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Motor competence, motivation and enjoyment in physical education to profile children in relation to physical activity behaviors

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ABSTRACT

Background: Motor competence (MC) has been recognized as a main goal in Physical Education (PE) and a determining element for the promotion of Physical Activity (PA). The interaction between MC and PA would be mediated not only by physical factors, but also by psychological and affective factors, so their study should consider an integral perspective. Evidence suggests that actual and perceived motor competence, motivation and enjoyment of PE classes play an important role in schoolchildren's PA practice. However, not all the schoolchildren behave in a similar manner, so it is necessary to understand how the combination of these variables can establish different subpopulations with different individual realities.

Purpose: Following a person-centered approach, the present study aims (1) to examine profiles of Chilean children according to Actual Motor Competence (AMC), Perceived Motor Competence (PMC), intrinsic motivation and enjoyment of PE classes, and (2) to analyze how these profiles behave in relation to BMI and Physical Activity.

Methods: Seven hundred and thirty schoolchildren (46.3% girls, age $M = 11.22$ $SD = 0.70$) in 5th and 6th grade of primary school participated. The instruments used for assessment were: MOBAK 5–6 test (AMC); SEMOK questionnaire (PMC); Questionnaire of Motivation in PE in Primary Education (intrinsic motivation); Physical Activity Enjoyment Scale (enjoyment); and ActiGraph wGT3X-BT accelerometers (PA). Latent class analysis was conducted to identify homogeneous groups of schoolchildren with respect to AMC, PMC, intrinsic motivation and enjoyment of PE classes.

Findings: Three-class solution was the best fit for the data. Profile 1 (high aligned) represents 21.9% of the sample, with high levels of AMC, PMC, motivation and enjoyment of PE classes. Profile 2 (nonaligned) represents 67.5% of the sample, with low levels of AMC, medium levels

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of PMC, and high motivation and enjoyment. Profile 3 (low aligned) represents 10.5% of the sample, with low levels of AMC and PMC, motivation and enjoyment. Schoolchildren of profile 1 were more active, with more daily minutes of MVPA, compared to schoolchildren of profile 2 or 3. The schoolchildren of profile 1 have a lower BMI than the schoolchildren of profile 2 or profile 3.

Conclusion: Children of two of the profiles, involving the majority of the sample, may be at risk of unhealthy lifestyles, with less motivation and enjoyment for PE classes. Therefore, for PE classes and PA programs, it is important to give the same importance to psychological and affective factors as to purely physical ones. The teaching methodologies should put an emphasis on the development of AMC and PMC, through didactic strategies that encourage autonomous motivation and provide pleasant experiences for the schoolchildren.

Introduction

Within the Physical Education (PE) boundaries, the benefits of physical activity (PA) in children and adolescents are widely recognized, however, globally, there is a high prevalence of physical inactivity in these age groups (Guthold et al. 2020). Considering that adherence to PA is developed during early childhood and continues during adolescence and adulthood (Telama et al. 2014), within the PE setting it is necessary to promote the development of factors that are positively associated with adherence to PA, starting in the childhood years. Among these factors, motor competence has been recognized as a main goal in PE and a determining factor for the promotion of PA. Evidence shows its direct association with PA levels in children and adolescents (Holfelder and Schott 2014; Lopes et al. 2019; Lopes et al. 2021; Lubans et al. 2010) and a positive development toward a healthy weight (Barnett et al. 2022; Robinson et al. 2015; Stodden et al. 2008). In addition, motor competence is negatively and consistently associated with body mass index (BMI) (Cattuzzo et al. 2016; Lopes et al. 2012; Saraiva et al. 2013). This inverse correlation depends on the type of motor competence, with locomotion and balance skills being most affected, thus indicating that excess body weight will be an obstacle to the development of motor competence, especially related to early childhood obesity (Barnett et al. 2022). Another relevant factor to take into account when analyzing motor competence in schoolchildren is sex; there are significant differences between boys and girls, specifically in activities related to object control, where boys show higher levels of motor competence than girls (Barnett et al. 2016; Lopes et al. 2021). In tasks related to locomotion and stability, there is still no consensus on the role of sex, since some studies indicate that girls perform better than boys (Iivonen and Sääkslahti 2014), while others could find no differences (Barnett et al. 2016).

