO, 2020; participating in 60 min of daily PA of moderate to vigorous intensity or being active for at least 60 min on five days per week), were insufficiently physically active (Guthold, Stevens, Riley, & Bull, 2020).

Adolescence is a life period of dramatic changes, from somatic to psychological ones. Social interactions play an important role among adoles-

cents; parents, peers, friends as well best friends may cause behavioral and lifestyle changes, namely, they all may influence the young whether be or not to be physically active and involved in exercise and sports (Gill, et al., 2018). In addition, adolescence is known as a period when PA levels decline (Dumith, Gigante, Domingues, & Kohl, 2011; Farooq, et al., 2018). Several factors could contribute to PA levels in adolescents. For instance, Sallis, Prochaska, and Taylor (2000), in a review study about the correlates of PA in children and adolescents, identified a pool of psychosocial variables related to adolescents' (13 to 18 years) PA, namely social support from parents and from others: peers, friends as well as the best friend (Gill, et al., 2018; Mendonca, Cheng, Melo, & De Farias Junior, 2014).

Social support can have a beneficial effect on a person's health and emotional state acting as a motivating factor in positive health behaviors (Uchino, Cacioppo, & Kiecolt-Glaser, 1996) and can be carried out in several ways: emotional, instrumental, informational and appraisal support

(Birch, 1998). In a systematic review (Mendonca, et al., 2014), it was found that social support was positive and consistently associated with the PA level of adolescents in cross-sectional and longitudinal studies. Those who received more overall social support as well as support from both parents, friends and family showed higher levels of PA. Although parents are important actors in the social support for adolescents' PA, friends play a crucial role (Cheng, Mendonça, & Júnior, 2014; Lopes, Gabbard, & Rodrigues, 2013; Marks, de la Haye, Barnett, & Allender, 2015).

Several theories considering psychosocial determinants have been proposed to explain PA (Glanz, Rimer, & Viswanath, 2015) such as the social cognitive theory (Bandura, 1998), the health belief model (Janz & Becker, 1984), the theory of planned behavior (Ajzen, 1991), the transtheoretical model (Prochaska & DiClemente, 1982), as well as the self-determination theory (Ryan & Deci, 2018). These theories have mainly been applied to adults and are based on cognitive reflections, which allow for conscious behavioral control, therefore, they may not work well in adolescents. Adolescents' brains are still in the state of development having limited cognitive control (Andrews-Hanna, et al., 2011; Luna, 2009)

Harter (1987) proposed the self-worth model to explain motivation for behavior of children and adolescents (8 to 18 years). The model is based on a developmental perspective and simultaneously considers the social and emotional factors (Harter & Marold, 1991). In Harter's model, social support and perceived competence predict self-esteem (Harter, 1987, 1993). Weiss and Ebbeck (1996) adapted the Harter's model to PA domain proposing that self-esteem was associated with PA levels. Perceived competence and social support are determinants of self-esteem and enjoyment and PA are outcomes (Weiss, 2000).

Self-esteem has been recognized as a major determinant of behavior throughout the history of educational and social psychology. Some researchers have suggested that self-esteem is a unidimensional construct reflecting a general view of the self (e.g. Rosenberg, 1979). Nevertheless, self-concept researchers, who have relied primarily on the single self-concept, have not provided strong support for their interpretations (Harter & Marold, 1991). There is a general agreement among researchers that self-esteem is a multifaceted, hierarchical, and dynamic construct (Harter & Marold, 1991; Marsh & Redmayne, 1994; Marsh, Smith, & Barnes, 1983). Shavelson, Hubner, and Stanton (1976) proposed a model where general self-concept was at the apex of a hierarchy with academic self-concept, social self-concept, emotional self-concept, and physical self-concept being considered as the second-order

factors. Fox and Corbin (1989) proposed a multidimensional and hierarchical model of physical self-concept, which is consistent with Shavelson et al.'s approach. The model posits global self-esteem at the apex of a hierarchy, followed by the physical self-worth at the domain level, and sport competence, attractive body, physical strength, and physical condition at the sub-domain levels. Additionally, they have devised the Physical Self-Perception Profile (PSPP), which assesses the four specific facets of physical self-concept as well as the global self-esteem and the physical self-worth (Fox & Corbin, 1989). The PSPP is an instrument widely used and validated (e.g., Bernardo & Matos, 2003; Karteroliotis, 2008; Nezhad, Nordentoft, Gildeh, & Stelter, 2011; Page, Fox, Biddle, & Ashford, 1993; Welk & Eklund, 2005).

