The role of motivation into the conceptual model of motor development in childhood

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Abstract

The aim of this study was twofold: first, to investigate whether perceived motor competence (PMC) mediates the relation between actual motor competence (AMC) and physical activity (PA) according to the conceptual model of motor development, and second to examine the role of different motivational regulations (i.e., intrinsic, identified, introjected, and external regulation) in the relationship between PMC and PA. A sample of 504 Spanish students (46.2% girls, 8-12 years old) voluntarily participated in this study. In relation to the first aim, structural equation modeling revealed that PMC indeed mediates the association between AMC and PA. In relation to the second aim, positive associations between AMC and PMC ($ß = .32$, $p < .001$), which in turn was positively related to intrinsic and identified regulations ($ß = .46$ and $ß = .43$ respectively, $p < .001$), were found. The model showed direct paths from intrinsic and introjected regulation to PA ($ß = .27$ and $ß = .22$, $p < .05$) and indirect paths from PMC through intrinsic motivation to PA ($ß =. 13$, $p < .05$). This study confirms that intrinsic motivation mediates the association between PMC and PA. Strategies targeting to build and develop children's AMC and PMC, and fostering children's intrinsic motivation should be targeted to promote children's PA engagement and motor development.

Keywords: fundamental motor skills; perceived motor competence; motivational regulations; physical activity; structural equation analysis.

The role of motivation into the conceptual model of motor development in childhood

The prevalence of overweight and obesity among children has increased globally in the last decades (Abarca-Gómez et al., 2017; Ng et al., 2014). In Spain, this number is even among the highest in Europe, together with Malta, Italy and Greece (Garrido-Miguel et al., 2019). More specifically, as many as 38.4 – 44.9% of Spanish children and adolescents (6- to 17-year-old) are overweight or obese (de Bont et al., 2019; Sánchez-Cruz et al., 2013), with the majority of those overweight/obese youngsters failing to meet the current World Health's Organization's physical activity (PA) recommendations of at least 60 min of daily moderate-to-vigorous PA (Ajejas et al., 2017; Martínez-Vizcaíno et al., 2020; Mielgo-Ayuso et al., 2016).

The conceptual model of motor development (Robinson et al., 2015; Stodden et al., 2008) outlines how higher levels of PA in childhood prevent the development of overweight and obesity, and that it is essential to gain insight in underlying factors that stimulate children's PA engagement. Actual and perceived motor competence (AMC and PMC, respectively) are factors preceding PA engagement and weight status, and are already integrated in the model: AMC reflects an individual's proficiency in fundamental movement skills (i.e., locomotion, object control and balance; Logan et al., 2018), and PMC refers to the individual's perception of his/her actual movement capabilities (Estevan & Barnett, 2018). Yet, while children's motivation to engage in PA (Deci & Ryan, 2002) is also an important underlying factor of their PA involvement (Cairney et al., 2019; De Meester et al., 2016a), this factor is currently not included in the conceptual model (Robinson et al., 2015; Stodden et al., 2008). In the present study, we examine several associations as outlined in the conceptual model in a unique sample of Spanish children, while simultaneously addressing the question of whether and how the addition of motivation into the conceptual model could improve the model.

Many of the pathways outlined in the conceptual model (Robinson et al., 2015; Stodden et al., 2008) have been extensively examined in childhood (Barnett et al., 2021). First, a positive association between AMC and PA has been found (e.g., Barnett et al., 2016; Barnet et al., 2021; Logan et al., 2015) suggesting that AMC contributes to children's engagement in PA (Jaakkola et al., 2016a; Stodden et al., 2008). Secondly, AMC is also positively associated with PMC with evidence reporting low to moderate relations (De Meester et al., 2020), suggesting that children who have high levels of PMC are more likely to develop their AMC. Third, studies found that children with high levels of PMC might have higher levels of PA (Babic et al., 2014; Bardid et al., 2016; Coppens et al., 2021), supporting the PMC-PA relation. Longitudinal studies further show that PMC not only has a short-, but also a long-term impact on PA practice, predicting students' amount (METs) and intensity (moderate and vigorous) of PA six years later (Jaakkola et al., 2016b). The more competent children feel about their abilities, the less difficult they perceive tasks and the more engaged in mastery attempts they are (Stodden et al., 2008). This persistence leads to further development of AMC and more participation in PA (Hulteen et al., 2018). Fourth, while it is suggested that PMC mediates the relation between AMC and PA (Stodden et al., 2008), a recent systematic review of cross-sectional, longitudinal, and experimental evidence on the conceptual model of motor development suggests that the evidence regarding mediation is inconclusive so far (Barnett et al., 2021). Some studies in Australian, Chinese, Finish, and American children provided evidence for a mediating effect (Barnett et al., 2008; Chan et al., 2019; Fu & Burns, 2018; Gu et al., 2017; Jaakkola et al., 2019). Others reported a partial mediation in Iranian children (Khodaverdi et al., 2016) and some studies from the USA (De Meester et al., 2018), Australia (Barnett et al., 2015) and Canada (Crane et al., 2015) did not find evidence for a mediating effect of PMC in the relation between AMC and PA (Barnett et al., 2021). These diverse findings could be due to the wide range of instrument types and measures used in these studies (e.g., subjective vs. objective measures of PA, and process vs. product-oriented MC assessments), as well as the small number of studies considered, which further highlights the need for more studies focusing on the mediation effect (Barnett et al., 2021). Fifth, the association of AMC and PMC with PA and weight status was exhibited (Barnett et al., 2021; De Meester et al., 2016a, 2016b; Estevan et al., 2019a; Khodaverdi et al., 2016; Markland & Ingledew, 2007) supporting the idea that children with high AMC and high PMC levels were more physically active and had a healthier weight status (lower body mass index, BMI). However, to our knowledge, up to date no study tested the full pathway from AMC via PMC towards PA and BMI, with most studies examining only the mediation role of PMC in the relation between AMC and PA.

Apart from AMC and PMC, Stodden et al. (2008, p. 292) also acknowledge ‘enjoyment’ as a common determinant of PA (Welk, 1999), suggesting that those who have limited competence will be less likely to enjoy participating in PA. Such assumptions are in line with Self-Determination Theory (SDT, Deci & Ryan, 2002), a broad and well-examined theory on motivation. SDT suggests that when people participate in an activity out of enjoyment, they are intrinsically motivated. Intrinsic motivation, could constitute one of the explanatory mechanisms in the relation between (perceived) motor competence and PA, because according to SDT, people who feel more competent are hypothesized to enjoy and endure their physical activities to a greater extend. Yet, up until today, the enjoyment - or the more general construct of intrinsic motivation - is not included in the conceptual model.

Next to intrinsic motivation, SDT also recognizes that people may be extrinsically motivated (Deci & Ryan, 2002). Extrinsic motivation refers to performing an activity for satisfying an external requirement or in order to avoid punishment or an internal requirement when the behavior yields outcomes that are personally valued or important (Deci & Ryan, 2002; Ryan & Deci, 2017). Different regulation types of extrinsic motivation (i.e., external, introjected, and identified regulation) vary in terms of the degree of self-determination or internalization (Deci & Ryan, 2002; Estevan et al., 2021). External regulation is the least self-determined and describes behavior that is performed because of external demands (e.g., awards or constraints), whereas introjected regulation is partially internalized and describes behavior that is carried out to achieve social recognition or avoid internal pressures. Identified regulation is the most internalized type of extrinsic motivation and describes behavior that occurs from the perception of personal value. Intrinsic motivation and identified regulation are considered autonomous forms of motivation, while introjected and external regulation are considered controlled types of motivation. SDT postulates that children who feel competent will be more likely to experience identified and intrinsic motivation, while feelings of incompetence or failure will be more likely to lead to introjected or external regulation (Haerens et al., 2015; Ryan & Deci, 2017; Ryan & Moller, 2017). Along these lines, an enhancement of children's AMC, experiencing mastery and effectiveness, would increase one's feelings of competence and thereby their level of autonomous motivation (Vallerand & Losier, 1999).

In the field of motor development, and in line with the aforementioned SDT postulates, studies in children (Bardid et al., 2016; Coppens et al., 2021; Rose et al., 1998) and adolescents (De Meester et al., 2016a; Estevan et al., 2021; Kalaja et al., 2009, 2010), revealed that AMC is positively associated with intrinsic motivation and identified regulation. Evidence also showed that children and adolescents with high PMC have been found to be more autonomously motivated than their peers with a lower PMC (Bardid et al., 2016; De Meester et al, 2016a; Estevan et al., 2021). Thus, high AMC and PMC might positively influence children's autonomous motivation to engage and persist in PA (De Meester et al., 2016a; Ensrud-Skraastad & Haga, 2020) because children who feel good about themselves and their abilities are resilient to challenges (Craven & Marsh, 2008; Rose et al., 1998). In terms of controlled forms of motivation, the relation with AMC/PMC is less clear with studies revealing a negative or no significant association between AMC/PMC and introjected/external regulation (Boiché et al., 2008; Ensrud-Skraastad & Haga, 2020; Estevan et al., 2021), and others revealing introjected regulation is positively related only with PMC (Çağlar & Aşçi, 2010; McDavid et al., 2014; Sebire et al., 2013), maybe as a way to get others' approval (Ryan & Deci, 2017; Ryan & Moller, 2017).