Conceptual models of motor development suggest that the association between motor competence and PA would be mediated by factors, such as perceived motor competence (PMC) and physical fitness (Robinson et al. 2015; Stodden et al. 2008), generating a reciprocal and synergistic mechanism, which can strengthen PA in childhood and adolescence, and generate an adherence throughout life (Hulteen et al. 2018; Robinson et al. 2015; Tyler et al. 2020). PMC is an individual's belief or self-perception of their ability to perform certain motor tasks (Estevan and Barnett 2018). It is considered a predictor and/or mediating factor in the relationship between actual motor competence (AMC) and PA (Barnett et al. 2022). Thus, children with high levels of PMC and/or physical self-perception are more likely to participate in PA (Babic et al. 2014; den Uil et al. 2023). Furthermore, children's perceptions of their physical competence are of great importance for their well-being, social acceptance, participation in play and willingness to participate in PE and PA in general (Ntoumanis 2001; Stodden et al. 2008). As a result, PMC is becoming a motivating agent for the participation of children and adolescents in PE and sport activities in general, as well as for the adoption of healthy behaviors (Bardid et al. 2016; De Meester et al. 2016; Estevan and Barnett 2018).

As well as AMC and PMC, the conceptual model proposed by Stodden et al. (2008, 292) also recognizes ‘enjoyment’ as one of the five most common determinants of PA (Welk 1999), suggesting that students with limited competence will be less likely to enjoy the practice of PA. Enjoyment is defined as an optimal psychological experience that is linked with feelings like pleasure, liking and fun (Kimiecik and Harris 1996); it is a multidimensional construct that incorporates excitement, attachment and the perception of competence (Jaakkola et al. 2016). Enjoyment is an affective process that is experienced when performing an activity (Ntoumanis 2001), so in the case of PE classes, it is a positive result or consequence of the appropriate experiences in classes. The higher the level of enjoyment, the higher is the commitment to the practice of PA, both in and outside of PE classes (Dishman et al. 2005; Hashim, Grove, and Whipp 2008; Sallis, Prochaska, and Taylor 2000).

As a positive emotion experienced when engaging in an activity that is considered pleasant or fun, the enjoyment of PE classes is deeply connected with intrinsic motivation (Huhtiniemi et al. 2019; Kimiecik and Harris 1996; Ntoumanis 2001) as part of its regulatory process (Ryan and Deci 2017). According to the Self-Determination Theory (SDT), behavior can be guided by different levels of motivation, which are categorized by a continuum of self-determination, according to the level of engagement adopted by individuals in a given situation. The highest level is intrinsic motivation, which is the impulse that leads people to engage in an activity; it is determined by the pleasure and satisfaction that an individual perceives in certain experiences (Ryan and Deci 2017).

The most autonomous levels of motivation (i.e. intrinsic motivation, identified regulation and integrated regulation) are positively associated with PA during childhood (Sebire et al. 2013), adolescence (Kalaja et al. 2010; Markland and Ingledew 2007) and adulthood (Teixeira et al. 2012). At the same time, intrinsic motivation is positively associated with AMC in both children (Menescardi et al. 2022) and adolescents (Boiché et al. 2008; Estevan et al. 2021a; Kalaja et al. 2010). Intrinsically motivated children enjoy using their abilities in motor challenges, which also leads to an improved PMC (Ryan and Deci 2017; Ryan and Moller 2017). In other words, children with a high PMC are more autonomously motivated than children with low PMC. Therefore, a high PMC might also positively influence children’s intrinsic motivation to participate and persist in PA (De Meester et al. 2016; Rotenstein et al. 2015), because individuals who feel good about themselves and their skills are persistent in facing different challenges (Craven and Marsh 2008). Indeed, in a recent study where motivational variables were included in the conceptual model of motor development, intrinsic motivation was the only mediator between PMC and PA participation, which in turns lead to a more in-depth understanding of the underlying mechanisms of children’s PA (Menescardi et al. 2022).

The evidence above provides an overview of the relations between students’ PA practice, AMC and PMC (Babic et al. 2014; Barnett et al. 2016; Khodaverdi et al. 2016) with motivation (Ng et al. 2012; Ntoumanis et al. 2021; van den Berghe et al. 2014) and enjoyment of PE classes (Dishman et al. 2005; Hashim, Grove, and Whipp 2008; Sallis, Prochaska, and Taylor 2000). However, not all the students behave in a similar manner and different profiles of children were found in terms of AMC, PMC and PA; from a variable-centered approach, it is difficult to study the optimal combination of the relationship between AMC and PMC, that appears to be key in PA practice (Estevan et al. 2019). As an alternative, maintaining a person-centered approach can lead researchers, PE teachers and practitioners to understand how the combination of these variables can establish different subpopulations with different individual realities.