Early and more recent self-esteem theorists have also suggested that self-esteem is a dynamic, changing construct depending on one's successes and expectations (Baldwin & Hoffmann, 2002). Quick physical, emotional, and social relationship changes during adolescence could be demanding and stressful, putting adolescents at risk of a decrease in self-esteem (Baldwin & Hoffmann, 2002; Robins & Trzesniewski, 2005). During adolescence, self-esteem is a dynamic rather than a static construct (Baldwin & Hoffmann, 2002).

Physical activity, exercise and sports practice may be seen as factors that have the potential to stabilize or enhance physical self-perception and self-esteem during adolescent years (Bowker, 2003; Fox, 2000). Engagement in physical exercise contributed to a positive body image and positive health perceptions among undergraduate students (Korn, Gonen, Shaked, & Golan, 2013). In a systematic review (Ekeland, Heian, & Hagen, 2005), it was found that exercise might have short term beneficial effects on self-esteem in adolescents. A meta-analysis (Liu, Wu, & Ming, 2015) found that PA interventions were associated with increased self-concept and self-esteem in adolescents. Other studies found that global self-esteem was associated with increased PA levels, acting as a mediator between pubertal development in girls at age 11 and PA at age 13 (Davison, Werder, Trost, Baker, & Birch, 2007), and being a predictor of PA levels during an 8-month period (Neumark-Sztainer, Story, Hannan, Tharp, & Rex, 2003). On the other hand, Inchley, Kirby, and Currie (2011) found that high self-esteem was associated with PA among girls but not among boys.

It was suggested (Harter, 1987; Weiss, 2000, 2008) that PA, social support and perceived competence for PA improve self-esteem. In addition, high self-esteem will cause a positive affect, that is, enjoyment in PA. Moreover, PA enjoyment and self-esteem are hypothesized to predict the amount

of PA. This model was tested by Jekauc et al. (2019), and they concluded that the prominent role of self-esteem in the model could not be confirmed. Despite important insights provided by previous literature (Ekeland, et al., 2005), there are still some issues that should be addressed, especially in terms of the relationship between PA and global self-esteem as well as in terms of the mediation role of global self-esteem between social support and different levels of PA (Jekauc, et al., 2019).

Therefore, the aim of the present study was to analyze the mediation role of global self-esteem in the interaction between social support from the best friend, friends and parents, and different intensity levels of PA, including light, moderate and vigorous ones, in male and female adolescents. More specifically, in agreement with the above-mentioned literature, we hypothesized that: (a) global self-esteem mediates the association between social support from the best friend, friends and parents with different PA intensity levels, including light, moderate and vigorous PA; (b) social support from the best friend, friends and parents should be associated positively with global self-esteem; (c) social support from the best friend, friends and parents should be associated positively with moderate and vigorous PA; (d) social support from the best friend, friends and parents should be associated positively, but not significantly with light PA in both sexes, and (e) global self-esteem should be positively associated with light, moderate and vigorous PA.

Methods

Participants and procedures

Participants were recruited from six different secondary schools in the north of Portugal. All students aged 12-18 years in the contacted schools were invited to participate and refusal was minimal (0.01%). To be eligible for this study, potential participants needed to be aged between 12 and 18 years, the age period accepted to correspond to adolescence (Sacks, 2003). Participants were N=444 adolescents (male= 205), aged 12-18 years (M= 16.02; SD= 1.57). School directors provided their authorization for data gathering. Written informed consent was obtained from participants' parents or legal tutors. Adolescents gave their verbal consent prior to data collection. Before data collection, the study was approved by the ethics committee of the institution of the first author, process No. 290221. All procedures were in accordance with the Helsinki declaration (2013) and its later amendments (World Medical Association, 2013).