Finally, autonomous motivation (including both identified regulation and intrinsic motivation) has been found to be positively associated with PA in childhood (Coppens et al., 2021; Sebire et al., 2013) and adolescence (Kalaja et al., 2010; Markland & Ingledew, 2007), while evidence of the association between controlled motivation (including both introjected and external regulation) and PA is inconsistent. Previous studies supported, against theoretical expectations, a positive relation between introjected motivation and PA (Markland & Ingledew, 2007; McDavid et al., 2014; Nogg et al., 2021; Taylor et al., 2017) while others did not find a significant relation between controlled forms of motivation and PA (Sebire et al., 2013). Although motivation is currently not included in the conceptual model (Stodden et al., 2008), the above-cited evidence suggests that it clearly relates to several of the included variables, specifically AMC, PMC and PA. Actually, eventhough scarce studies have analyzed the mediated role of motivation into the model of Stodden there is supported evidence that children who felt competent, also participated in PA mostly out of enjoyment/intrinsic motivation. In this line, previous studies in British, Chinese, and American children exhibited that children's intrinsic motivation/enjoyment mediated the association between perceived competence and PA (Chang et al., 2019; Sebire et al., 2013; Zhang et al., 2021). Yet none of these studies included a measure of AMC.

The first aim of this study was to examine the pathways outlined in the conceptual model (Stodden et al., 2018), involving the relations from AMC to PMC, from PMC to PA, and from PA to BMI in a sample of Spanish children (see hypothesized model 1; Figure S1.1). Moreover, we wanted to specifically examine the intervening role of PMC in the AMC and PA relation. The second aim was to examine whether the addition of the motivational regulations in between the PMC-PA relation improves the conceptual model (see hypothesized model 2; Figure S1.2).

Method

Study design and participants

A convenience sample of 504 (233 girls, 46.2%) 8- to-12-year-old students (M = 9.48, SD = 1.16) was recruited from six elementary schools in (CITY AND COUNTRY BLINDED FOR PEER REVIEW) to participate in this study (response rate 89.7%). The data were collected between November 2019 and February 2020 and were not published in previous studies. Written consent from a parent or guardian, and oral child assent, was obtained for all participants prior to participation. The study was approved by the Ethics Committee of the first author's university (CODE BLINDED FOR PEER REVIEW).

Measures

Actual motor competence

The Canadian Agility Movement Skill Assessment (CAMSA) (Longmuir et al., 2017) was used to assess AMC, which has been proven to be a valid and reliable measure of motor competence in Australian, Chinese, Danish, Greek, and Spanish children (Cao et al., 2020; Dania et al., 2020; Elsborg et al., 2021; Lander et al., 2015; Lander et al., 2017; Longmuir et al., 2017; Mendoza-Muñoz et al, 2021; Menescardi et al., 2022). This motor test battery can be considered an authentic and hybrid assessment tool including both product- and process-oriented measures (Tyler et al., 2018). It requires children to engage in a series of seven movement tasks: (1) 2-footed jumping into and out of three hoops on the ground, (2) sliding from side to side over a 3 m distance, (3) catching a ball and then (4) throwing the ball at a wall target 5 m away, (5) skipping, (6) 1-footed hopping in and out of six hoops on the ground, and (7) kicking a ball between two cones placed 5 m away to be completed in a row in a continuous dynamic obstacle course. Children's performance was assessed using the time taken to complete the obstacle course (product-based criteria) and the performance on 14 items assessing the quality of movement patterns (process-based criteria). Tests that include both product-oriented and process-oriented measures can provide a comprehensive assessment of AMC (Robinson et al., 2015). Regarding the product-based criteria, the timekeeping started when the participant began 2-foot jumping (i.e., the first task) and was stopped when the participant kicked the ball (i.e., the 7th and final task). Time was converted into a score out of 14 points (Longmuir et al., 2017). Regarding the process-based criteria, participants' technical performance was scored on 14 criteria, with one point awarded for each skill performance criterion that was correctly executed. Both product and process scores provided a CAMSA score ranging from 0 to 28 (Lander et al., 2017; Longmuir et al., 2017). This CAMSA score was used as a measure of AMC. In a subsample (n = 90; 43 girls, 47.8%) the concurrent validity of the CAMSA was established by examining the association between the children's CAMSA score and the *Körperkoordinationstest für Kinder* (Kiphard, & Schilling, 2007) motor quotient. A moderate correlation between both tests was observed (r = .45, p < .01). The reliability of the CAMSA was established in two ways. First, a subsample of 69 children performed the test twice at a 1-week interval. As such, 138 video-recorded performances were coded to determine test-retest reliability. Intra-class correlation coefficients (ICCs) were moderate-to-excellent for time score (ICC = .83, 95% CI [.76, .88]), item scores (ICC = .70, 95% CI [.58, .79]), and total CAMSA scores (ICC = .82, 95% CI [.75, .87]). Secondly, the same 84 performances were coded twice with a 1-week difference in between observations by two different observers to assess intra- and inter-rater reliability. Intra-rater reliability was excellent for time scores (ICC = 1.00), item scores (ICC = .99, 95%

CI [.98, .99]), and total CAMSA scores (ICC = .99, 95% CI [.99, 1.00]). Inter-rater reliability was also excellent for time scores (ICC = .1.00), item scores (.83, 95% CI [.75, .89]), and total CAMSA scores (ICC = 95, 95% CI [.86, .96]) (Fleiss, 1981).

Perceived motor competence

The second version of the pictorial scale of the Perceived Movement Skill Competence (PMSC; Johnson et al., 2016) validated in Spanish (Estevan et al., 2019b) was used to assess participants' PMC by means of thirteen pictographic tasks (run, gallop, hop, jump, step slide and skip, throw upper arm, catch, kick, hit, bounce, throw underarm, and racket). According to the validated protocol, the child's perception in each skill was rated from 1 (lower perception) to 4 (higher perception) by using a double dichotomy process in an interview conducted by a research assistant (Johnson et al., 2016). Results from the confirmatory factor analysis (CFA) with all items loading on one latent factor showed satisfactory fit indexes ($\chi^2(65) = 103.635$; the Comparative Fit Index (CFI) = .94; the Root Mean Square Error of Approximation (RMSEA) = .03; and the Standardized Root Mean Residual (SRMR) = .04). Cutoff values were established at CFI > .90 and RMSEA/SRMR < .08 to indicate good model fit (Cangur & Ercan, 2015; Hu & Bentler, 1999). In this model, all item loadings ranged from .38 to .55. The scale showed good reliability ($\alpha = .76$). The average score of the 13 items was used as a measure of PMC in the analyses.

Motivation

A shortened child-adapted version of the Behavioural Regulation in Exercise Questionnaire (BREQ) was used to measure participants' motivational regulations (Sebire et al., 2013). Before data collection, the scale was translated into Spanish using a back- and fordward-translation procedure (i.e., English-Spanish-English) by two independent English specialist translators. In line with previous studies (Estevan et al., 2019b), the translations were inspected by two Spanish-speaking expert-authors who validated the content of the scale and suggested minor language adjustments to the translated items. This questionnaire consisted of 12 items with a five-point Likert scale, which varied between 1 (“not true for me”) and 5 (“very true for me”) preceded by the stem “I am active because…”. Three items measured intrinsic motivation (e.g., “…being active is fun”), three measured identified regulation (e.g., “…it is important to me to do active things”), three measured introjected regulation (e.g., “…when I am not active I feel bad”), and three measured external regulation (e.g., “…other people say I should”). One item of the introjection scale (i.e., “…I want to show other people how good I am”) was ultimately removed based on the results of the modification indices that suggested this item loaded more strongly on external than introjected regulation. A CFA of the three-item factors of intrinsic, identified, and external regulation and the two-item factor of introjected regulation showed satisfactory fit indexes ($\chi^2(38) = 61.489$; CFI = .97; RMSEA = .04; SRMR = .04). All factor loadings ranged from .39 to .74. Internal consistencies were acceptable with Cronbach's alphas of .72, .54, .61, and .66 for intrinsic, identified, introjected and external regulations, respectively (Hair et al., 2014; van Griethuijsen et al., 2015).

Physical activity

The Physical Activity Questionnaire for Older Children (PAQ-C; Kowalski et al., 2004) adapted to Spanish was used (Manchola-González et al., 2017). The PAQ-C is a self-reported 7-day recall questionnaire that assesses participation in different types of physical activities (e.g., “Have you done any of the following activities…? If yes, how many times?”), as well as the level and frequency of PA during PE, lunch break, and recess (e.g., “ …what did you do most of the time at recess?”), after school, in the evenings (e.g., “…on how many evenings did you do sports, dance, or play games in which you were very active?”), and at weekends by the use of nine items scored on a five-point Likert scale ranging from 1 (low) to 5 (high). The following item “During your physical education classes, how often were you very active (playing hard, running, jumping, throwing)?" was removed because the item loading was lower than .30 (Field, 2018). Next, one last item assessed whether the participants were sick in the week previous to completing the questionnaire, or whether anything prevented them from engaging in their normal PA. This item is not included in the sum of the PAQ score but is used to detect individual's unusual PA levels. For those children reporting illness, the PAQ-C was re-administered two weeks later. A CFA on the PAQ-C after item removing revealed a good fit ($\chi^2(20) = 33.583$; CFI = .98; RMSEA = .04; SRMR = .03). The scale showed good reliability ($\alpha = .73$). All item loadings ranged from .36 to .74.

Anthropometry

Height and weight were measured without shoes, using a stadiometer scale (SECA, Hamburg, Germany) and an electronic body composition analyzer (Tanita BC-601; Tanita Corporation of America, Inc, Arlington Heights, IL), respectively. For each child, body mass index (BMI) was first calculated as weight/height^2 (kg/m^2). Subsequently, an age- and sex-adjusted BMI percentile score was calculated using a children's BMI group calculator–metric, provided by the Centers for Disease Control and Prevention (CDC, Kuczmarski et al., 2002).