Studies following a person-centered approach (Bardid et al. 2016; De Meester et al. 2016; Estevan et al. 2019; Estevan et al. 2021b; Gråstén et al. 2021; Lawson et al. 2022; Masci et al. 2018; Utesch et al. 2018) have involved children aged 4–14 years from different countries in Europe (Belgium, Finland, Italy, Germany, Spain and United Kingdom); low, medium or high aligned (also named convergent or accurate estimators) and nonaligned (named divergent or over-/underestimators) profiles according to AMC and PMC were found. In the majority of these studies, those children in nonaligned profiles, being underestimators (high PMC and low AMC) or with medium or low values in the input variables, were at risk of maintaining unhealthy lifestyles such as lower PA participation and lower odds of maintaining normal weight (De Meester et al. 2016; Estevan

et al. 2019; Estevan et al. 2021b; Masci et al. 2018; Utesch et al. 2018) and they seemed to be less autonomously motivated for PE and sport (Bardid et al. 2016; De Meester et al. 2016; Lawson et al. 2022). However, due to the heterogeneity of the findings and since the evidence base was sparse and limited by a relative lack of person-centered studies (Lawson et al. 2022), these findings are inconclusive and more research is needed.

Based on a person-centered approach, evidence shows how students belonging to the same group can differ and form subpopulations, either by considering their levels of AMC and PMC (Bardid et al. 2016; De Meester et al. 2016; Estevan et al. 2019) or their different degrees of motivation and enjoyment (Yli-Piipari et al. 2012), highlighting the importance of these variables in the promotion of PA. Also, considering that the levels of AMC, PMC, intrinsic motivation, and enjoyment differ according to sex, where boys tend to have higher values than girls in these variables (Cairney et al. 2012; Menescardi et al. 2022; Romero-Parra et al. 2023; Tsuda et al. 2020), this paper seeks to understand whether children's AMC, PMC, intrinsic motivation and enjoyment affects their PA behaviors and weight status. Considering the relation between motor competence and motivation (Menescardi et al. 2022; 2023), where intrinsic motivation mediates the association between MC and PA, and the above mentioned research in the field of motor development, using a person-centered approach, it is hypothesized that the profiles found will be determined by the different degrees of alignment on each input variable. It is also hypothesized that profiles with a high level of alignment in the input variables will differ from the other profiles in relation to sex, BMI, and PA levels, confirming that this high alignment profile would be more likely to have a healthier lifestyle. To the authors' knowledge no study analyzing children's AMC, PMC, intrinsic motivation and enjoyment as input variables to examine profiles of children has yet been conducted. Studying profiles of children according to the aforementioned input variables might help researchers and experts to more thoroughly understand children's motor development and behavior. Furthermore, previous studies have only addressed the European school population. Therefore, it is also necessary to study how this issue develops in other populations, such as Latin America, where we have no studies that analyze profiles of children with regard to aspects that favor an active and healthy lifestyle, where we have no major precedents, and which has traditionally been undervalued in global research on child development (Draper et al. 2022; Nielsen et al. 2017). For this reason, by following a person-centered approach, we aimed to examine profiles of Chilean children according to AMC, PMC, intrinsic motivation and enjoyment of PE classes, and to analyze how these profiles behave in relation to sex, BMI and the levels of PA.

Materials and methods

Participants

A total of 730 schoolchildren (338 girls, 46.3%) between the ages of 9 and 13 years ($M = 11.22$ $SD = 0.70$) in 5th and 6th grade of primary school participated in this study. The schoolchildren were from seven different schools in the Araucanía Region (Chile), and were stratified according to the proportions of different categories of dependency (municipal, subsidized and private). All schoolchildren participated voluntarily, expressing their consent in writing. Furthermore, all parents and/or legal guardians of the children authorized the participation by means of an informed consent form. The consent rate was 80.2%. The Scientific Ethical Committee of the Universidad de La Frontera approved the protocol of the study according to Act. No. 122_17.

Instruments

Actual motor competence

To assess AMC, the MOBAK 5–6 test (Herrmann and Seelig 2017a) was used in its Spanish validated version (Carcamo-Oyarzun and Herrmann 2020; Carcamo-Oyarzun, Peña-Troncoso, and

Cumilef-Bustamante 2022). This MOBAK test (acronym of the German term ‘MOTORISCHE BASIS-KOMPETENZEN’) is divided into two latent factors, object control and self-movement, which are further operationalized into four motor tasks each: throwing, catching, bouncing, dribbling (object control); and balancing, rolling, jumping, running (self-movement). The confirmatory factor analysis has shown a good model fit ($\chi^2 = 55.48$; $df = 19$; $p < 0.001$; CFI = 0.926; RMSEA = 0.05). For the reliability, the factor reliabilities (FR) were calculated using the results of the confirmatory factor analysis (Yang and Green 2015). The FR were satisfactory in object control (0.66) and in self-movement (0.57).