The surveys were filled out in a classroom during school hours. Before students started to answer the surveys, researchers, who collected all the data, explained the objective of each questionnaire, and removed any doubt.

Instruments

Physical activity

Physical activity behavior was assessed via the International Physical Activity Questionnaire (IPAQ) – short form (Craig, et al., 2003; Hagströmer, et al., 2008). This questionnaire was self-administered. It referenced to the last seven days of the recalled PA and asked about the three specific types of activity: leisure time, domestic activities, e.g., gardening/yard activities or work activities (for the purpose of the present study, this last domain was replaced with school related PA, including activity during physical education classes and breaks), and transport-related activity. Furthermore, three specific levels of PA intensity were assessed: walking, moderate (MPA) and vigorous (VPA). Frequency was measured in days per week and duration was measured by time per day, which was collected individually for each specific type of activity. The items were organized to offer a distinct score on walking, moderate and vigorous PA as well as a combined global score of PA level, which was given in metabolic equivalents per minutes per week (e.g., MET-min⁻¹ · week⁻¹), using the following formulas: Walking: MET-min · week⁻¹ = 3.3 × walking minutes × walking days; Moderate: MET-min · week⁻¹ = 4.0 × moderate-intensity activity minutes × moderate days; Vigorous: MET-min week⁻¹ = 8.0 × vigorous-intensity activity minutes × vigorous-intensity days. More details about this questionnaire are available at <https://sites.google.com/site/theipaq/>. The short version of the IPAQ has been tested extensively with the reported reliability and validity of .80 and .30, respectively (Craig, et al., 2003). Using a sample of adolescents, the reported reliability was .49 to .83 and validity .24 to .55 (Guedes, Lopes, & Guedes, 2005).

Psychosocial variables

The Portuguese version of the Physical Self-Perception Profile for Children and Youth (PSPP-CY) (Bernardo & Matos, 2003) was used to measure global self-esteem. The PSPP-CY consists of 36 items and uses Harter's (1982) structured alternative format designed to minimize the tendency towards socially desirable responses. This instrument has six subscales: sport competence, physical condition, attractive body, physical strength, physical self-worth, and global self-esteem. Each subscale consists of six items in which participants are presented with two contrasting descriptions (e.g., those with unattractive bodies and those with attractive bodies) and are asked which description is most like themselves and whether the description they select is "sort of true" or "really true" for them. Item scores can range from 1 to 4. A value of 3 or 4 represents a positive perception and a value of 2 or 1

a negative perception. The result of each subscale is obtained with an average of six items belonging to the scale. The reported internal consistency (alpha) for the different subscales was between 0.73 and 0.85, while test-retest reliability was between 0.71 and 0.77 (Bernardo & Matos, 2003). Test-retest reliability for our study sample varied between 0.63 and 0.91.

For the purpose of the present study, we used only the global self-esteem subscale. The CFA of this subscale displayed the following fit: ($\chi^2=70.01$ (9); $SRMR=.048$; $B-Sp <.001$; $RMSEA=.078$ [$90\%CI=.062, .081$]; $TLI=.907$; $CFI=.917$). Internal consistency showed a suitable value (.78).

Perception of social support from the best friend, friends and parents was assessed through a Portuguese adaptation of the Friend Support Scale (Jago, Page, & Cooper, 2012), which is an adaptation of Prochaska, Rodgers, and Sallis' Peers Support Scale (2002). The only difference was the item stem used before items-questions. In the case of the best friend, the following stem was used: "How often does your best friend...?"; regarding parents, the following stem was used: "How often do your parents...?"; in terms of friends, the following stem was used: "How often do your friends...?". The following items-questions were used: (1) ... encourage you to exercise or do sports?; (2) ... exercise or do sports with you?; (3) ... tell you that you are doing well in exercise or sports?; and (4) ... watch you take part in exercise or sports?. The CFA of this questionnaire was the following: ($\chi^2=16.76$; $SRMR=.026$; $B-Sp <.001$; $RMSEA=.077$ [$90\%CI=.061, .080$]; $TLI=.946$; $CFI=.982$); ($\chi^2=53.42$; $SRMR=.069$; $B-Sp <.001$; $RMSEA=.067$ [$90\%CI=.059, .078$]; $TLI=.9006$; $CFI=.918$); ($\chi^2=6.12$; $SRMR=.018$; $B-Sp=.236$; $RMSEA=.057$ [$90\%CI=.003, .117$]; $TLI=.981$; $CFI=.994$), for the best friend, parents and friends' social support, respectively. Posteriorly, the items-questions were grouped into a single factor, which aimed at the social support from the best friend, friends, and parents. Internal consistency showed suitable values of each social support: the best friend social support (.86); friends social support (.82) and parents social support (.77).