Procedure

The administration of questionnaires (PAQ-C, PMSC, and BREQ) and anthropometry measurements were conducted prior to the assessment of AMC. CAMSA measurements were conducted in a large sports hall by three trained research assistants. Two were involved in the AMC assessment directly, that is, one research assistant operated the camera and another threw a soft ball to the participants and placed the ball at the kicking line. The third research assistant was responsible for demonstrating the tasks at a second, identical CAMSA circuit prior to the actual measurements. Participants were divided in groups of three and were instructed to complete the assessment as fast as possible while performing the skills to the best of their ability (Longmuir et al., 2017). Each child was allowed to perform two-practice attempts and two assessment trials. Each child's performance was video recorded at 25 Hz with a Lumix TZ7 camera (Panasonic, Japan ©) for subsequent coding.

Plan of analysis

Preliminary analyses

Descriptive and correlation analyses were conducted to examine whether age was correlated with any of the study variables, and to examine the correlation among study variables, using SPSS (Version 24; SPSS Inc., Chicago, IL, USA). To examine whether the main study variables differed according to student sex, we conducted a MANOVA with student sex as an independent variable and with the eight study variables (AMC, PMC, the four regulations, PA, and BMI percentile) as dependent variables.

Primary analyses

In relation to our first aim, a structural equation modeling (SEM) approach was used to test the hypotheses embedded in the conceptual model (Stodden et al., 2008; see Figure S1), using Mplus v.8 (Muthén & Muthén, 2017). Apart from direct paths (1a) from AMC to PMC, (1b) from AMC to PA, (1c) from PMC to PA, (1d) from PA to BMI, also indirect effects were tested from AMC to PA via PMC. In relation to our second aim, motivational regulations were added to the second model. This led to the following direct paths: (2a) from AMC to PMC, (2b) from PMC to motivational regulations, (2c) from motivational regulations to PA, (2d) from PCM to PA, and (2e) from PA to BMI. In addition, indirect effects were tested between (i) AMC and motivational regulations via PMC and (ii) PMC and PA via motivational regulations through the model indirect procedure in Mplus (Muthén & Muthén 2017). These models were computed with age and sex as covariates (see preliminary analyses).

In order to reduce the number of parameters that would be estimated, item parceling was conducted (Heitzler et al., 2010) with the PMSC and PAQ-C scales. Item parceling constitutes a common practice in SEM analyses, which involves summing together two or more items by combining the items which have the highest and lowest loading in an exploratory factor analysis (Fuller et al., 2006). In the current study, three and four parcels per factor were created (also see Haerens et al., 2015; Chan et al., 2019) for the PMSC and PAQ-C, respectively. To determine the amount of variability possibly explained by the selected factors, the R-squared (R^2) was calculated (Khodaverdi et al., 2016). Model 1 and 2 were compared by using the χ^2/df ratio, which smaller ratio suggests better model fit (Cangur & Ercan, 2015).

Results

Preliminary analyses

Acording to the CDC norms, a total of 65.9% of children were classified as under or normal weight (BMI percentile < 85th, Kuczmarski et al., 2002), while the remaining 34.1% were classified as overweight or obese (≥ 85th percentile). Means, standard deviations, and correlations among the study variables are presented in Table 1. Pearson bivariate correlations between participants' age and six of the eight study variables (AMC, PMC, identified regulation, introjected regulation, PA, and BMI percentile) were significant. Positive relations were found between age and AMC, and between age and BMI, indicating that older children obtained better scores for AMC and had a higher BMI. All other relations were negative indicating that older children reported lower PMC, identified regulation, introjected regulation, and PA.

The multivariate effect of participants' sex was significant (Wilks' Lambda = .89, $F(9,494) = 6.89$, $p < .01$, $\eta_p^2 = .11$). Univariate tests were significant for AMC ($F(1,502) = 22.42$, $p < .01$, $\eta_p^2 = .04$), PMC ($F(1,502) = 16.29$, $p < .01$, $\eta_p^2 = .03$), introjected regulation

($F(1,502) = 4.60$, $p = .03$, $\eta_p^2 = .01$), and PA ($F(1,502) = 13.54$, $p < .01$, $\eta_p^2 = .03$). Boys scored higher on AMC, PMC and PA than girls, while girls scored higher on introjected regulation (see Table 1). In light of these findings, we controlled for age and sex in the model tested in the primary analyses.

[Table 1]

Primary analyses

The first model showed an acceptable fit to the data ($\chi2(33) = 116.130$; $\chi^2/df = 3.52$; CFI = .92; RMSEA = .07; SRMR = .04). In this model, all indicator loadings ranged between .51 and .94. This model explained 18% of the variance in PA. Figure S2 represents the results of the path analysis, controlled for age and sex. In terms of direct paths, the model showed that AMC was positively associated with PMC (ß = .23, $p < .001$), which in turn was positively related to PA (ß = .27, $p < .001$). A marginally significant direct positive relation was found between AMC to PA (ß = .11, $p = .07$), while PA was not significantly associated with BMI (ß = -.07, $p = .20$). The indirect path from AMC via PMC to PA (standardized indirect effect = .06, $p = .03$, 95% CI [.01, .12]) was significant.

Adding motivation in Model 2 improved the model fit ($\chi^2(182) = 332.818$; $\chi^2/df = 1.83$; CFI = .92; RMSEA = .04; SRMR = .05). In this model, all indicator loadings ranged between .38 and .78. The addition of the motivational regulations increased the explained variance in PA to 32%. Findings thus revealed that Model 2 exhibited a smaller χ^2/df ratio ($\chi^2/df = 1.83$) and explained a larger percentage of PA (32%) than Model 1 ($\chi^2/df = 3.52$; 18%). Figure 1 represents the results of the path analysis, controlled for age and sex. In terms of direct paths, the model confirmed that AMC was positively associated with PMC (ß = .32, $p < .001$). PMC in turn was positively related to intrinsic and identified regulations (ß = .46 and ß = .43, $p < .001$), and a marginally significant direct positive relation was also found between PMC and introjected regulation (ß = .15, $p = .05$). The direct relation between PMC and PA was marginally significant (ß = .13, $p = .07$). The model further showed direct positive relations from intrinsic (ß = .27, $p = .04$) and introjected (ß = .22, $p = .04$) regulations to PA. PA was not significantly associated with BMI (ß = -.08, $p = .13$).

When moving along the model from left to right, we note that indirect paths from AMC via PMC to intrinsic (standardized indirect effect = .15, $p < .001$, 95% CI [.08, .22]) and identified regulation (standardized indirect effect = .14, $p < .001$, 95% CI [.07, .21]) were significant. The indirect path from PMC to PA via the four motivational regulations was also significant (standardized sum of indirect effect ß = .20, $p < .001$, 95% CI [.11, .29]). Inspection of the indirect paths for each motivational regulation separately showed that the indirect effect from PMC towards PA through intrinsic motivation was significant (standardized indirect effect = .13, $p = .049$, 95% CI [.00, .25]). All other indirect paths through the motivational regulations were not significant ($p < .05$).

[Figure 1]

Discussion

Examining the association among factors related to PA and in turn BMI is highly valuable in light of the promotion of a healthy lifestyle (Cairney et al., 2019; Deci & Ryan, 2002; Robinson et al., 2015; Ryan & Deci, 2017; Stodden et al., 2008). The first aim of this study was to examine the pathways from AMC via PMC to PA and BMI as outlined in the conceptual model of motor development (Robinson et al., 2015; Stodden et al., 2008) in a sample of 8- to 12-year-old Spanish children. A second aim was to test, for the first time, whether the addition of SDT's motivational regulations (Deci & Ryan, 2002) improved the conceptual model. In line with what is postulated by SDT, our model hypothesis is fulfilled as children's AMC was associated with their PMC and PA, with the AMC-PA relation fully mediated by children's PMC. The findings also supported that motivation should be considered as a crucial factor in relation to children's participation in PA (Coppens et al., 2021; Sebire et al., 2013; Ryan & Deci, 2017).

Relations between AMC-PMC and children's physical activity levels

In line with previous research (e.g., Logan et al., 2015; Barnett et al., 2021), we found a positive association between AMC and PA. This association suggests that children who are more motor competent are also more physically active (and vice versa). Yet, we did note that this association was weak and only borderline significant in the full model when controlling for other influencing factors such as PMC and motivation. The relationship between AMC and PA was thus rather weak, which aligns with the findings of Barnett and colleagues (Barnett et al., 2021) who found an unclear or non-robust association between AMC and PA when considering all available literature on this topic. We further found a positive relation between AMC and PMC, suggesting that children who are more competent will also perceive themselves as more competent. The strength of the relation was weak though, which aligns with findings from a recently published meta-analysis that reported consistent evidence for low to moderately strong relations (De Meester et al., 2020). These findings are not surprising as children (8- to-12-year-old) tend to overestimate their PMC levels (De Meester et al., 2020), thereby generating discrepancies between AMC and PMC, which could explain the weak relation found.

