Students' physical activity intensity and sedentary behaviour by physical self-concept profiles: A latent profile analysis

Abstract

Aims of this study were to identify student clusters in physical appearance, sport competence, global physical self-concept and self-esteem, and to examine whether different physical self-concept groups differ in their moderate-to-vigorous physical activity (MVPA) and sedentary behaviour. Participants of the study were 211 boys and 183 girls aged 13-16 years. MVPA and sedentary behaviour were monitored by GT3X accelerometers during seven days. Participants' physical self-concept was measured by the short Physical Self-Description Questionnaire. Latent profile analyses revealed a four-cluster solution: 1) "low sport competence, moderate global physical self-concept and self-esteem, and high physical appearance"; 2) "high sport competence, moderate global physical self-concept and self-esteem, and low physical appearance"; 3) "moderate sport competence, global physical self-concept, self-esteem, and physical appearance", and 4) "moderate sport competence and global physical self-concept, high self-esteem, and low physical appearance". Multivariate analysis of variance showed differences in MVPA between boys' in clusters 2 and 3 ($p <$ .05). Students' MVPA levels differ by physical self-concept profiles.

Keywords: physical self-perceptions; physical activity; sedentary behaviour; clusters; accelerometry.

Intensidad de la actividad física y comportamiento sedentario de los estudiantes por perfiles de autoconcepto físico: Un análisis de perfil latente

Resumen

Los objetivos del estudio fueron identificar grupos de estudiantes en apariencia física, competencia deportiva, autoconcepto físico global y autoestima, y examinar si los diferentes grupos de autoconcepto físico difieren en su actividad física moderada-vigorosa (AFMV) y comportamiento sedentario. Los participantes del estudio fueron 211 varones y 183 mujeres de 13-16 años. La AFMV y el comportamiento sedentario fueron monitorizados por acelerómetros GT3X durante siete días. El autoconcepto físico de los estudiantes fue medido por la versión corta del *Physical Self-Description Questionnaire*. Los análisis de perfil latente revelaron una solución de cuatro grupos: 1) "baja competencia deportiva, moderado autoconcepto físico global y autoestima, y alta apariencia física"; 2) alta competencia deportiva, moderado autoconcepto físico global y autoestima, y baja apariencia física"; 3) "moderada competencia deportiva, autoconcepto físico global, autoestima, y apariencia física"; y 4) "moderada competencia deportiva y autoconcepto físico global, alta autoestima, y baja apariencia física". Los análisis multivariados de la varianza mostraron diferencias en la AFMV entre los grupos de chicos 2 y 3 ($p <$,05). Los niveles de AFMV de los estudiantes difieren según los perfiles de autoconcepto físico.

Palabras clave: autopercepciones físicas; actividad física; comportamiento sedentario; clusters; acelerometría.

Introduction

Physical activity (PA) is considered a strong health marker among children and adolescents (Poitras et al., 2016). More specifically, there is consistent evidence on favourable relationships between moderate-to-vigorous PA (MVPA) with adiposity, cardiometabolic biomarkers, physical fitness, bone health, cognition and academic performance within youth (Esteban-Cornejo, Tejero-Gonzalez, Sallis, & Veiga, 2015; Poitras et al., 2016). Participating in regular PA may also improve psychological health in adolescents and avoid mental health problems such as anxiety or depression (Biddle, Ciaccioni, Thomas, & Vergeer, 2018). Regarding, sedentary behaviour is also considered as an important health risk factor among children and adolescents (Carson et al., 2016). Higher amount of sedentary behaviour in adolescence is related with an unfavourable cardiometabolic risk, physical fitness, and body composition (Carson et al., 2016).