Statistical analysis

Data were initially screened for missing values and normality. Descriptive statistics and bivariate correlations were calculated using IBM SPSS STATISTICS v.23. Data were imputed in participants with missing values >5% using the multiple imputation approach (Allison, 2000).

According to Fritz and Mackinnon (2007), the present sample size was in line with simulations for mediation purposes with this number of variables, thus, ensuring proper statistical power. Finally, multicollinearity diagnoses through tolerance and

variance inflation factor (VIF) were performed as proposed by Hair, Babin, Anderson, and Black (2019), considering scores ≤ 10 as acceptable.

For hypothesis testing, parallel mediation procedures (model 4) of Hayes (2018) were developed using IBM SPSS macro-PROCESS v.3.5 and according to Hayes, suggestions. This procedure allows the estimation of the direct and indirect effects in the proposed models, while controlling for k mediators influence between variables. Additionally, when the independent variables are significantly correlated, it is advised to beware of possible variables influence in the proposed test. Thus, the independent variables not considered in each model were included as covariates to account for their effects in the proposed models (Hayes, 2018).

In all variable interactions, bias-correct bootstrapped point estimates were calculated (considering standard errors and 95% CI). A 5000 samples bootstrap was used according to several authors' recommendations (Hayes, 2018; Williams & MacKinnon, 2008), and significant indirect effects were considered if the confidence interval did not include zero ($\alpha = .05$). The ratio of total indirect effect over total effect (PM) was calculated to quantify mediation strength (Shrout & Bolger, 2002).

Results

Preliminary analysis

Regarding normal distribution, no univariate outliers were observed. The results showed that both in tolerance and VIF tests scores were above 0.1 and below 10, respectively, ensuring the appropriate conditions to test the regression model.

Descriptive results (Table 1) revealed that the participants perceived higher social support from friends and the best friend than from parents. In addition, all the bivariate correlations were positive and significant, except for the associations across different social support and self-esteem with light and moderate PA.

Table 2 shows the results of the mediation models between social support from the best friend (model 1), friends (model 2), and parents (model 3), and different levels of PA via self-esteem for the whole sample. Overall, partial mediation appeared in all the models with VPA, since the total indirect effect was significant, but not higher than the total direct effect. In addition, the mediator self-esteem explained .21, .41, and .06 for models 1, 2 and 3, respectively, of the interaction between different sources of social support and VPA. No mediation was observed with walking and MPA.

Table 3 shows the results of the mediation models in the female sample. Partial mediation occurred in models 1 and 2 and full mediation in model 3. In the case of models 1 and 2, partial medi-