When compared to the relation between AMC and PA, the relation between PMC and PA was relatively stronger. It thus appears that PMC is more decisive than AMC when it comes to PA engagement in children as was also suggested in prior research (De Meester et al., 2016a). It has been suggested that the more competent children feel about their abilities, the more engaged in mastery attempts they are (Stodden et al., 2008), which affects their persistence in PA (Hulteen et al., 2018). Yet, the role of AMC should not be ignored as there appears to be a dynamic and synergistic role between AMC and PMC in driving PA engagement (Bardid et al., 2016; De Meester et al., 2016b). Specifically, we found an indirect effect from AMC to PA via PMC. In that respect, our findings align with prior studies in Australian and Finish 8- to-12 years-old, Chinese 11-12 years-old, and American 9-13 years-old children that provided evidence for a mediated relation (Barnett et al., 2008; Fu & Burns, 2018; Gu et al., 2017; Jaakkola et al., 2019). As motor abilities represent a source of information for constructing the physical self-concept (Jekauc et al., 2017), we can support that children with higher abilities (i.e., AMC) seem to be confident in relation to their motor skills (i.e., PMC) which encourages them to engage in further physical activities (De Meester et al., 2020; Jekauc et al., 2017; Stodden et al., 2008). Accordingly, children engage more in PA not only when they are competent but particularly when this leads them to feel more competent (De Meester et al., 2018; Jaakkola et al., 2019).

Adding SDT's motivational regulations to the conceptual model of motor development

The second purpose of the current study was to examine whether the conceptual model could be improved by adding SDT's motivational regulations. Up until now, few studies have analyzed the role of motivation in relation to the variables of the conceptual model (Robinson et al., 2015; Stodden et al., 2008) even though there is plenty of evidence that children's competence and success experiences can affect their motivation (Bardid et al., 2016; De Meester et al, 2016a; Estevan et al., 2021; Sebire et al., 2013; Vallerand & Losier, 1999). We found an indirect effect from AMC to intrinsic and identified regulation via PMC. The results of the tested model suggest that well-developed AMC is positively associated with psychological factors, such as PMC and motivation to engage and persist in PA. These findings align with a prior study in Belgian children (aged from 9- to 13-year-old, Coppens et al., 2021) reporting autonomously motivated children to have a higher AMC. These results are not surprising as competent children are more likely to experience a positive affect when they master experiences (i.e., increased PMC) and, it has been shown that they are also more intrinsically motivated to accept challenges (Craven & Marsh, 2008; Jekauc et al., 2017; Rose et al., 1998).

To the best of our knowledge, this study represents the first attempt to examine the indirect role of the four motivational regulations into the sequence of the conceptual model, hereby displaying that the addition of the four motivational regulations clearly improved the model with a substantial increase in explained variance in PA. The findings largely confirm the conceptual model's suggestion (Stodden et al., 2008; p. 292) that 'enjoyment' needs to be considered as one of the most common determinants of PA. Stodden and colleagues (2008) particularly suggested that those children who have limited perceived competence (low PMC) are less likely to enjoy participating in PA. The findings of the current study provide empirical support for this premise by identifying an indirect relation from PMC towards PA via intrinsic motivation. Children who felt more competent, also reported participating in PA mostly out of enjoyment, which in turn related to increased PA levels. These findings are consistent with prior research. In 7- to 11-year-old British children, Sebire et al. (2013) showed how intrinsic motivation mediated the relation between the basic psychological needs (including competence) and PA (Sebire et al., 2013). More recently, in a sample of 7- to 12-year-old Chinese children, Chan et al. (2019) also provided evidence for the mediating role of children's enjoyment in the relation between perceived physical competence (which includes perceived competence, social acceptance and athletic competence) and PA. Similarly, in a sample of 10- to 12- year-old American children, Zhang et al. (2021) found that PA enjoyment mediated the relationship between perceived competence (in basketball, overhand throwing, and striking) and PA. It seems there is consistent support of the indirect relation of intrinsic motivation in the association between PMC and PA in childhood. All together the findings of our study and prior research (Sebire et al., 2013, Chan et al., 2019, Zhang et al., 2021) confirm the postulates of SDT (Deci & Ryan, 2002), highlighting that children need to *be* competent (i.e., high AMC) and *feel* competent (by fostering their PMC) as well as enjoy PA in order to regularly participate in it.

SDT (Deci & Ryan, 2002) suggests that not only intrinsic motivation, but also identified regulation stems from enhanced feelings of competence, while feelings of incompetence or failure will more likely lead to introjected or external regulation (Haerens et al., 2015; Ryan & Deci, 2017; Ryan & Moller, 2017). These theoretical premises were only partially confirmed. As expected and in line with prior research (Çağlar & Aşçi, 2010; Coppens et al., 2021; Estevan et al., 2021; McDavid et al., 2014; Sebire et al., 2013) a positive relation was found between PMC and PA with identified regulation next to intrinsic motivation, supporting a sequential model where children's perception of competence influences their motivation which also determines their PA levels (Sebire et al., 2013; Vallerand & Losier, 1999). Children who feel more competent are thus more likely to participate in PA because they value and enjoy it. Yet, in contrast to our expectations, the relation between PMC and introjected regulation appeared positive rather than negative. Thus, children who feel more competent seem also more likely to feel internally pressured to participate in PA. Previous studies have argued that competence satisfaction in the absence of autonomy satisfaction may lead to introjected reasons to participate in an activity (Çağlar & Aşçi, 2010; Deci & Ryan, 2002; McDavid et al., 2014). Such findings were also reported in previous studies in 10- to 13- year-old U.S. children (McDavid et al. 2014-), 11 to 14 years-old Spanish (Estevan et al. 2021) as well as 16- to 19-year-old Turkish adolescents (Çağlar & Aşçi, 2010). As we did not measure childrens' autonomy satisfaction, it was not possible to test this premise. PMC though did not relate to external regulation. Feelings of competence are thus unlikely to influence external regulation (and vice versa, Ryan & Moller, 2017; Sebire et al., 2013). These findings are in line with prior research in children and adolescents (e.g., Çağlar & Aşçi, 2010; Estevan et al., 2021; McDavid et al., 2014), which showed that external regulation did not relate to PMC. Moreover, external regulation did not relate to PA in the full model confirming prior research results in 10- to 13-year-old U.S. Children (McDavid et al., 2014), 12- to 17-year-old U.S. (Nogg et al., 2021) and British adolescents (Markland & Ingledew, 2007; Taylor et al., 2017), thereby supporting the hypothesis that PA motivation associated with others' demands would be negatively associated with PA levels.

Relations with BMI

The postulated association between PA and children's weight status (Stodden et al., 2008) was not exhibited in the current study. Consistent with previous literature (Morrison et al., 2012), our findings suggest that PA engagement did not depend on BMI (and vice versa) in 8- to 12-year-old children. One explanation that has been put forward in the literature is that a higher BMI may be beneficial for some types of PA/sports such as those wherein object control (e.g., shot-put and discus throw) and/or defensive position are key (e.g., basketball, and/or rugby; Holway, & Spriet, 2011; Klungland & Sundgot-Borgen, 2012). The aforementioned reason might also explain why the hypothesized negative association between weight status and AMC (Barnett et al., 2021) was not confirmed. That is, in the current study BMI did not relate to AMC or PMC. It is proposed that children's weight status does not have to play an important role in how competent children are and feel (Deforche et al., 2003; Morano et al., 2011). For instance, in stationary activities that do not require locomotion children with unhealthy BMI can be and feel as motor competent as their counterparts with healthier BMI (Duncan et al., 2017; Southall et al., 2004; Trecoci et al., 2021).

We did find that children with a higher BMI tend to have a lower intrinsic and identified regulation, and higher external regulation, reflecting that a negative weight status is associated with less self-determined and more controlled forms of motivation. It is possible that children with a higher BMI feel more pressured by their environment to engage in PA

(Hwang & Kim, 2013; Markland & Ingledew, 2002). This matches findings from previous studies in South Korean (Hwang & Kim, 2013) and British adolescents (Markland & Ingledew, 2002), which showed the positive relation between controlled forms of motivation (external and introjected regulation) and BMI while a negative relation was found between intrinsic motivation and BMI. As the reduced individual's autonomous motivation toward PA could lead to a long-term disengagement, it is suggested that PA strategies in obese and overweight children should be tailored to increase identified and intrinsic motivation to contribute to higher PA levels (Hwang & Kim, 2013).

The role of children's age and sex

The findings regarding children's age and sex were largely in line with prior research. AMC increased with increasing age (Bolger et al., 2018) while PMC (Estevan & Barnett, 2018; van Veen et al., 2019) and PA (Griffiths et al., 2016) seemed to decrease with increasing age. The negative relation between PMC and age has been reported earlier and is subscribed to the fact that younger children seem to overestimate themselves while PMC seems to become more aligned with AMC when children grow older, as supported by the findings of the current study (see Table S1), because their cognitive ability improves (Estevan & Barnett, 2018; van Veen et al., 2019, Harter, 2012).

Furthermore, sex disparities in PA, PMC and AMC have been well-documented in prior research, with some studies reporting values in favor of boys (Barnett et al., 2015, 2016; De Meester et al., 2018; Duncan et al., 2018; Estevan et al., 2019b; Lubans et al., 2010; van Veen et al., 2019). The Spanish boys in the current study appeared to be more proficient in fundamental movement skills (also see Barnett et al., 2015, 2016; Duncan et al., 2018; Lubans et al., 2010; van Veen et al., 2019), had more positive self-perceptions (also see Duncan et al., 2018; Estevan et al., 2019b) and were more physically active (also see Barnett et al., 2015; De Meester et al., 2018) than their female counterparts.