For each of the motor tasks, the students had two attempts, except for the throwing and catching tasks, where they had six attempts. For the tasks consisting of two attempts, the scoring was as follows: 0 points = no successful attempts, 1 point = 1 successful attempt, 2 points = 2 successful attempts, while for the tasks consisting of six attempts (throwing and catching) 0–2 successful attempts were scored as 0 points, 3–4 successful attempts as 1 point, and 5–6 successful attempts as 2 points. Since each item could be scored with a minimum of 0 points and a maximum of 2 points, the maximum score that could be achieved for each factor (object control and self-movement) was 8 points.

Perceived motor competence

To assess PMC, the SEMOK questionnaire (acronym of the German term ‘SELBSTWAHRNEHMUNG MOTORISCHER KOMPETENZEN’), developed by Herrmann and Seelig (2017b) and validated in Spanish by Carcamo-Oyarzun, Estevan, and Herrmann (2020), was used. It consists of eight items directly aligned to those of the MOBAK test battery, so its structure is also composed of the two factors, object control and self-movement. The alignment of the MOBAK test and the SEMOK questionnaire through a confirmatory factor analysis presented an acceptable adjustment index for this study ($\chi^2 = 107.458$; $df = 19$; $p < 0.001$; CFI = 0.937; RMSEA = 0.08). As in the MOBAK test, the reliability of the SEMOK questionnaire was obtained by the results of the confirmatory factor analysis, using the FR, which was satisfactory in both factors (SEMOK object control 0.75, SEMOK self-movement 0.61). Acceptable values of internal consistency were found with a Cronbach’s alpha coefficient of 0.745.

The schoolchildren were asked to answer the question ‘Do you think that you can do the following activities?’, indicating to what extent they considered to be able to perform the motor tasks of the MOBAK test battery. In addition to the verbal description, all items were complemented with a graphic description of the motor task to ensure that the students understood it. The response format consisted of a Likert scale from 1 to 5 (1 = strongly disagree, 5 = strongly agree).

Intrinsic motivation of physical education classes

The Motivation in Physical Education Questionnaire in Primary Education (CMEF-EP), developed and validated by Leo et al. (2016), was used to assess intrinsic motivation. This questionnaire has been designed in Spanish, specifically for primary school students. It is based on the SDT and considers five factors: intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. The scale consists of the initial sentence ‘I participate in Physical Education classes ...’, followed by 18 items that analyze the five factors. For this study, we only considered the factor intrinsic motivation with four items. An example of an item from the intrinsic motivation subscale is the sentence ‘I participate in Physical Education classes ... because Physical Education is fun’ (item 1 of the questionnaire). The students had to express their degree of agreement for each sentence, using a Likert-type scale with five response options, from totally disagree (1) to totally agree (5). The scale showed a robust factorial validity ($\chi^2 = 0.774$; $df = 2$; CFI = 1.000; RMSEA = 0.00), as well as acceptable internal consistency values with a Cronbach’s Alpha coefficient of 0.734.

Enjoyment in physical education classes

The questionnaire Physical Activity Enjoyment Scale (PACES) by Motl et al. (2001) was used, which was validated in the Spanish context by Moreno-Murcia et al. (2008). The initial phrase ‘When I am active ...’ was changed to ‘When I am in PE class ...’ in order to evaluate the enjoyment in PE classes. An example of an item is ‘When I am in PE class ... it gives me energy’ (item 6). The scale consisted of 16 Likert-type response items, with a range of scores from 1 (strongly disagree) to 5 (strongly agree). The confirmatory factor analysis showed adequate fit values ($\chi^2 = 465.79$; $df = 104$; CFI = 0.915; RMSEA = 0.07). The Cronbach’s Alpha coefficient of 0.850 informed a good internal consistency of this scale.

Physical activity

ActiGraph wGT3X-BT accelerometers (ActiGraph, Pensacola, FL) were used and the schoolchildren were encouraged to wear the device without interruptions for 7 days, according to the established protocols (Tudor-Locke, Barreira, and Schuna 2015), only removing it for activities that involved water (e. g. to take a shower or go swimming). The accelerometer was placed on the right side, at waist level, at the level of the mid-axillary line and at the height of the iliac crest. Acti-life 6.13.4 software (Pensacola, FL, USA) was used for downloading the data, collected in 60-second epochs. We used the measured time spent in moderate and vigorous physical activity, expressed in minutes. The minimum amount of data considered as valid was 4 days, with at least 10 h of use per day, including at least one weekend day. The data that were not detected as nonuse and as sleep were analyzed to identify the time spent in sedentary behaviors and/or physical activity of different intensities, by using the cutoff points of Evenson et al. (2008).

Body mass index

The BMI was determined by using the formula kg/m^2 . The weight and height were determined by means of a Tanita UM2204 floor scale (accuracy 0.2 kg, maximum capacity 136 kg) and a Seca 273 measuring rod. The children had bare feet and wore the least clothing possible.