Table 1. Descriptive statistics and zero order bivariate correlations

Whole sample								
Variables	M	SD	1	2	3	4	5	6
1. SS-BF	3.10	.75	-	-	-	-	-	-
2. F-SS	3.14	.64	.70**	-	-	-	-	-
3. P-SS	2.72	.75	.36**	.36**	-	-	-	-
4. GSE	2.74	.54	.23**	.34**	.14**	-	-	-
5. WPA	842.46	1033.07	.01	-.03	.03	-.01	-	-
6. MPA	763.28	798.83	.05	.03	.03	.06	.22**	-
7. VPA	1842.49	1529.23	.14**	.11*	.08	.16**	.14**	.35**
Female sample								
Variable	M	SD	1	2	3	4	5	6
1. SS-BF	3.07	.79	-	-	-	-	-	-
2. F-SS	3.11	.69	.71**	-	-	-	-	-
3. P-SS	2.73	.75	.43**	.48**	-	-	-	-
4. GSE	2.72	.55	.22**	.39**	.17**	-	-	-
5. WPA	891.43	1094.53	-.01	-.05	-.02	-.06	-	-
6. MPA	789.25	907.71	.07	.05	.05	.06	.24**	-
7. VPA	1867.92	1541.32	.10*	.06*	.26**	.15**	.18**	.40**
Male sample								
Variables	M	SD	1	2	3	4	5	6
1. SS-BF	3.12	.71	-	-	-	-	-	-
2. F-SS	3.19	.57	.70**	-	-	-	-	-
3. P-SS	2.72	.75	.27**	.20**	-	-	-	-
4. GSE	2.78	.53	.24**	.24**	.14*	-	-	-
5. WPA	779.97	947.88	.03	.01	.02	.08	-	-
6. MPA	730.15	634.04	.02	.01	.04	.09	.19**	-
7. VPA	1810.05	1516.85	.20**	.20**	.16**	.18**	.08	.29*

Note. M = mean; SD = standard deviation; BF-SS = best friend social support; F-SS = friend's social support; P-SS = parents' social support; GSE = global self-esteem; WPA = walking; MPA = moderate physical activity; VPA = vigorous physical activity; ** $p < .01$; * $p < .05$.

ation was observed with VPA, since the total indirect effect was significant but not higher than the total direct effect. In the case of model 3, full mediation was identified since the total indirect effect was significant and higher than the total direct effect. Furthermore, the mediator self-esteem explained .31, .16, and .67 for models 1, 2 and 3, respectively, of the interaction between different social supports and VPA. However, in model 1, both in terms of walking and moderate physical activity, the mediation was not observed since the indirect effect was not significant. In model 1 (walking) and model 2 (MPA), no mediation was observed.

Table 4 shows mediation models between social support from the best friend, friends, and parents, and different levels of PA via self-esteem in male sample. In general, partial mediation emerged in all models with VPA, since the total indirect effect was significant but not higher than the total direct effect. In addition, the mediator self-esteem explained .18, .20, and .56 for model 1, 2 and 3, respectively, of the interaction between different social supports and VPA. Regarding the models with walking and moderate PA as an outcome variable, no mediation was observed because the total indirect effect was not significant.

Table 2. Mediation analysis – the whole sample

Models	Paths	β	CI -95%	Total indirect effect
Model 1	BF-SS→GSE	.19	[.102, .204]	-.001ns
	BF-SS→WPA	.01	[-.115, .134]	
	GSE→WPA	-.01	[-.181, .162]	
	BF-SS→GSE	.19	[.102, .204]	.02ns
	BF-SS→MPA	.11	[.071, .275]	
	GSE→MPA	.05	[-.072, .177]	
	BF-SS→GSE	.19	[.102, .204]	.04 [.014; .071]
	BF-SS→VPA	.15	[.025, .271]	
	GSE→VPA	.25	[.078, .275]	
Model 2	F-SS→GSE	.28	[.210, .357]	.004 ns
	F-SS→WPA	-.06	[-.208, .096]	
	GSE→WPA	.02	[-.163, .195]	
	F-SS→GSE	.28	[.210, .357]	.03 ns
	F-SS→MPA	.01	[-.139, .165]	
	SE→MPA	.11	[-.065, .192]	
	F-SS→GSE	.28	[.210, .357]	.07 [.024; .126]
	F-SS→VPA	.10	[.048, .252]	
	GSE→VPA	.26	[.079, .433]	
Model 3	P-SS→GSE	.10	[.036, .168]	-.001 ns
	P-SS→WPA	-.02	[-.186, .153]	
	GSE→WPA	.05	[-.019, .019]	
	P-SS→GSE	.10	[.036, .168]	.01 ns
	P-SS→MPA	.09	[-.071, .269]	
	GSE→MPA	.03	[-.093, .150]	
	P-SS→GSE	.10	[.036, .168]	.03 [.009, .053]
	P-SS→VPA	.29	[.124, .459]	
	GSE→VPA	.10	[.023, .233]	