Limitations and future directions

Some limitations of this work must be noted. Even though the BREQ scale used in the current study was translated through robust back-and-forward translation procedures with content validity of the items being confirmed by two independent Spanish experts, the internal consistency of the scales was borderline acceptable (Hair et al., 2014; van Griethuijsen et al., 2015). One of the reasons for this lower internal consistency may be that a shortened version of the original scale was used to increase the feasibility of the measures with younger children. Evidence in terms of reliability was inconsistent though with some studies using this shortened scale reporting good reliability scores (Sebire et al., 2013, 2016). As a result, particular attention could be given to further testing how to improve the internal consistency of the identified, introjected and external items and whether a longer version of the scale is needed. Also, a pictorial-based scale for children (Davies et al., 2021) has been recently published which could provide a more accurate measurement of motivational regulations in children. The second limitation was the use of self-reported PA questionnaires which has been extensively critiqued (i.e., Power et al., 2011), because in younger children it might capture biased and imprecise perceptions of PA levels (Jiménez-Pavón et al., 2010) even though PAQ scores have reported being a valid and reliable, low cost and ease of administration alternative to an accelerometer measures of PA (Janz et al., 2008; Manchola-González et al., 2017; Martínez-Gómez et al., 2009). The third limitation is related to the BMI norms (i.e., CDC, WHO, etc.) and the method of analysis (i.e., raw, percentile, or z-score) used because it might impact the findings in terms of children's distribution in different group of weigth status (Martínez-Vizcaino et al., 2008). In line with previous studies in Spanish populations (de Bont et al., 2019; Sánchez-Cruz et al., 2013), a large percentage of the current sample (34.1%) was classified as overweight or obese based on CDC norms (Kuczmarski et al., 2002). Although the prevalence rates of overweight and obesity were similar to those reported in prior studies in Spanish children that relied on CDC (Martínez-Vizcaino et al., 2008) or WHO norms (de Bont et al., 2019; Sánchez-Cruz et al., 2013), the chosen norm and method of analysis may have influenced the categorization of children as overweight or obese (Martínez-Vizcaino et al., 2008). In future studies, BMI-measures could be used in conjunction with a measure of waist circumference, which has been proven to be more related to healthy weight status (Lehto et al., 2011). For these reasons, future studies could: 1) include pictorial scales to assess psychological variables, 2) measure PA levels by using accelerometers, and 3) incorporate a diversity of variables assessing weight status (i.e., not only BMI percentiles but also waist circumference; Clark et al., 2020) to gain insights into the factors that are related to children's PA engagement under the umbrella of the motor development framework.

Practical implications

From a practical perspective, PE teachers should teach motor skills and foster AMC, as well as provide experiences/tasks that ensure children success to foster their PMC (Estevan et al., 2021) and enhance children's intrinsic motivation to encourage them to practice PA (Lander et al., 2019). Despite its importance and being recognized as key components of the PE curricula in many countries, PMC and motivation are not acknowledged in the Spanish curricula explicitly (Estevan et al., 2021). Accordingly, it is necessary to enhance students' cognitive understanding to promote a physically active lifestyle in a holistic way (McLennan & Thompson, 2015), as suggested by Physical Literacy research (Cairney et al., 2019). In this sense, a high-quality PE curriculum should promote lifelong PA engagement by providing children with learning experiences that allow them to acquire and develop their motor and emotional skills. As a result, PE interventions aiming to promote PA engagement, should focus on increasing children's AMC and, aligning their PMC to their increased AMC in a fun and safe environment.

Conclusion

This study, which was the first to include motivational variables in the conceptual model of motor development (Stodden et al., 2008), led to a more in-depth understanding of the underlying mechanisms of children's PA involvement. Specifically, Spanish 8-12-year-old children who felt more competent were more physically active, because they were more likely to enjoy participating in PA. Results suggest that the inclusion of the motivational regulations as discerned within SDT into the conceptual model of motor development will enhance our understanding of why children do or do not engage in PA.

References

Abarca-Gómez, L., Abdeen, Z.A., Hamid, Z.A., Abu-Rmeileh, N.M., Acosta-Cazares, B.,…& , Ezzati, M. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 1289 million children, adolescents, and adults. *Lancet, 390* (10113), 2627-2642.

Ajejas, M.J., Jiménez-Trujillo, M.I., Wärnberg, J., Domínguez, S., López-de-Andrés, A., & Pérez- Farinós, N. (2018). Prevalence of childhood overweight/obesity in Spain 1993-2011 and associated risk factors in 2011. *Nutrición Hospitalaria, 8*(35), 84-89. http://dx.doi.org/10.20960/nh.1355

Babic, M. J., Morgan, P. J., Plotnikoff, R. C., Lonsdale, C., White, R. L., & Lubans, D. R. (2014). Physical activity and physical self-concept in youth: Systematic review and meta-analysis. *Sports Medicine, 44*(11), 1589-1601. https://doi.org/10.1007/s40279-014-0229-z

Bardid, F., De Meester, A., Tallir, I., Cardon, G., Lenoir, M., & Haerens L. (2016). Configurations of actual and perceived motor competence among children: Associations with motivation for sports and global self-worth. *Human Movement Science, 50*, 1-9. https://doi.org/10.1016/j.humov.2016.09.001.

Barnett, L. M., Lai, S. K., Veldman, S. L., Hardy, L. L., Cliff, D. P., Morgan, P. J., ... & Okely, A. D. (2016). Correlates of gross motor competence in children and adolescents: A systematic review and meta-analysis. *Sports Medicine, 46*(11), 1663-1688. https://doi.org/10.1007/s40279-016-0495-z

Barnett, L., Morgan, P., van Beurden, E., & Beard, J. (2008). Perceived sports competence mediates the relationship between childhood motor skill proficiency and adolescent physical activity and fitness: A longitudinal assessment. *The International Journal of Behavioral Nutrition and Physical Activity, 5*(1), 40. https://doi.org/10.1186/1479-5868-5-40

Barnett, L. M., Ridgers, N. D., & Salmon, J. (2015). Associations between young children's perceived and actual ball skill competence and physical activity. *Journal of Science and Medicine in Sport, 18,* 167–171. https://doi.org/10.1016/j.jsams.2014.03.001

Barnett, L.M., Webster, E. K., Hulteen, R., De Meester, A., Valentini, N.C., Lenoir, M., Pesce, C., Getchell, N., Lopes, V.P., Robinson, L.E., Brian, A., & Rodrigues, L.P. (2021).

Through the looking glass: A systematic review of longitudinal evidence, providing new insight for motor competence and health. *Sports Medicine.* https://doi.org/10.1007/s40279-021-01516-8

Boiché, J., Sarrazin, P., Grouzet, F., Pelletier, L., & Chanal, J. (2008). Students' Motivational Profiles and Achievement Outcomes in Physical Education: A Self-Determination Perspective. *Journal of Educational Psychology, 100*(3), 688-701. https://doi.org/10.1037/0022-0663.100.3.688

Bolger, L. E., Bolger, L. A., O'Neill, C., Coughlan, E., O'Brien, W., Lacey, S., & Burns, C. (2018). Age and sex differences in fundamental movement skills among a cohort of Irish school children. *Journal of Motor Learning and Development, 6*(1), 81-100. https://doi.org/10.1123/jmld.2017-0003

Çağlar, E., & Aşçı, F. H. (2010). Motivational cluster profiles of adolescent athletes: an examination of differences in physical-self-perception. *Journal of Sports Science & Medicine, 9*(2), 231-238.

Cairney, J., Dudley, D., Kwan, M., Bulten, R., & Kriellaars, D. (2019). Physical literacy, physical activity and health: Toward an evidence-informed conceptual model. *Sports Medicine, 49*(3), 371-383.

Cangur, S., & Ercan, I. (2015). Comparison of Model Fit Indices Used in Structural Equation Modeling Under Multivariate Normality. *Journal of Modern Applied Statistical Methods, 14*(1), article 14- doi: 10.22237/jmasm/1430453580

Cao, Y., Zhang, C., Guo, R., Zhang, D., & Wang, S. (2020). Performances of the Canadian Agility and Movement Skill Assessment (CAMSA), and validity of timing components in comparison with three commonly used agility tests in Chinese boys: an exploratory study. *PeerJ, 8,* Article e8784. https://doi.org/10.7717/peerj.8784

Chan, C. H., Ha, A. S., Ng, J. Y., & Lubans, D. R. (2019). Associations between fundamental movement skill competence, physical activity and psycho-social determinants in Hong Kong Chinese children. *Journal of Sports Sciences, 37*(2), 229-236. https://doi.org/10.1080/02640414.2018.1490055

Clark, C. C., Duncan, M. J., Eyre, E. L., Stratton, G., García-Massó, X., & Estevan, I. (2020). Profiling movement behaviours in pre-school children: A self-organised map approach. *Journal of Sports Sciences, 38*(2), 150-158. https://doi.org/10.1080/02640414.2019.1686942

Coppens, E., De Meester, A., Deconinck, F. J., De Martelaer, K., Haerens, L., Bardid, F., ... & D'Hondt, E. (2021). Differences in weight status and autonomous motivation towards sports among children with various profiles of motor competence and organized sports participation. *Children, 8*(2), 156.

Crane, J. R., Naylor, P. J., Cook, R., & Temple, V. A. (2015). Do perceptions of competence mediate the relationship between fundamental motor skill proficiency and physical activity levels of children in kindergarten? *Journal of Physical Activity and Health, 12*(7), 954-961. http://dx.doi.org/10.1123/jpah.2013-0398

Craven, R.G., & Marsh, H.W. (2008). The centrality of the self-concept construct for psychological wellbeing and unlocking human potential: Implications for child and educational psychologists. *Educational & Child Psychology, 25*(2), 104-118.

Dania, A., Kaioglou, V., & Venetsanou, F. (2020). Validation of the Canadian Assessment of Physical Literacy for Greek children: Understanding assessment in response to culture and pedagogy. *European Physical Education Review,* 1–17. https://doi.org/10.1177/1356336X20904079

Dankel, S. J., Loenneke, J. P., & Loprinzi, P. D. (2016). Does the fat-but-fit paradigm hold true for all-cause mortality when considering the duration of overweight/obesity?