Unfortunately, previous studies have shown that the intensity of PA participation decreases from childhood to adolescence and from adolescence to young adulthood (Corder et al., 2017; Ortega et al., 2013). Additionally, sedentary behaviour has been also shown to increase from childhood to adolescence (Ortega et al., 2013; Pearson, Haycraft, Johnston, & Atkin, 2017). Physical inactivity has been suggested as becoming a worldwide challenge (Ferreira de Moraes, Guerra, & Rossi-Menezes, 2013), which affects more than 80% of adolescents in the world (World Health Organization [WHO], 2018). Research has revealed that there are many psychological antecedents such as students' motivation toward PA or physical self-concept for the intensity of PA participation and sedentary behaviour (Cortis et al., 2017; Rollo, Gaston, & Prapavessis, 2016). This study aims to extend this area of research by investigating the relationship among physical self-perceptions, the intensity of PA participation and sedentariness.

The way people think about themselves in achievement settings has a remarkable association on their behaviour (Babic et al., 2014; Harter, 1978). According to Shavelson, Hubner, and Stanton (1976) general self-concept represents a multidimensional structure including four sub-domains: emotional, social, academic and physical self-concept. Generally, physical self-concept refers to a judgement a person has about his or her physical abilities when interacting with the environment (Shavelson et al., 1976). Based on Shavelson et al. (1976) model, later Marsh, Richards, Johnson, Roche, and Tremayne (1994) determined the physical self-concept by eleven components: health, coordination, activity, body fat, physical appearance, sport competence, global physical self-concept, self esteem, strength, flexibility and endurance.

This study considered only four sub-domains - physical appearance ("being good looking, having a nice face"), sport competence ("being good at sports, being athletic, having good sports skills"), global physical self-concept ("feeling positive about one's physical self") and self-esteem ("overall positive feelings about self") (Marsh, Martin, & Jackson, 2010, 473) - because the focus of the current study is to investigate psychological aspects of the physical self-concept. Other seven sub-domains represent physical (health, health-related fitness) and behavioural (PA participation) aspects of physical self-concept.

Physical self-concept is recognized as a relevant health marker during adolescence (Esnaola, Goñi, & Madariaga, 2008). For example, research has demonstrated that physical self-concept and its sub-domains are significantly associated with PA within youth (Babic et al., 2014; Revuelta, Esnaola, & Goñi, 2016). In contrast, negative physical self-concept is associated with low PA levels within children and adolescents (Babic et al., 2014; Grao-Cruces, Nuviala, Fernandez-Martinez, & Perez-Turpin, 2014).

In their systematic review and meta-analysis Babic et al. (2014) highlighted the importance of understanding the structure of physical self-concept and its relationships with health-related behaviours. Previous studies within children and adolescent samples have indicated a positive association between self-esteem and PA (Carter, 2018; Reddon, Meyre, & Cariney, 2017) and between sport competence and PA (Babic et al., 2014; Utesch, Dreiskämper, Naul, & Geukes, 2018). Studies have also shown that physical appearance has a positive but weak association with PA within adolescent samples (Babic et al., 2014). More specifically, several studies have found positive associations between physical appearance and PA among boys but negative among girls (Grao-Cruces et al., 2014; Moreno-Murcia, Hellín, González-Cutre, & Martínez-Galindo, 2011). Additionally, global physical self-concept has shown been positively correlated with PA within adolescents (Contreras, Fernández, García, Palou, & Ponseti, 2010; Reigal Garrido, Videra García, Parra Flores, & Ruiz de Mier, 2012).

A review of sport science literature demonstrates that there is a lack of studies investigating associations between sub-domains of physical self-concept and sedentary behaviour. Concretely, we found only three studies that analyse these associations (Carson et al., 2016; Suchert, Hanewinkel, & Isensee, 2016; Webb, Benjamin, Gammon, McKee, & Biddle, 2013). These studies showed that sedentary behaviour was negatively associated with self-esteem, physical appearance and sport competence (Carson et al., 2016; Suchert et al., 2016). However, to our knowledge, there are no studies that examine the relationships between global physical self-concept sub-domain and sedentary behaviour within adolescent samples.