Note. Model 1 = best-friend social support (independent variable), GSE = global self-esteem (mediator). WPA (walking), MPA (moderate physical activity), and VPA (vigorous physical activity) are dependent variables. Model 2 = friends social support (independent variable), SE = self-esteem (mediator). WPA (walking), MPA (moderate physical activity), and VPA (vigorous physical activity) are dependent variables. Model 3 = parents social support (independent variable), SE = self-esteem (mediator). WPA (walking), MPA (moderate physical activity), and VPA (vigorous physical activity) are dependent variables. BF-SS = best-friend social support; F-SS = friends social support; P-SS = parents social support; β = effects; CI 95% = confidence interval.

Table 3. Mediation analysis – the female sample

Models	Paths	β	CI -95%	Total indirect effect
Model 1	BF-SS→GSE	.16	[.073, .241]	-.02ns
	BF-SS→WPA	.07	[-.162, .176]	
	GSE→WPA	.11	[-.349, .133]	
	BF-SS→GSE	.16	[.073, .241]	.01ns
	BF-SS→MPA	.08	[-.096, .265]	
	GSE→MPA	.09	[-.167, .349]	
	BF-SS→GSE	.16	[.073, .241]	.04 [.016; .112]
	BF-SS→VPA	.10	[.064, .253]	
	GSE→VPA	.25	[.078, .275]	
Model 2	F-SS→GSE	.31	[.223, .405]	-.02 ns
	F-SS→WPA	-.06	[-.263, .147]	
	GSE→WPA	.08	[.177, .332]	
	F-SS→GSE	.31	[.223, .405]	.03 ns
	F-SS→MPA	.04	[-.177, .263]	
	GSE→MPA	.10	[.076, .370]	
F-SS→GSE	.31	[.223, .405]	.09 [.021; .164]	
F-SS→VPA	.08	[.091; .195]		
GSE→VPA	.27	[.034, .515]		
Model 3	P-SS→GSE	.13	[.037, .217]	-.01 ns
	P-SS→WPA	-.02	[-.196, .157]	
	GSE→WPA	.11	[-.339, .137]	
	P-SS→GSE	.13	[.037, .217]	.01 ns
	P-SS→MPA	.07	[-.120, .258]	
	GSE→MPA	.10	[.153, .357]	
	P-SS→GSE	.13	[.037, .217]	.04 [.007, .067]
	P-SS→VPA	.13	[.067, .165]	
GSE→VPA	.28	[.051, .501]		

Note. Model 1 = best-friend social support (independent variable), GSE = global self-esteem (mediator). WPA (walking), MPA (moderate physical activity), and VPA (vigorous physical activity) are dependent variables. Model 2 = friends social support (independent variable), SE = self-esteem (mediator). WPA (walking), MPA (moderate physical activity), and VPA (vigorous physical activity) are dependent variables. Model 3 = parents social support (independent variable), SE = self-esteem (mediator). WPA (walking), MPA (moderate physical activity), and VPA (vigorous physical activity) are dependent variables. BF-SS = best-friend social support; F-SS = friends social support; P-SS = parents social support; β = effects; CI 95% = confidence interval.

Table 4. Mediation analysis – the male sample

Models	Paths	β	CI -95%	Total indirect effect
Model 1	BF-SS→GSE	.18	[.077, .279]	.03ns
	BF-SS→WPA	.02	[-.169, .203]	
	GSE→WPA	.14	[-.109, .388]	
	BF-SS→GSE	.18	[.077, .279]	.03ns
	BF-SS→MPA	.04	[-.156, .165]	
	GSE→MPA	.13	[.089, .341]	
	BF-SS→GSE	.18	[.077, .279]	.05 [.003; .105]
	BF-SS→VPA	.24	[.040, .433]	
	GSE→VPA	.26	[.007, .517]	
Model 2	F-SS→GSE	.22	[.098, .348]	.03 ns
	F-SS→WPA	-.02	[-.244, .173]	
	GSE→WPA	.15	[.101, .397]	
	F-SS→GSE	.22	[.098, .348]	.03 ns
	F-SS→MPA	-.03	[-.226, .173]	
	GSE→MPA	.13	[.080, .350]	
	F-SS→GSE	.22	[.098, .348]	.06 [.006, .135]
	F-SS→VPA	.29	[.042; .503]	
	GSE→VPA	.26	[.066, .519]	
Model 3	P-SS→GSE	.07	[.025, .168]	.01 ns
	P-SS→WPA	.13	[.038, .199]	
	GSE→WPA	.13	[.116, .367]	
	P-SS→GSE	.07	[.025, .168]	.01 ns
	P-SS→MPA	.14	[.009, .282]	
	GSE→MPA	.11	[.100, .316]	
	P-SS→GSE	.07	[.025, .168]	.05 [.004, .063]
	P-SS→VPA	.16	[.116, .245]	
	GSE→VPA	.32	[.061, .580]	