Analyzing the WATCH (Weight, Activity and Time Contributes to Health) paradigm. *Preventive Medicine, 83,* 37-40. https://doi.org/10.1016/j.ypmed.2015.12.002

Davies, K. F., Watson, P. M., Rudd, J. R., Roberts, S., Bardid, F., Knowles, Z., & Foweather, L. (2021). Development and validity of the Motivation Assessment Tool for Physical Education (MAT-PE) among young children. *Psychology of Sport and Exercise, 54*, 101915. https://doi.org/10.1016/j.psychsport.2021.101915

de Bont, J., Casas,M., Barrera-Gómez, J., Cirach, M., Rivas, I., Valvi,D., …. Vrijheid, M. (2019). Ambient air pollution and overweight and obesity in school-aged children in Barcelona, Spain, *Environment International, 125,* 58-64. https://doi.org/10.1016/j.envint.2019.01.048.

Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research.* University of Rochester Press

Deforche, B., Lefevre, J., De Bourdeaudhuij, I., Hills, A. P., Duquet, W., & Bouckaert, J. (2003). Physical fitness and physical activity in obese and nonobese Flemish youth. *Obesity Research, 11*(3), 434-441. https://doi.org/10.1038/oby.2003.59

De Meester, A., Barnett, L. M., Brian, A., Bowe, S. J., Jiménez-Díaz, J., Van Duyse, F., ... & Haerens, L. (2020). The Relationship Between Actual and Perceived Motor Competence in Children, Adolescents and Young Adults: A Systematic Review and Meta-analysis. *Sports Medicine, 50*(11), 2001-2049. https://doi.org/10.1007/s40279-020-01336-2

De Meester, A., Maes, J., Stodden, D., Cardon, G., Goodway J, Lenoir, M., & Haerens, L. (2016a) Identifying profiles of actual and perceived motor competence among adolescents: associations with motivation, physical activity, and sports participation. *Journal of Sports Sciences, 34*(21), 2027-2037. https://doi.org/10.1080/02640414.2016.1149608

De Meester, A., Stodden, D., Brian, A., True, L., Cardon, G., Tallir, I., & Haerens, L. (2016b). Associations among elementary school children's actual motor competence, perceived motor competence, physical activity and BMI: A cross-sectional study. *PLoS One, 11*(10):e0164600. https://doi.org/10.1371/journal.pone.0164600.

De Meester, A., Stodden, D., Goodway, J., True, L., Brian, A., Ferkel, R., & Haerens, L. (2018). Identifying a motor proficiency barrier for meeting physical activity guidelines in children. *Journal of Science and Medicine in Sport, 21*(1), 58-62. https://doi.org/10.1016/j.jsams.2017.05.007

Duncan, M. J., Bryant, E., & Stodden, D. (2017). Low fundamental movement skill proficiency is associated with high BMI and body fatness in girls but not boys aged 6–11 years old. *Journal of Sports Sciences, 35,* 21, 2135-2141. https://doi.org/10.1080/02640414.2016.1258483

Duncan, M. J., Jones, V., O'Brien, W., Barnett, L. M., & Eyre, E. L. (2018). Self-perceived and actual motor competence in young British children. *Perceptual and Motor Skills, 125*(2), 251-264. https://doi.org/10.1177/0031512517752833

Elsborg, P., Melby, P. S., Kurtzhals, M., Tremblay, M. S., Nielsen, G., & Bentsen, P. (2021). Translation and validation of the Canadian assessment of physical literacy-2 in a Danish sample. *BMC Public Health, 21*, article 2236. https://doi.org/10.1186/s12889-021-12301-7

Ensrud-Skraastad, O. K., & Haga, M. (2020). Associations between motor competence, physical self-perception and autonomous motivation for physical activity in children. *Sports, 8*(9), 120. https://doi.org/10.3390/sports8090120

Estevan, I., Bardid, F., Utesch, T., Menescardi, C., Barnett, L. M., & Castillo, I. (2021). Examining early adolescents' motivation for physical education: associations with actual and perceived motor competence. *Physical Education and Sport Pedagogy, 26*(4), 359-374. https://doi.org/10.1080/17408989.2020.1806995

Estevan, I., & Barnett, L. M. (2018). Considerations related to the definition, measurement and analysis of perceived motor competence. *Sports Medicine, 48*(12), 2685-2694.

Estevan, I., García-Massó, X., Molina García, J., & Barnett, L. M. (2019a). Identifying profiles of children at risk of being less physically active: an exploratory study using a self-organised map approach for motor competence. *Journal of Sports Sciences, 37*(12), 1356-1364. https://doi.org/10.1080/02640414.2018.1559491

Estevan, I., Molina-García, J., Queralt, A., Bowe, S. J., Abbott, G., & Barnett, L. M. (2019b). The new version of the pictorial scale of Perceived Movement Skill Competence in Spanish children: Evidence of validity and reliability. *Revista Internacional de Ciencias del Deporte, 55*(15), 35-54. https://doi.org/10.5232/ricyde2019.05503

Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics* (5th ed). Sage.

Fleiss, J.L. (1981). *Statistical methods for rates and proportions* (2nd ed.). Wiley.

Fu, Y., & Burns, R. D. (2018). Gross motor skills and school day physical activity: Mediating effect of perceived competence. *Journal of Motor Learning and Development, 6*(2), 287-300. https://doi.org/10.1123/jmld.2017-0043

Fuller, B.J., Hester, K., Barnett, T., & Relyea, L.F.C. (2006). Perceived Organizational Support and Perceived External Prestige: Predicting Organizational Attachment for University Faculty, Staff, and Administrators. *The Journal of Social Psychology, 146*(3), 327-347. https://doi.org/10.3200/SOCP.146.3.327-347

Garrido-Miguel, M., Cavero-Redondo, I., Álvarez-Bueno, C., Rodríguez-Artalejo, F., Moreno, L. A., Ruiz, J. R., ... & Martínez-Vizcaíno, V. (2019). Prevalence and trends of overweight and obesity in European children from 1999 to 2016: a systematic review and meta-analysis. *JAMA pediatrics, 173*(10), e192430-e192430.

Griffiths, L. J., Sera, F., Cortina-Borja, M., Law, C., Ness, A., & Dezateux, C. (2016). Objectively measured physical activity and sedentary time: cross-sectional and prospective associations with adiposity in the Millennium Cohort Study. *BMJ Open, 6*(4), e010366. https://doi.org/10.1136/bmjopen-2015-010366

Gu, X., Thomas, K. T., & Chen, Y. L. (2017). The role of perceived and actual motor competency on children's physical activity and cardiorespiratory fitness during middle childhood. Journal of teaching in physical education, 36(4), 388-397. https://doi.org/10.1123/jtpe.2016-0192

Haerens, L., Aelterman, N., Vansteenkiste, M., Soenens, B., & Van Petegem, S. (2015). Do perceived autonomy-supportive and controlling teaching relate to physical education students' motivational experiences through unique pathways? Distinguishing between the bright and dark side of motivation. *Psychology of Sport and Exercise, 16*(3), 26-36. https://doi.org/10.1016/j.psychsport.2014.08.013.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate Data Analysis* (7ªed.). Pearson.

Harter (2012). *Self-Perception Profile for Children: Manual and Questionnaires.* Denver CO: University of Denver.

Heitzler, C.D., Lytle, L.A., Erickson, D.J., Barr-Anderson, D., Sirard, J.R., & Story, M. (2010). Evaluating a Model of Youth Physical Activity. *American journal of health behavior, 34*(5), 593–606. https://doi.org/10.5993/AJHB.34.5.9

Holway, F. E., & Spriet, L. L. (2011). Sport-specific nutrition: practical strategies for team sports. J*ournal of Sports Sciences, 29*(sup1), S115-S125. https://doi.org/10.1080/02640414.2011.605459

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Hulteen, R. M., Morgan, P. J., Barnett, L. M., Stodden, D. F., & Lubans, D. R. (2018). Development of foundational movement skills: a conceptual model for physical activity across the lifespan, *Sports medicine*, *48*(7), 1533-1540. https://doi.org/10.1007/s40279-018-0892-6.

Hwang, J., & Kim, Y. H. (2013). Physical activity and its related motivational attributes in adolescents with different BMI. *International Journal of Behavioral Medicine, 20*(1), 106-113. https://doi.org/10.1007/s12529-011-9196-z

Jaakkola, T., Yli-Piipari, S., Huotari, P., Watt, A., & Liukkonen, J. (2016a). Fundamental movement skills and physical fitness as predictors of physical activity: A 6-year follow-up study. *Scandinavian Journal of Medicine & Science in Sports*, 26(1), 74–81. https://doi.org/10.1111/sms.12407

Jaakkola, T., Huhtiniemi, M., Salin, K., Seppälä, S., Lahti, J., Hakonen, H., & Stodden, D.F. (2019). Motor competence, perceived physical competence, physical fitness, and physical activity within Finnish children. *Scandinavian Journal of Medicine & Science in Sports, 29,* 1013–1021. https://doi.org/10.1111/sms.13412

Jaakkola, T., Yli-Piipari, S., Watt, A., & Liukkonen, J. (2016b). Perceived physical competence towards physical activity, and motivation and enjoyment in physical education as longitudinal predictors of adolescents' self-reported physical activity. *Journal of Science and Medicine in Sport, 19*(9), 750-754. https://doi.org/10.1016/j.jsams.2015.11.003

Janz, K. F., Lutuchy, E. M., Wenthe, P., & Levy, S. M. (2008). Measuring activity in children and adolescents using self-report: PAQ-C and PAQ-A. *Medicine and Science in Sports and Exercise, 40*(4), 767-772. https://doi.org/10.1249/mss.0b013e3181620ed1

Jekauc, D., Wagner, M. O., Herrmann, C., Hegazy, K., & Woll, A. (2017). Does physical self-concept mediate the relationship between motor abilities and physical activity in adolescents and young adults? *PLOS One, 12*(1), e0168539. https://doi.org/10.1371/journal.pone.0168539

Jiménez-Pavón, D., Kelly, J., & Reilly, J. J. (2010). Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review. *International Journal of Pediatric Obesity,* 5(1), 3-18.