Procedure

The assessments were carried out during PE class, in two sessions, on different days. The first session was used to brief the students on the purpose of the study and to ask them to answer the questionnaires for PMC (SEMOK), motivation in PE (CMEF-EP), and enjoyment of PE classes (PACES) assessment, which they completed in the presence of the evaluators. Each group spent 20–30 min answering the questionnaires after which the schoolchildren were given instructions on how to use the accelerometers, which were then handed over to them and checked for correct positioning. One of the evaluators attended the students’ school 7 days later for the removal of the accelerometers.

During the second session (1 week after the first session), the MOBAK 5–6 test was applied and the weight and height of the students was measured. A team of eight well-instructed evaluators applied the MOBAK test battery and took the measurements. Each evaluator was responsible for a group of three to five students, completing each of the stations until all the items were completed, including the weight and height measurements. At each station, the evaluator explained how to perform the motor task and then performed it once for demonstration. As indicated in the description of the instrument, each child performed two attempts (except the tasks of throwing and catching, where they performed six attempts) with no familiarization trials. The approximate duration for completion of all stations was 45 min per group.

Statistical treatment

Considering that this study used a person-centered approach, latent class analysis (LCA) was conducted to identify homogeneous groups of schoolchildren with respect to AMC, PMC, intrinsic

motivation and enjoyment of PE classes. LCA is a model testing process, so multiple models with different levels of profiles were fitted to determine the number of classes with well-defined distinct groups in the sample (Ferguson, Moore, and Hull 2020). The determination of the number of profiles was based on the recommendations of Ferguson, Moore, and Hull (2020), following two criteria: (1) considering the following measures of model fit: The Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC), and the sample size-adjusted BIC (SABIC); where low values of these fit indices show a better fit of the model (Ferguson, Moore, and Hull 2020; Marsh et al. 2009; Tein, Coxé, and Cham 2013). Subsequently, (2) the p -values of the Lo–Mendell–Rubin test (LMR) and the Bootstrap likelihood ratio (BLRT) were considered to determine whether a more complex model (k classes) would fit the data significantly better than a more simple model ($k-1$ class) (Marsh et al. 2009; Tein, Coxé, and Cham 2013). In addition, the sample size per class was evaluated, deciding that models with any class of $< 5\%$ would not be taken into account, as they may be spurious (Marsh et al. 2009). Entropy was also considered to determine the accuracy of class classification, where values of approximately 0.80 indicate a high accuracy (Lubke and Muthén 2007). Entropy was considered as a final step as it may not be used for final model selection (Tein, Coxé, and Cham 2013).

Once the profiles were determined, they were labeled discretionally, according to the relative value of the input variables (i.e. AMC, PMC, intrinsic motivation and enjoyment). An input variable was labeled as high when the z -score was above $+0.15$, medium when the z -score was equal to or between -0.15 and $+0.15$, and low when the z -score was below -0.15 . Alignment was determined for those profiles, where the input variables z -score (high, medium or low) were similar; otherwise, it was considered as nonaligned. Lastly, they were compared with each other to determine whether they significantly differed in terms of sex, BMI and moderate–vigorous physical activity (MVPA). For this purpose, the Bolck–Croon–Hagenaars (BCH) approach was used, an auxiliary function of Mplus (Asparouhov and Muthén 2014), that allows comparison of the groups, taking into account the participants' partial class membership. At the same time, it also allowed us to analyze the relationships between profiles and covariate variables, without including them directly in the model. Mplus 8.1 (Muthén and Muthén 2012) was used to compute all analyzes.

Results

Table 1 show the results of the LCA based on AMC, PMC, motivation and enjoyment of PE classes. It shows that the values of Log likelihood, AIC, BIC, and SABIC decrease coherently as the number of classes increases (Tein, Coxé, and Cham 2013). Thus, the three-class solution is the best fit for the data, since the p -values of the LMR and BLRT tests are statistically significant, the smallest class contains more than 5% of the sample, and the entropy has a value of > 0.70 , indicating good accuracy. Compared to the three-profile solution, in the four-group and five-group solutions, the p -values for LMR and BLRT do not indicate statistically significant differences, presenting a profile that includes less than 5% of the participants.

Table 1. Model fit of the latent class analysis.