Note. Model 1 = best-friend social support (independent variable), GSE = global self-esteem (mediator). WPA (walking), MPA (moderate physical activity), and VPA (vigorous physical activity) are dependent variables. Model 2 = friends social support (independent variable), SE = self-esteem (mediator). WPA (walking), MPA (moderate physical activity), and VPA (vigorous physical activity) are dependent variables. Model 3 = parents social support (independent variable), SE = self-esteem (mediator). WPA (walking), MPA (moderate physical activity), and VPA (vigorous physical activity) are dependent variables. BF-SS = best-friend social support; F-SS = friends social support; P-SS = parents social support; β = effects; CI 95% = confidence interval.

Discussion and conclusions

The aim of the present study was to analyze the mediation role of global self-esteem in the interaction between social support from the best friend, friends, and parents, and different levels of PA, including light (walking), moderate and vigorous ones, in male and female adolescents. Overall, hypotheses (a), (c), (d), and (e) were partially confirmed, while hypothesis (b) was fully confirmed. The zero-order correlation among

different sources of social support presented higher values, while lower values were observed across different sources of social support and global self-esteem (moderate to low association) as well as with different levels of PA (low associations). However, most of these bivariate correlations are significant. Therefore, it seems that all the studied variables will interact with each other and are important to explain PA levels in adolescents, namely VPA.

As predicted, social support was found to positively predict MPA and VPA but not walking, although parents' social support was only significant in the case of VPA. Friends seem to be a more important source of social support in both male and female adolescents. For instance, in a study developed by Stearns et al. (2019) it was found that, in girls, the female best friends exhibited more similar levels of overall PA than the non-friends did, whereas in boys similar PA levels were only presented among best friends. Similar results were found by Lopes et al. (2013) and Lopes, Gabbard, and Rodrigues (2015). The findings of the present study confirm what has been observed in previous studies (Duncan, Duncan, & Strycker, 2005; Hohepa, Scragg, Schofield, Kolt, & Schaaf, 2007; King, Tergerson, & Wilson, 2008) and demonstrate that social support is an important component of PA promotion in adolescents.

The results showed that the mediation effect of self-esteem only exists between the association of the different sources of social support (the best friend, friends, and parents) with VPA, and not with walking or MPA. Furthermore, the mediation strength is different for girls and boys. For boys and girls altogether, self-esteem partially mediates social support and VPA, this mediation being stronger in the case of a friend's social support.

For girls, self-esteem also partially mediates the associations between the best friend and friends' social support with VPA, but it fully mediates the relationship between parents' social support and VPA. For boys, self-esteem only partially mediates the associations between social support and VPA and the effect of this mediation is higher in the relationship between parents' social support and VPA. These differences maybe lay in the difference between boys and girls in their perception of social support. Indeed, some studies showed differences between adolescent boys and girls in perceived social support (Gill, et al., 2018; Väänänen, Marttunen, Helminen, & Kaltiala-Heino, 2014). The present results mean that, for adolescents, social support from friends is more relevant than from best friends and parents. However, parents' social support leads to higher self-esteem, and then the higher his or her self-esteem will be leading them to attain greater VPA. These results are in line with literature in this research field. For instance, in a systematic review it was found that those adolescents who received more support from both parents and friends showed higher levels of physical activity (Mendonca, et al., 2014). Gill et al. (2018) found that support from family and friends were both consistently strong predictors of adolescents' PA. The practice of VPA is more demanding in terms of motivation and commitment, therefore it requires greater social support, and usually this level of intensity is reached in structured physical practices like sport.