Johnson, T. M., Ridgers, N. D., Hulteen, R. M., Mellecker, R. R., & Barnett, L. M. (2016). Does playing a sports active video game improve young children's ball skill competence? *Journal of Science and Medicine in Sport, 19*(5), 432-436. https://doi.org/10.1016/j.jsams.2015.05.002

Kalaja, S., Jaakkola, T., Liukkonen, J., & Watt, A. (2010). Fundamental movement skills and motivational factors influencing engagement in physical activity. *Perceptual and motor skills, 111*(1), 115-128. https://doi.org/10.2466/06.10.25.PMS.111.4.115-128

Kalaja, S., Jaakkola, T., Watt, A., Liukkonen, J., & Ommundsen, Y. (2009). The associations between seventh grade Finnish students' motivational climate, perceived competence, self-determined motivation, and fundamental movement skills. *European Physical education review, 15*(3), 315-335. https://doi.org/10.1177/1356336X09364714]

Khodaverdi, Z., Bahram, A., Stodden, D., & Kazemnejad, A. (2016). The relationship between actual motor competence and physical activity in children: mediating roles of perceived motor competence and health-related physical fitness, *Journal of Sports Sciences, 34*(16), 1523-1529. https://doi.org/10.1080/02640414.2015.1122202

Kiphard, E. J., & Schilling, F. (2007). *Körperkoordinationstest für kinder.* KTK. Beltz-Test.

Klungland, M., & Sundgot-Borgen, J. (2012). Are under-and overweight female elite athletes thin and fat? A controlled study. *Medicine & Science in Sports & Exercise, 44*(5), 949-957. https://doi.org/10.1249/MSS.0b013e31823fe4ef

Kowalski, K.C., Crocker, R.E., & Donen, R.M. (2004). *The Physical Activity Questionnaire for Older Children (PAC-C) and Adolescents (PAQ-A) Manual.* Saskatoon, Canada: University of Saskatchewan.

Kuczmarski, R.J., Ogden, C.L., Guo, S.S., Grummer-Strawn, L.M., Flegal, K.M., Mei, Z., Wei, R., Curtin, L.R., Roche, A.F., & Johnson, C.L. (2002). *CDC Growth Charts for the United States: methods and development.* Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

Lander, N., Mergen, J., Morgan, P. J., Salmon, J., & Barnett, L. M. (2019). Can a teacher-led RCT improve adolescent girls' physical self-perception and perceived motor competence? *Journal of Sports Sciences, 37*(4), 357-363. https://doi.org/10.1080/02640414.2018.1504397

Lander, N. J., Morgan, P. J., Salmon, J., & Barnett, L. M. (2015). Teachers' perceptions of a fundamental movement skill (FMS) assessment battery in a school setting. *Measurement in Physical Education and Exercise Science, 20*(1), 1–13. https://doi.org/10.1080/1091367X.2015.1095758

Lander, N., Morgan, P. J., Salmon, J. O., & Barnett, L. M. (2017). Improving Early Adolescent Girls' Motor Skill: A Cluster Randomized Controlled Trial. *Medicine and science in sports and exercise, 49*(12), 2498–2505. https://doi.org/10.1249/MSS.0000000000001382

Lehto, R., Ray, C., Lahti-Koski, M., & Roos, E. (2011). Health behaviors, waist circumference and waist-to-height ratio in children. *European Journal of Clinical Nutrition, 65*(7), 841-848.

Logan, S. W., Ross, S. M., Chee, K., Stodden, D. F., & Robinson, L. E. (2018). Fundamental motor skills: A systematic review of terminology. *Journal of Sports Sciences, 36*(7), 781-796. https://doi.org/10.1080/02640414.2017.1340660

Logan, S. W., Webster, E. K., Getchell, N., Pfeiffer, K. A., & Robinson, L. E. (2015). Relationship between fundamental motor skill competence and physical activity during childhood and adolescence: A systematic review. *Kinesiology Review, 4*(4), 416-426. http://dx.doi.org/10.1123/kr.2013-0012

Longmuir, P.E., Boyer, C., Lloyd, M., Borghese, M.M., Knight, E., Saunders, T.J., Boiarskaia, E., Zhu, W., & Tremblay, M.S. (2017). Canadian agility and movement skill assessment (CAMSA): validity, objectivity, and reliability evidence for children 8–12 years of age. *Journal of sport and health science,6*(2), 231–40. https://doi.org/10.1016/j.jshs.2015.11.004

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental movement skills in children and adolescents. *Sports medicine, 40*(12), 1019-1035. https://doi.org/10.2165/11536850-000000000-00000

Manchola-González, J., Bagur-Calafat, C., & Girabent-Farrés, M. (2017). Reliability Spanish Version of Questionnaire of Physical Activity PAQ-C. *Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte, 17*(65), 139-152. http://dx.doi.org/10.15366/rimcafd2017.65.008

Markland, D., & Ingledew, D.J. (2007). The relationships between body mass and body image and relative autonomy for exercise among adolescent males and females. *Psychology of Sport and Exercise, 8,* 836–853. https://doi.org/10.1016/j.psychsport.2006.11.002

Martínez-Gómez, D., Martínez-de-Haro, V., Pozo, T., Welk, G. J., Villagra, A., Calle, M. E., ... & Veiga, O. L. (2009). Reliability and validity of the PAQ-A questionnaire to assess physical activity in Spanish adolescents. *Revista Española de Salud Pública, 83*(3), 427-439. http://dx.doi.org/10.1590/s1135-57272009000300008

Martínez-Vizcaino, V., López, M. S., Martínez, P. M., Martinez, M. S., Pacheco, B. N., Aguilar, F. S., & Rodríguez-Artalejo, F. (2008). Trends in excess weight and thinness among Spanish schoolchildren in the period 1992–2004: the Cuenca study. *Public Health Nutrition, 12*(7), 1015-1018. https://doi.org/10.1017/S1368980008003571

Martínez-Vizcaíno, V., Pozuelo-Carrascosa, D.P., García-Prieto, J.C., Cavero-Redondo, I., Solera-Martínez, M., …Sánchez-López, M. (2020). Effectiveness of a school-based physical activity intervention on adiposity, fitness and blood pressure: MOVI-KIDS study. *British Journal of Sports Medicine, 54*, 279–285.

McDavid, L., Cox, A. E., & McDonough, M. H. (2014). Need fulfillment and motivation in physical education predict trajectories of change in leisure-time physical activity in early adolescence. *Psychology of Sport and Exercise, 15*(5), 471-480. https://doi.org/10.1016/j.psychsport.2014.04.006

McLennan, N., & Thompson, J. (2015). *Quality Physical Education. In Guidelines for Policy-Makers.* UNESCO.

Mendoza-Muñoz, M., Barrios-Fernández, S., Adsuar, J. C., Pastor-Cisneros, R., Risco-Gil, M., García-Gordillo, M. Á., & Carlos-Vivas, J. (2021). Influence of body composition on physical literacy in spanish children. *Biology, 10*(6), 482. https://doi.org/10.3390/biology10060482

Menescardi, C., Villarrasa-Sapiña, I., Lander, N., & Estevan, I. (2022). Canadian Agility Movement Skill Assessment (CAMSA) in a Spanish Context: Evidences of Reliability and Validity. *Measurement in Physical Education and Exercise Science.* https://doi.org/10.1080/1091367X.2021.2020794

Mielgo-Ayuso, J., Aparicio-Ugarriza, R., Castillo, A., Ruiz, E., Ávila, J. M., Aranceta-Batrina, J., … González-Gross, M. (2016). Physical activity patterns of the Spanish population are mostly determined by sex and age: Findings in the ANIBES study. *PloS One, 11*(2), e0149969.

Morano, M., Colella, D., & Capranica, L. (2011). Body image, perceived and actual physical abilities in normal-weight and overweight boys involved in individual and team sports. *Journal of Sports Sciences, 29*(4), 355-362.https://doi.org/10.1080/02640414.2010.530678

Morrison, K. M., Bugge, A., El-Naaman, B., Eisenmann, J. C., Froberg, K., Pfeiffer, K. A., & Andersen, L. B. (2012). Inter-relationships among physical activity, body fat, and motor performance in 6-to 8-year-old Danish children. *Pediatric Exercise Science, 24*(2), 199-209.

Muthén, L. K., & Muthén, B. O. (2017). *Mplus user's guide*. (Eigth ed.). Muthén & Muthén.