No. of profiles	Log likelihood	AIC	BIC	SABIC	Entropy	Smallest class %	LMR p -value	BLRT p -value
1 class	−5600.336	11224.67	11279.79	11241.68				
2 classes	−5372.633	10783.27	10870.53	10810.20	0.84	11.2	0.001	<0.001
3 classes	−5274.240	10600.48	10719.90	10637.34	0.74	10.5	0.001	<0.001
4 classes	−5212.885	10491.77	10643.34	10538.56	0.77	1.3	0.092	<0.001
5 classes	−5152.173	10384.35	10568.07	10441.06	0.74	1.6	0.112	0.1160

Note: $n = 730$; the LMR test and the BLRT compare the current model to a model with $k-1$ profiles. AIC = Akaike's information criterion; BIC = Bayesian information criterion; SABIC = sample-adjusted BIC; LMR = Lo–Mendell–Rubin; BLRT = bootstrap likelihood ratio test.

Table 2. Mean values and standard deviations of the study's variables by profile.

	Profile 1 aligned high (n = 160)		Profile 2 nonaligned (n = 493)		Profile 3 aligned low (n = 77)		Total sample	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
AMC object control	4.43	0.29	2.52	0.16	2.68	0.28	3.00	2.01
AMC self-movement	4.89	0.36	1.74	0.11	1.57	0.21	2.46	1.97
PMC object control	4.31	0.09	3.83	0.06	3.31	0.15	3.88	0.83
PMC self-movement	4.16	0.08	3.43	0.06	2.90	0.15	3.54	0.92
Intrinsic motivation	4.74	0.04	4.63	0.03	3.28	0.18	4.52	0.62
Enjoyment of PE class	4.63	0.04	4.50	0.03	3.21	0.12	4.38	0.59

Note: AMC = actual motor competence; PMC = perceived motor competence; PE = physical education.

Three profiles were found. Profile 1, labeled high aligned, represents 21.9% of the sample, with high levels of AMC, PMC, motivation and enjoyment of PE classes. Profile 2, labeled nonaligned, represents 67.5% of the sample and is characterized by low levels of AMC, while showing medium levels of PMC, and high motivation and enjoyment. Profile 3 represents 10.5% of the sample, with low levels of both AMC and PMC, motivation and enjoyment, and was marked as low aligned. The mean values and standard deviations of the study's variables for each group are presented in Table 2. For ease of interpretation, the standardized mean values are graphically presented in Figure 1.

Table 3 presents the descriptive statistics for the variables sex, BMI and MVPA for each profile, as well as the chi-squared values of the BCH procedure when comparing the profiles with each other. With respect to sex (0 = boys, 1 = girls), the three profiles do not differ from each other. Regarding BMI and MVPA, children in profile 1 showed a significantly lower BMI and higher MVPA, than children in profiles 2 and 3.

Discussion

The purpose of this study was to analyze the profiles of Chilean schoolchildren according to AMC, PMC, intrinsic motivation and enjoyment of PE classes, and to determine whether these profiles differ from each other regarding sex, BMI and MVPA. The three profiles found in this study match the ones of previous studies (Bardid et al. 2016; De Meester et al. 2016; Estevan et al. 2019; Utesch et al. 2018) that categorize schoolchildren according to the degree of alignment between the input variables. Our study complements previous literature in the analysis of profiles of motor development by not only examining physical and psychological factors but also affective ones. Profile 1, high aligned, shows high values of input variables and is similar to Spanish schoolchildren (i.e. AMC, PMC and physical fitness) (Estevan et al. 2019), where the researchers highlighted the importance of alignment of AMC and PMC. Profile 2, nonaligned, comprised two thirds of the sample and showed low AMC values, intermediate PMC values and high motivation and enjoyment in PE classes; they perceived themselves as more competent than they are and showed high intrinsic motivation and high enjoyment in PE classes. Based on the relative values regarding the sample of this study, children in this profile could also be considered as overestimators, which in turn supports the findings by De Meester et al. (2016), who determined that children with a low AMC but high PMC show higher motivation toward PE classes than that of schoolchildren who also have a low AMC but with a low PMC (aligned). Profile 3, low aligned, represented 10.5% of the sample, with the lowest values of the input variables. The characteristics of this profile are consistent with the results obtained by Bardid et al. (2016), where schoolchildren with low PMC also present a lower autonomous motivation compared to schoolchildren with high PMC.

When comparing the profiles with each other, no differences were found according to sex, but statistically significant differences were found in BMI and MVPA. In the case of sex, it is possible to observe a balanced composition in each profile, which coincides with the person-centered analysis

Table 3. Differences between the profiles according to BMI, MVPA and sex.