According to Howie, Daniels, and Guagliano's (2018) review, and in line with our results, friendships were key to both initiation and maintenance of sports participation, whereas parents facilitated participation.

According to Harter's model of self-esteem (Harter, 1987), adapted by Weiss and Ebbeck (1996) for PA domain, the main factors for participating in PA are enjoyment, perceived competence, and social support. Self-esteem acts as the mediator of perceived competence and social support in the relationship with PA. Our results show that, in fact, self-esteem could act as the mediator, but only with VPA. It makes sense, since VPA practice needs more motivation and effort than light and moderate PA (Fenton, Duda, Appleton, & Barrett, 2017; Teixeira, Carraça, Markland, Silva, & Ryan, 2012), given its more strenuous physical effort demands.

We test self-esteem as a mediator in the relationship between social support and PA. Although there is a debate going on to know if self-esteem is a cause or consequence of social support. For instance, a study developed by Marshall, Parker, Ciarrochi, and Heaven (2014), analyzed two models (self-esteem as an antecedent and self-esteem as an outcome) and concluded that self-esteem predicted social support, while other studies (e.g., Bum & Jeon, 2016; Haugen, Säfvenbom, & Ommundsen, 2011) included self-esteem as an outcome. Bum and Jeon (2016) showed that parents', professors', and peers' social support were significant antecedent variables that increased the students' self-esteem. Haugen et al. (2011) found that increased levels of PA were beneficial for global self-worth in male and female adolescents ough enhancing their perceptions of physical self-esteem. Thus, future studies, namely more longitudinal studies, systematic reviews, and meta-analysis are needed to explore these associations in more detail.

Although the present study contributes to the understanding of the relationship between social support, self-esteem, and PA, it has some limitations. The study is cross-sectional, so we can only address the associations among the variables without determining their causality. In this sense, longitudinal or experimental studies are necessary to further examine the effects of the studied variables on each other. In addition, PA was assessed by a questionnaire. Although IPAQ is extensively used, valid, and reliable population wise, the use of questionnaires for assessing PA can be limitative, since they rely on participants' memory and, in the case of IPAQ, their capability to remember PA in the last seven days. Future research should include objective measures (e.g., pedometer and/or accelerometer). The data from this study were from the north of Portugal, which consequently imposes regional limits on their generalizability. Hence, forthcoming

studies should try, to make an effort and collect a large and stratified sample of other regions of Portugal and analyze these variables across regions. To the best of our knowledge, it seems that this was the first study to consider the self-esteem as a mediator in the interaction between social support from the best friend, friends, and parents, and different levels of PA. Therefore, future studies should also test our hypothesized model under similar contexts and in different cultures. Finally, other variables such as age and sports practice experience should be included in future studies, and their interaction as a mediator or moderator between social support and PA might be considered. All in all, our findings suggest that the proposed model operates in the same way, independently of the adolescent sex, particularly in terms of VPA, which strongly corroborates previous findings (Reddon, Meyre, & Cairney, 2017). In this regard, the findings of the present study could help future researchers to improve their intervention in terms of enhancing PA levels in adolescents by considering the impor-

tance of self-esteem. In addition, another important avenue is related to social support. While changes toward lower self-worth, self-efficacy, self-esteem, lower perception of social support may be attributed to pubertal changes, an emerging capacity to think abstractly about oneself, confusion and shifts in roles and responsibilities as well as identity development, the social support from friends, parents and the best friends may be seen as one factor that operates to improve levels of self-esteem in adolescents and, consequently, to improve or maintain their PA levels.

In conclusion, self-esteem mediates the relationship between social support and VPA; the strength of mediation is higher in girls than in boys; in both genders the mediation is higher when the social support has come from parents. Therefore, it could be said that the more social support an adolescent receives, particularly from the parents, the higher his or her self-esteem will be, leading him or her to attain greater physical activity.

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