Only three previous cluster analytic studies have investigated physical self-concept profiles among adolescents in the physical education (PE) setting, and also demonstrated that profiles differ in the intensity of PA participation (Biddle & Wang, 2003; De Meester et al., 2016; Wang, Sun, Liu, Yao, & Pyun, 2015). Additionally, apart from self-perceptions, these studies included motivation (Biddle & Wang, 2003), and physical variables such as actual motor competence (De Meester et al., 2016) as clustering variables. Biddle and Wang (2003) clustered students based on sport competence, physical condition, strength, attractiveness and motivation. They found five types of motivation and physical self-concept profile groups: 1) amotivated; 2) very low motivation and low physical self-concept; 3) moderate motivation and physical self-concept; 4) moderate motivation and high physical self-concept; and 5) high motivation and physical self-concept. Additionally, they found that, higher profiles of motivation and physical self-concept generally showed higher PA levels than lower profiles (Biddle & Wang, 2003). De Meester et al. (2016) clustered students based on perceived and actual motor competence. They found four physical self-concept profile groups: 1) low perceived and actual motor competence; 2) average perceived and actual motor competence; 3) high perceived and low actual motor competence; and 4) high perceived and average motor competence.

Their study also demonstrated that low perceived and actual motor competence cluster showed the lowest PA levels comparing with other clusters. Regarding Wang et al. (2015) clustered students based on physical activity, physical appearance, body fat, coordination, endurance, self-esteem, flexibility, global physical self-concept, health, sport competence and strength. They found three types of physical self-concept profiles groups: 1) low in each; 2) moderate in each; and 3) high in each. In this study the highest physical self-concept profile

showed the highest PA levels following by the moderate profile, while the lowest physical self-concept profile showed the lowest PA levels. However, it should be noticed that all these studies measured PA levels by self-reports, which can lead to under- or overestimation of the intensity of PA participation (Bermúdez et al., 2013).

Additionally, the aforementioned studies did not measure sedentariness. The present study expands previous cluster analytical studies by investigating MVPA and sedentariness through objective measures. The first aim of this study is to identify groups of students with homogenous profiles in physical appearance, sport competence, global physical self-concept and self-esteem. The second aim of the study is to examine whether the different physical self-concept profiles differ in their MVPA and sedentary behaviour.

Methods

Participants

A sample of 394 adolescents, 211 boys (53.6%) and 183 girls (46.4%) from one state-subsidised high school chosen by convenience of the province of Granada (age = 13.9 ±1.1 years, body mass = 57.2 ± 12.0 kg, and body height = 162.6 ± 8.4 cm) were invited to participate in the present study. The inclusion criteria were: 1) belonged to the first to fourth grades of the secondary education level; 2) did not have any health disorder that would have made impossible the performance of the PA normally; 3) wore the accelerometer during a whole week; 4) completed the whole self-physical self-concept questionnaire; 5) presented the corresponding signed students' assent, and; 6) presented the corresponding signed consent by their parents or legal tutors.

Measures

Moderate-to-vigorous physical activity and sedentary behaviour. Participants' objective MVPA and sedentary behaviour were measured trough GT3X+ accelerometers (ActiGraph, LLC, Pensacola, FL, USA). The GT3X+ accelerometer is a triaxial monitor that registers and measures variations of acceleration in the time that range in magnitude from approximately .05 to 2.50 Gs. The ActiLife Lifestyle Monitoring System Software (version 6.9.2) was used to treat the data. The first day with the data obtained was considered as a familiarization day and it was not used for statistical analyses (Dössegger et al., 2014; Autor, 2018). Since adolescents' PA patterns are characterized by short bursts of rapidly changing activity, the interval of time (epoch) was set at 1 s (Cain, Sallis, Conway, Van Dyck, & Calhoon, 2013). A minimum wear time of 600 min per day was established (Migueles et al., 2017). A minimum length of 60 min of consecutive zero-count epochs with up to two minutes spike tolerance was established as non-wear periods (Oliver, Badland, Schofiedl, & Shepherd, 2011). The percentage of time engaged in MVPA (e.g., ≥ 2,296 counts/min) and sedentary behaviour (e.g., 0-100 counts/min) were determined according to Evenson's cut-off points (Evenson, Catellier, Gill, Ondrak, & McMurray, 2008; Trost, Loprinzi, Moore, & Pfeiffer, 2011). Firstly, with the purpose of avoiding potential bias due to differences in the length of total valid wear time, the percentage of time that participants spent on MVPA and sedentary behaviour in relation with the total valid wear time during the day were calculated (Autor, 2018). Then, the weighted average time of the week engaged in MVPA and sedentary behaviour was calculated (e.g., (5 x MVPA during weekdays + 2 x MVPA during weekend days)/ 7)). ActiGraph accelerometer-measured MVPA and sedentary behaviour has shown a high level of validity among adolescents (MVPA, ROC-AUC = .90; Se = .88; Sp = .92; sedentary behaviour, ROC-AUC = .90; Se = 1.00; Sp = .79) (Trost et al., 2011).