	Profile 1		Profile 2		Profile 3											
	Aligned high (<i>n</i> = 160)		Nonaligned (<i>n</i> = 493)		Aligned low (<i>n</i> = 77)		Total sample		Overall		1 vs. 2		1 vs. 3		2 vs. 3	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	Chi-square	<i>p</i> value	Chi-square	<i>p</i> value	Chi-square	<i>p</i> value	Chi-square	<i>p</i> value
BMI	20.1	0.30	22.3	0.23	22.7	0.69	21.6	3.83	32.949	0.000	27.948	0.000	12.044	0.001	0.285	0.594
MVPA	50.8	2.50	39.3	1.46	37.4	3.52	40.6	19.81	15.875	0.000	13.226	0.000	9.647	0.002	0.215	0.643
Sex (girls)	47.5%		40.3%		45.6%		46.3%		1.465	0.481	0.217	0.642	0.590	0.442	1.451	0.228

Note: BMI = body mass index; MVPA = moderate to vigorous physical activity; 1 vs. 2, 1 vs. 3 and 2 vs. 3 = comparison between specific profiles.

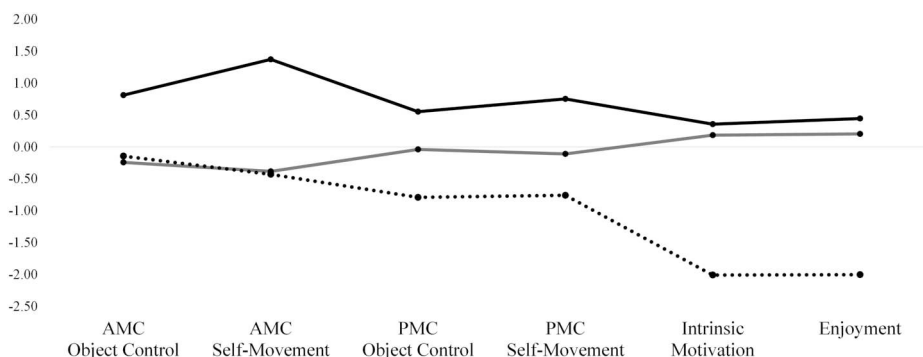


Figure 1. Standardized mean values for AMC (actual motor competence), PMC (perceived motor competence), intrinsic motivation and enjoyment of PE (physical education) class by profiles. Solid black line represents profile 1 high aligned; solid gray line represents profile 2 nonaligned; dashed black line represents profile 3 low aligned.

of De Meester et al. (2016), who found a proportionate representation of sex in the clusters. This shows that, from the person-centered approach, it seems that sex does not play such a determinant role in the definition of the profiles. However, from the variable-centered approach, comparing boys and girls separately, it is possible to infer that sex is related to both AMC and PMC. Although it was not the aim of this study, supplementary tables are presented for both the comparison by sex (Table S1) and the correlation between variables (Table S2), where the relationship between MC and sex favors boys in object control and girls in self-movement, coinciding with previous studies (Iivonen and Sääkslahti 2014). Regarding PA, the profiles differ from each other, where schoolchildren in profile 1 (high aligned) were more active, with more daily minutes of MVPA, compared to schoolchildren in profiles 2 (nonaligned) and 3 (low aligned). These findings are in line with other studies that have used the person-centered approach with consideration of the combination of these variables (Estevan et al. 2019; Gråstén et al. 2021; Utesch et al. 2018), wherein schoolchildren with high aligned levels of AMC and PMC are more active than schoolchildren whose AMC and PMC are low (Utesch et al. 2018) or differ (Estevan et al. 2019; Gråstén et al. 2021). Furthermore, regarding the variables intrinsic motivation and enjoyment, our results support those found by Yli-Piipari et al. (2012), where schoolchildren with greater intrinsic motivation and greater enjoyment of PE-classes also have higher levels of PA. Thus, in addition to supporting this connection between intrinsic motivation and enjoyment (Kimiecik and Harris 1996; Ntoumanis 2001), the results are in line with Stodden et al. (2008) and Welk (1999), who concluded that schoolchildren with lower AMC are less likely to enjoy the practice of PA.

Regarding the impact of profiles in BMI, the schoolchildren in profile 1 (high aligned) showed a lower BMI than that of the schoolchildren of profiles 2 (nonaligned) and 3 (low aligned). This finding is also in line with the results by Estevan et al. (2019), who found that children with high levels of AMC and PMC have a lower BMI and waist circumference compared to schoolchildren with lower AMC and PMC. It is interesting to consider that when analyzing the correlations between AMC and BMI (Table S2) there is a correlation only in self-movement, but not in object control, information which may be useful for planning PE classes. Taking into account the high prevalence of overweight and obesity in Chilean schoolchildren, it is necessary to consider strategies that develop not only AMC but also PMC and motivation, so that schoolchildren with low levels of AMC and PMC can be able to change to the other profiles, since children with high PMC tend to shift or remain in profiles with healthier behaviors (Bardid et al. 2016; Estevan et al. 2021b).