Physical self-concept. Physical self-concept was measured through the adapted and validated Spanish version of the short form of *Physical Self-Description Questionnaire* (PSDQ-S) (Marsh et al., 2010). This questionnaire consists of 40 items that measure nine specific components of physical self-concept (health, coordination, body fat, PA, sport competence, physical appearance, strength, flexibility, and cardiorespiratory fitness) and two global components (global physical self-concept and self-esteem). In this study, only sport competence (three items; e.g., *"I am good at most sports"*), physical appearance (three items; e.g., *"I have a nice looking face"*), global physical self-concept (three items; e.g., *"Physically, I feel good about myself"*) and self-esteem (five items; e.g., *"Overall, I am no good"*) scales were used. According to previous studies (e.g., Autor, 2017a), a 10-point Likert-type scale (1 = "Totally false"… 10 = "Totally true") was used. Since the self-esteem dimension had two negatively worded items, they were recoded before statistical analyses. The present data showed adequate psychometric properties among adolescents (Crombach's alpha = .9, .87, .89 and .76; average variance extracted = .7, .7, .7 and .29; Omega = .87, .88, .88 and .60 for sport competence, physical appearance, global physical self-concept and self-esteem dimensions, respectively).

Anthropometric. Participants' body mass (Seca, Ltd., Hamburg, Germany; accuracy = 0.1 kg) and height (Holtain Ltd., Crymmych, Pembs, United Kingdom; accuracy = 0.1 cm) were measured. Participants' body mass and height were measured in shorts, T-shirts, and barefoot. Two measurements of both body mass and height were performed and the average of each was calculated (International Society for the Advancement of Kinanthropometry, 2001).

Procedure

Firstly, the research protocol was approved by the Ethical Committee of the University of [omitted for peer review]. Then, the principal and PE teacher of a state-subsidised high school chosen by convenience of the province of [omitted for peer review] were informed about the project and the permission to carry out the study was requested. After the school approvals were obtained, adolescents and their legal tutors were fully informed about all the features of the study and were requested to sign an informed consent form. During the first week, students were instructed about when they should wear the accelerometer (during the whole day, from getting up until they go to sleep, less when they do aquatic activities or have a shower). Then, accelerometers were placed on the right hip by using an elastic waistband and students wore them during a whole week. Students were urged to continue with their normal PA habits. In the second week, the PSDQ-S questionnaire was administered to students in quiet conditions in an ordinary classroom (15-20 minutes approximately). Before answering the questionnaire, the researchers explained how to complete it and answered students' questions regarding the questionnaire. A week later, the anthropometric measurements were taken during an ordinary classroom session.

Data analysis

First, normal distribution, outliers, and missing values of the study variables were examined. A graphical display showed that the data were approximately normally distributed. No significant outliers were detected based on the standardised values (± 3.0) of the study variables (Tabachnick & Fidell, 2007). The data comprised 16.3% of missing values out of all 2,364 measured values. The Missing Completely at Random (MCAR) test ($\chi^2 = 9.05$, $df = 6$, $p = .171$) indicated no differences between data with and without missing values (Little & Rubin, 2002). Missing values were not imputed, but estimated using full information maximum likelihood, which has been shown to produce unbiased parameter estimates and

standard errors under MCAR conditions (Muthén & Asparouhov, 2003). Additionally, descriptive statistics including correlations, means, and standard deviations for the study variables were determined.

To answer the first research question of identifying groups of students with homogenous profiles in physical appearance, sport competence, global physical self-concept, and self-esteem, a Latent Profile Analysis (LPA) was implemented. The maximum likelihood ratio (MLR) estimator was used and the maximum number of iterations was 500 (Muthén & Muthén, 2013). A model fit for one to seven cluster solutions were tested using Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), sample-size adjusted BIC (SSA-BIC), and Lo-Mendell-Rubin likelihood ratio test (LMR). Lower values for AIC, BIC, and SSA-BIC indicated a better model fit. In addition, the LMR test was used to compare the estimated model with a model with one class less than the estimated model. A statistically significant p-value indicated that the LMR test supported the retention of the model related to the number clusters. Finally, the estimated models with less than 1% and less than 5% of the cases were analysed. However, only clusters with more than 5% of the participants were considered as adequate, based on the relatively large sample in the current study (Marsh, Lüdtke, Trautwein, & Morin, 2009). After the most suitable cluster solution was determined, a detailed description and statistics for each cluster was provided.

For the second research question of investigating whether different physical self-concept profiles differ in their MVPA and sedentary behaviour, a Multivariate Analysis of Variance (MANOVA) including gender and cluster membership as independent variables and MVPA and sedentary time as dependent variables, was conducted. Post-hoc Tukey tests were used to examine the pairwise comparisons of the clusters. Finally, adjusted squared multiple correlations were used to explain the variances in MVPA and sedentary time variables. The MCAR test for missing values and MANOVA models were performed using SPSS Version 22.0 and LPA models using Mplus Version 8.0.

Results

Table 1 shows means and standard deviations of the main variables for the overall sample, as well as for the boys and for the girls. Generally, students perceived high self-esteem and global physical self-concept, moderate sport competence and physical appearance, and they showed high average scores of MVPA and sedentary behaviour. Correlations demonstrated that all physical self-perceptions were positively associated among each other for the boys and for the girls. Additionally, MVPA was negatively associated with sedentary behaviour in both gender groups.

Table 1

Correlation coefficients for the study variables among boys (upper triangle) and among girls (lower triangle), and descriptive statistics for the overall sample, and for boys and girls

							Overall			Boys			Girls		
	1.	2.	3	4	5	6	*n*	Mean	SD	*n*	Mean	SD	*n*	Mean	SD
1. Sport competence	-	.34**	.52**	.63**	-.15	.15	376	4.17	1.22	202	4.50	1.16	174	3.79	1.18
2. Physical appearance	.42**	-	.32**	.38**	-.07	.00	376	3.92	1.20	202	4.03	1.22	174	3.79	1.17
3. Global physical self-concept	.40**	.59**	-	.51**	.00	.10	376	4.27	1.28	202	4.48	1.23	174	4.03	1.30
4. Self-esteem	.61**	.57**	.67**	-	.02	.01	376	4.56	.84	202	4.73	.77	174	4.36	.87
5. Sedentary behaviour	-.00	.09	.08	.02	-	-.77**	232	82.98	3.78	118	81.70	4.01	114	84.36	2.98
6. MVPA	-.04	-.09	-.09	.00	-.80**	-	232	6.52	2.19	118	7.37	2.20	114	5.61	1.77

Note. SD = Standard deviation; MVPA = Moderate-to-vigorous physical activity.
* $p < .05$; ** $p < .01$

The results of the LPA including the variables of sport competence, physical appearance, global physical self-concept, and self-esteem were examined (Table 2). The AIC, BIC, and SSA-BIC indices decreased, when the number of groups increased, but only marginally after the four-group solution. The *p* values of the LMR for K versus K-1 classes were also non-significant for each higher group solution. For instance, the four-group solution was better than the three-group solution, whereas the five-group solution was not significantly better than the four-group solution. Based on all considerations, a four-group solution was considered as most justifiable.