In addition, determining three types of profiles based on AMC, PMC, intrinsic motivation and enjoyment, and finding that these three profiles differ in BMI, PA and sex, the results of this study also shed light on other findings that may allow us to better understand the combination of these variables. Considering the six input variables, physical, psychological and affective domains (with

intrinsic motivation and enjoyment as regulators of children's movement behaviors) seems to be relevant to profile children. According to the physical domain, profiles 2 and 3 presented a lower AMC than profile 1, whereas in the affective domain, profile 3 clearly reported a lower motivation and enjoyment than profiles 1 and 2. It is the children's PMC that seems to label different levels of profiles for each group (i.e. profile 1, 2 and 3 as relatively-high, -medium and -low, respectively). Thus, in line with Menescardi et al. (2022; 2023), the combination of AMC, PMC and volitive factors, such as motivation, must be considered to understand children's movement behaviors and to provide meaningful PE classes. Moreover, based on similar relative values in both intrinsic motivation and enjoyment in each profile and the moderate-strong correlation between both variables (Table S2), it seems that both contribute in a similar way to the distribution of profiles. That indicates that for future studies aiming to profile children by considering affective elements, the analysis could be conducted by including only one of these factors, because it may be sufficient to determine profiles of children.

To the authors' knowledge, the current study is the first to analyze profiles of Latin-American schoolchildren maintaining a holistic perspective and including physical, psychological and affective factors, following a person-centered approach. Furthermore, we measured PA by using accelerometers, which offer greater accuracy and objectivity in the determination of this variable and reduce possible inaccuracies that may occur in self-report questionnaires. However, this study was not free of limitations. The design of the study was cross-sectional, what does not allow us to determine causal relations between the study variables. Although one of the strengths of this study was the use of accelerometers, when interpreting and comparing the results with other studies of objectively measured PA, it must be considered that not all studies used the same protocol, whether regarding the time of use, accelerometer thresholds and the selection of the duration of the periods, as these factors can have a substantial impact on the results of PA intensity (Steene-Johannessen et al. 2020). For future research, we recommend to include sedentary behavior as one of the comparative variables, and even to study the results of the profiles according to Compositional Data Analysis (CoDA), to know whether increasing a certain number of minutes of MVPA to the detriment of sedentary or light PA may lead to changes among the profiles. We also recommend that future studies consider longitudinal designs to better understand the interaction between the variables, the development of the profiles and how they relate to the students' movement behavior.

Practical implications

Considering the profiles found, with almost 80% of the sample within a nonaligned or low aligned AMC and PMC, tending to perform less MVPA, while presenting a higher BMI than the schoolchildren in profile 1, who present values of high alignment (only 21.9% of the sample), it seems key that school-based PE interventions monitor and stimulate not only physical factors (AMC, PA and BMI), but also psychological and affective factors. By identifying this healthier profile, it is possible to generate strategies so that schoolchildren in profiles 2 and 3, who practice lower PA and show an unhealthier weight status than profile 1, might migrate to this profile. This is very important in a region like South-America, and especially in Chile, which has a very low percentage of compliance with PA recommendations (Ceppi-Larraín et al. 2021). As a result, PE classes are considered as a key setting to conduct interventions to foster motor development in a holistic way. In this way, the development of the quality and improvement of AMC and PMC in PE classes is also key to stimulate motivation toward PA (Estevan et al. 2021a; Lawson et al. 2022). Our findings support the need to maintain holistic approaches in PE, and, for this reason, it is necessary that PE interventions are based on theoretical principles, such as the SAAFE (supportive, active, autonomy, fair and enjoyment) (Lubans et al. 2017), where the teacher applies strategies to foster motor competence and to support basic psychological needs. Thus, the challenge is to create a need-supportive and mastery-oriented environment focused on developing students' competence,

confidence, and motivation, with the aim of instilling physical literacy to promote a lifelong engagement in PA (Menescardi et al. 2023).

Conclusions

The present study with Chilean schoolchildren identified three profiles according to the alignment of their AMC, PMC, intrinsic motivation and enjoyment of PE classes. Children in two of the profiles, involving the majority of the sample, may be at risk of unhealthy lifestyles and less motivated and enjoyed for PE. Therefore, taking into account that schoolchildren with low or nonaligned values regarding the input variables have a higher BMI and spend less time per day on MVPA than schoolchildren with high aligned values, it is important that PE classes maintain a holistic perspective, giving the same importance to psychological and affective factors as to purely physical ones. Therefore, the methodologies used in PE classes and programs for children's PA should put an emphasis on the development of AMC and PMC through teaching methods that encourage autonomous motivation and provide pleasant experiences based on the motor needs of schoolchildren.

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Data availability statement

The datasets analyzed for the current study are not publicly available due to sensitivity of the data and the restrictions from the informed consent but are available from the corresponding author on reasonable request.

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