Table 2

AICs, BICs, and sample-size adjusted BICs values for model parameterizations

No. Group	No. Parameters	AIC	BIC	SSA-BIC	pLMR	Group sizes	
						LT1%	LT5%
1	8	4631	4662	4637	-	0	0
2	13	4252	4303	4262	.001	0	0
3	18	4149	4220	4163	.012	1	1
4	23	4114	4202	4131	.003	1	1
5	28	4113	4223	4135	.344	1	1
6	33	4072	4201	4097	.316	1	1
7	38	4056	4204	4084	.641	1	3
8	43	4055	4223	4087	.186	2	4

Note. AIC = Akaike's information criterion; BIC = Bayesian information criterion; SSA-BIC = Sample-size adjusted bayesian information criterion; pLMR = Lo-mendell-rubin likelihood ratio test; LT = less than.

Means and standard deviations of the study variables in clusters are presented in Table 3. Cluster 1 was labeled as *"low sport competence, moderate global physical, self-concept and self-esteem, and high physical appearance"* group. This cluster was comprised of 12 girls and 9 boys, nearly 6% of the total sample. Cluster 2 was labeled as *"high sport competence, moderate global physical self-concept and self-esteem, and low physical appearance"* group. This group represented 43% (73 girls, 87 boys) of the total sample. Cluster 3 was labeled as *"moderate sport competence, global physical self-concept, self-esteem, and physical appearance"* group. This group comprised 31% (53 girls, 62 boys) of the total sample. Cluster 4 was named as *"moderate sport competence and global physical self-concept, high self-esteem, and low physical appearance"* group. This profile was 21% (35 girl s, 45 boys) of the entire sample.

Table 3

Means and standard deviations (in the parentheses) of the study variables in four clusters

	Cluster 1 (n = 21)	Cluster 2 (n = 160)	Cluster 3 (n = 115)	Cluster 4 (n = 80)
Sport competence	3.97 (1.09)	4.31 (1.21)	4.09 (1.23)	4.04 (1.27)
Physical appearance	4.17 (1.19)	3.91 (1.20)	3.95 (1.26)	3.83 (1.21)
Global physical self-concept	4.30 (1.46)	4.31 (1.20)	4.26 (1.39)	4.24 (1.33)
Self-esteem	4.47 (.88)	4.53 (.80)	4.58 (.89)	4.61 (.87)

Sedentary time	82.50 (3.68)	82.84 (3.79)	83.29 (3.62)	82.98 (4.31)
MVPA	6.65 (2.22)	6.69 (2.23)	6.09 (1.82)	6.57 (2.45)

Note. MVPA = Moderate-to-vigorous physical activity.

The results of the MANOVA, including gender and cluster membership as independent variables and sedentary time and MVPA as dependent variables, showed a significant interaction effect between gender and cluster membership in MVPA ($F_{(3, 376)}$ = 2.97, $p < .05$). In addition, girls accumulated higher sedentary time ($F_{(1, 376)} = 23.93$, $p < .001$) and lower MVPA ($F_{(1, 376)} = 24.13$, $p < .001$) than boys.

In order to clarify the group differences with more details in MVPA, the data of girls and boys were separately examined. The results revealed significant differences between clusters in MVPA ($F_{(1, 202)} = 3.90$, $p < .05$) in the sample of boys.

Tukey's post-hoc tests confirmed that Cluster 2 boys had higher MVPA ($p < .01$) than Cluster 3 boys. No differences between groups in the data of girls were found. Adjusted squared multiple correlations (R^2) showed that the effect sizes ranged from weak to moderate with explaining 12% of the variance in sedentary time and 18% of the variance in the MVPA variable.

Discussion

The aim of this study was twofold. The first aim was to identify groups of students with homogenous profiles in physical appearance, sport competence, global physical self-concept and self-esteem. The second aim was to examine whether different physical self-concept profiles differ in their MVPA and sedentary behaviour. The present study extended previous cluster analytical studies by investigating MVPA and sedentariness through objective measures.

In the present study, the LPA revealed a four-cluster solution and suggests that in PE there are students with different physical conception of themselves. This finding is in line with previous studies which demonstrated three to five self-perception clusters (Biddle & Wang, 2003; De Meester et al., 2016; Wang et al, 2015). The most remarkable difference between the current study and previous cluster analytic studies is that previous studies revealed clearly low, moderate or high physical self-concept profiles (Biddle & Wang, 2003; De Meester et al., 2016; Wang et al, 2015), whereas in this study different profiles had very mixed qualities (e.g., Cluster 2, high sport competence, moderate global physical self-concept and self-esteem, and low physical appearance).

PE teacher should recognize that the classes include subgroups of students who have different self-perceptions (Biddle & Wang, 2003; De Meester et al., 2016; Wang et al, 2015). These groups may vary in their physical self-concept, capabilities for learning and intensity of PA participation. Therefore, to organize PE classes effectively, a teacher should be able to firstly recognize students with different self-perception profiles, and secondly to organize their pedagogies to fulfil the needs of each group. It is important that the PE teacher uses differentiated pedagogies and didactics for each "self-perception" group of students.

The achievement goal theory (Nicholls, 1989) and the self-determination theory provide effective frameworks to contribute to students' positive self-perceptions in PE. More specifically, previous studies have shown that the principles of the task-involving motivational climate of the TARGET –model (Epstein, 1989) are effective methodologies for positively affecting PE students' physical self-perceptions. These principles represent six didactical areas which are present in any learning setting: task (design and variability of

activities), authority (create opportunities for decision-making), recognition (use of positive feedback and rewarding), grouping (selection of mixed, varied and heterogeneous working groups), evaluation (assessment criteria focused in the process and students' effort) and timing (suitable time for learning) (TARGET; (Epstein, 1989). Previous research has shown that modification of pedagogical and didactical principles based on the TARGET –model has been associated with increases in PE students' self-perceptions. For example, Abós, Julián, Abarca-Sos, and García-González (2017) found that after applying an intervention program based on TARGET areas for 15 to 17 years-old Spanish students their perceived competence increased. Additionally, the fulfilment of students' competence, autonomy, and relatedness needs has also been demonstrated to be an effective method in increasing PE students' physical self-perceptions. For instance, Cheon, Reeve, and Moon (2012) demonstrated that the application of an autonomy-supportive intervention program in middle and high school aged Korean students, increased their perceived competence towards physical activity. Furthermore, it should be recognized that previous studies have demonstrated that increased task-involving motivational climate and satisfaction of basic psychological needs in PE have also positively increased students PE motivation and leisure-time and PE physical activity participation (Abós et al., 2017; González-Cutre, Sicilia, Beas-Jiménez, & Hagger, 2014).

The results of the present study also showed that there were differences in MVPA participation between boys' clusters 2 and 3. Cluster 2 showed high sport competence, moderate global physical self-concept and self-esteem, and low physical appearance, whereas cluster 3 showed moderate sport competence, global physical self-concept self-esteem and physical appearance. It should be recognized that previous cluster analytic studies also found differences in the intensity of self-reported PA participation among different clusters (Biddle & Wang, 2003; De Meester et al., 2016; Wang et al., 2015). More specifically, previous studies found that a higher physical self-concept profile showed higher PA levels, whereas a lower physical self-concept profile showed lower PA levels (Biddle & Wang, 2003; De Meester et al., 2016; Wang et al., 2015). However, it should be recognized that the physical self-perception profiles of the present study were not extreme (e.g., low/high) profiles like they were in previous studies.

An interesting finding was that differences in MVPA among clusters within the girls were not found. This finding is in contrast to the results obtained by Biddle and Wang (2003), who found that different girls' physical self-concept profiles had also different PA levels. Probably the fact that Biddle and Wang (2003) measured the intensity of PA participation by self-reports may be the reason for different results. Previous studies have shown that self-reports have had low validity and reliability (Farias Júnior, Lopes, Florindo, & Hallal, 2010).

Moreover, this study showed that the boys accumulated higher MVPA levels than the girls. These results are in accordance with previous studies which have shown that the boys spent more time in MVPA than the girls (Autor, 2016; Autor, 2017b). Therefore, increasing MVPA levels, especially among girls, should be an important target in PE. Previous studies have shown that students collect higher MVPA levels during PE days than in non-PE days (Autor, 2018; Autor, 2017b). Therefore, it is important that PE teachers put special emphasis in increasing girls' MVPA levels during PE lessons, contributing to the compliance of daily MVPA recommendations (WHO, 2010). Additionally, in their systematic review, Lonsdale et al. (2013) found that PE-based interventions increase the time that students are involved in MVPA during PE lessons by 24%. More specifically, they found two main types of interventions (Lonsdale et al., 2013). Firstly, those in which PE teachers introduced high-intensity activities (e.g., running or jumping) in usual PE lesson to increase MVPA levels, and secondly, interventions in which PE teachers learned strategies to encourage MVPA

through appropriate activity selection, organization, instruction and management of the classes. It is important to recognize that these interventions seem to have a small but positive effect especially on girls' MVPA participation (Owen, Curry, Kerner, Newson, & Fairclough, 2017). A feasible solution to increase girls' MVPA levels in the school setting could also be the utilization of recess time. Previous studies have shown that the interventions performed during school recess to increases students' MVPA are effective (Parrish, Okely, Stanley, & Ridgers, 2013). These interventions focused mainly on modifying school playgrounds and/or improving sport equipment, allowing students to have more opportunities to perform different activities during recess time. Additionally, another possible solution that has shown to be effective in increasing students' MVPA levels, is the participation in after-school programmes like multisport or dance, for example (Mears & Jago, 2016).

Regarding sedentary behaviour, the results of the present study did not show significant differences between different physical self-concept profiles. To our knowledge, this was the first study to examine differences in sedentary behaviour in different physical self-concept profiles among adolescents. The finding of this study suggests that the physical self-concept profile may not be a significant determinant of sedentary behaviour among adolescents. However, the girls accumulated higher sedentary time than the boys, being similar to previous studies which have objectively examined differences in sedentary time between the boys and the girls (Cooper et al., 2015; Martinez-Gomez et al., 2011). Therefore, PE should contribute to decrease sedentariness especially among girls. In this line, previous studies have examined the difference in sedentary time among PE days and non-PE days showing that the PE subject is an effective mean to decrease sedentary time among students (Kerr et al., 2018; Autor, 2018). Moreover, the implementation of standing desk classrooms have also shown to be an effective strategy in reducing sedentary behaviour in the school setting (Altenburg, Kist-van Holthe, & Chinapaw, 2016).

The main strength of the present study was the use of objective measures to analyse MVPA and sedentary behaviour. However, this study has some limitations that should be considered. Firstly, the main limitation was the relatively small sample size, which allows lower generalization-power than larger samples. Additionally, this study was focused on a single high school, with specific features of being allocated in the city centre and situated in a middle-high socioeconomic neighbourhood, which will limit the obtained outcomes to a similar context. Secondly, the cross-sectional design does not allow us to make causal relationships. Thirdly, results obtained regarding associations of self-esteem with the other variables, should be taken with caution because of its Cronbach's alpha (.70). Future studies should include larger samples, which provided a higher generalization of the obtained outcomes. Furthermore, longitudinal studies are required to analyze the associations among physical self-perceptions, MVPA and sedentariness. Additionally, it could be interesting to perform interventions in order to influence physical self-concept and analyze possible effects on MVPA and sedentary behaviour.

Conclusion

This is the first study that examines differences in students' objective measured MVPA and sedentariness among physical self-concept profiles. The results of this study suggest that students' perceptions of their physical self-concept differ considerably. Additionally, it is also remarkable that these perceptions are associated with different levels of MVPA. Physical Education teachers should promote a good physical self-concept among students, encouraging them to achieve healthy MVPA levels and to reduce sedentary behaviour during their leisure time.

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