Ng, M., Fleming, T., Robinson, M., Thompson, B., Graetz, N., …& Gakidou, E. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: A systematic analysis for the Global Burden of Disease Study 2013. *Lancet,* 384, 766–81

Nogg, K. A., Vaughn, A. A., Levy, S. S., & Blashill, A. J. (2021). Motivation for Physical Activity among US Adolescents: A Self-Determination Theory Perspective. *Annals of Behavioral Medicine, 55,* 133–143. https://doi.org/10.1093/abm/kaaa037

Power, T. G., Ullrich-French, S. C., Steele, M. M., Daratha, K. B., & Bindler, R. C. (2011). Obesity, cardiovascular fitness, and physically active adolescents' motivations for activity: A self-determination theory approach. *Psychology of Sport and Exercise, 12*(6), 593-598. https://doi.org/10.1016/j.psychsport.2011.07.002

Robinson, L.E., Stodden, D.F., Barnett, L., Lopes, V.P., Logan, S.W…, & D'Hondt, E. (2015). Motor Competence and its Effect on Positive Developmental Trajectories of Health. *Sports Medicine, 45*(9), 1273-1284. https://doi.org/ 10.1007/s40279-015-0351-6

Rose, B., Larking, D., & Berger, B.G. (1998). The Importance of Motor Coordination for Children's Motivational Orientations in Sport. *Adapted Physical Activity Quarterly, 15,* 316-327.

Ryan, R. M., & Deci, E. L. (2017). *Self-determination Theory: Basic Psychological Needs in Motivation, Development and Wellness.* The Guilford Press.

Ryan, R. M., & Moller, A.C. (2017). Competence as Central, but Not Sufficient, for High-Quality Motivation: A self-determination theory. In A. J. Elliot, C.S. Dweck, & D.S. Yeager (Eds.), *Handbook of Competence and Motivation: Theory and Application* (2ed.) (pp. 214-231). The Guilford Press.

Sánchez-Cruz, J. J., Jiménez-Moleón, J. J., Fernández-Quesada, F., & Sánchez, M. J. (2013). Prevalence of child and youth obesity in Spain in 2012. *Revista Española de Cardiología, 66*(5), 371-376.

Sebire, S. J., Edwards, M. J., Fox, K. R., Davies, B., Banfield, K., Wood, L., & Jago, R. (2016). Delivery and receipt of a self-determination-theory-based extracurricular physical activity intervention: exploring theoretical Fidelity in action 3: 30. *Journal of Sport and Exercise Psychology, 38*(4), 381-395. https://doi.org/10.1123/jsep.2015-0217

Sebire, S. J., Jago, R., Fox, K. R., Edwards, M. J., & Thompson, J. L. (2013). Testing a self-determination theory model of children's physical activity motivation: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity, 10*(1), 111.

Southall, J. E., Okely, A. D., & Steele, J. R. (2004). Actual and perceived physical competence in overweight and nonoverweight children. *Pediatric Exercise Science, 16*(1), 15-24. https://doi.org/10.1123/pes.16.1.15

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest, 60*(2), 290-306. https://doi.org/10.1080/00336297.2008.10483582

Taylor, I. M. (2017). Reciprocal effects of motivation in physical education and self-reported physical activity. *Psychology of Sport and Exercise, 31,* 131-138. http://dx.doi.org/10.1016/j.psychsport.2017.01.003

Trecroci, A., Invernizzi, P. L., Monacis, D., & Colella, D. (2021). Actual and perceived motor competence in relation to body mass index in primary school-aged children: A systematic review. *Sustainability, 13*(17), 9994. https://doi.org/10.3390/su13179994

Tyler, R., Foweather, L., Mackintosh, K. A., & Stratton, G. (2018). A Dynamic Assessment of Children's Physical Competence: The Dragon Challenge. *Medicine and science in sports and exercise*, *50*(12), 2474–2487. https://doi.org/10.1249/MSS.0000000000001739

Vallerand, R. J., & Losier, G. F. (1999). An integrative analysis of intrinsic and extrinsic motivation in sport. *Journal of Applied Sport Psychology, 11*(1), 142–169. https://doi.org/10.1080/10413209908402956

van Griethuijsen, R. A., van Eijck, M. W., Haste, H., den Brok, P. J., Skinner, N. C., Mansour, N., ... & BouJaoude, S. (2015). Global patterns in students' views of science and interest in science. *Research in science education, 45*(4), 581-603.

van Veen, C., Schott, N., Lander, N., Tietjens, M., Hinkley, T., Dreiskämper, D., ... & Barnett, L. M. (2020). The stability of perceived motor competence of primary school children from two countries over one year. *Measurement in Physical Education and Exercise Science, 24*(1), 74-80. https://doi.org/10.1080/1091367X.2019.1675665

Welk, G. J. (1999) The Youth Physical Activity Promotion Model: A Conceptual Bridge Between Theory and Practice, *Quest, 51*(1), 5-23. https://doi.org/10.1080/00336297.1999.10484297

Zhang, T., Lee, J., Barnett, L. M., & Gu, X. (2021). Does Perceived Competence Mediate between Ball Skills and Children's Physical Activity and Enjoyment? *Children, 8,* 575. https://doi.org/ 10.3390/children8070575

Table 1

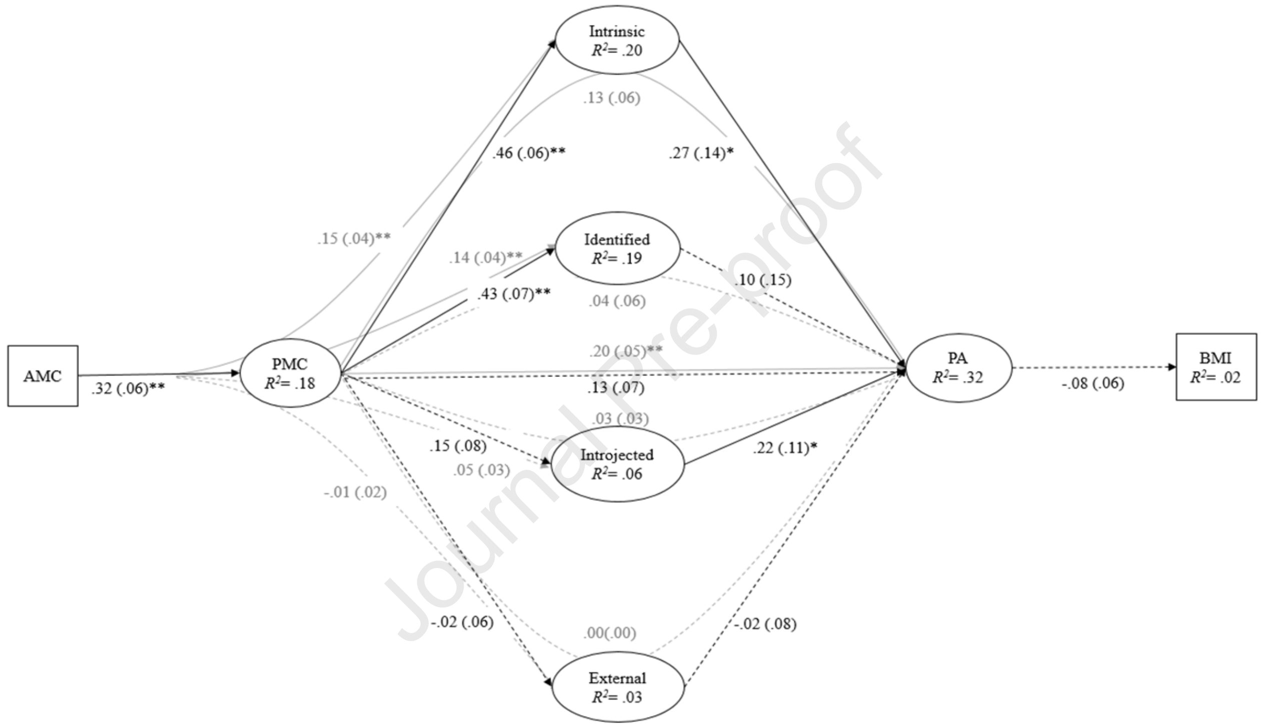
Descriptive statistics, results of the MANOVA and correlations analyses

	Total sample	*F*- value	Boys	Girls	Correlations							
	Mean (SD)		*Mean (SD)*	*Mean (SD)*	1	2	3	4	5	6	7	8
1. Age	9.48 (1.16)	.95	9.53 (1.17)	9.43 (1.15)	-							
2. AMC	19.53 (3.37)	22.42**	20.18 (3.42)	18.78 (3.16)	.39**	-						
3. PMC	3.08 (.44)	16.29**	3.15 (.39)	2.99 (.48)	-.20**	.17**	-					
4. Intrinsic	4.58 (.63)	1.00	4.61 (.61)	4.55 (.65)	-.08	.17**	.33**	-				
5. Identified	4.48 (.61)	.66	4.50 (.60)	4.45 (.63)	-.10*	.13**	.26**	.47**	-			
6. Introjected	3.04 (1.18)	4.60*	2.94 (1.18)	3.16 (1.17)	-.14**	-.02	.11*	.16**	.28**	-		
7. External	2.62 (1.16)	2.21	2.69 (1.19)	2.53 (1.13)	-.09	-.12**	.03	.00	.12**	.27**	-	
8. PA	3.11 (.73)	13.54**	3.22 (.73)	2.98 (.72)	-.12**	.10*	.27**	.31**	.28**	.22**	.10**	-
9. BMI %tile	63.20 (29.40)	2.07	64.94 (28.71)	61.17 (30.13)	.11*	-.05	-.01	-.17**	-.09*	-.02	.09*	-.04

Note: SD = Standard deviation, Age expressed in years, AMC = Actual motor competence (minimum -maximum: 1- 28), PMC = Perceived motor competence (1-4), Intrinsic = intrinsic motivation, identified = identified regulation, introjected = introjected regulation = external = external regulation (1-5), PA = physical activity (1-5), BMI %tile = body mass index percentile value. ***p* ≤ .01, * *p* ≤ .05.

Figure 1

Path model for relations between AMC, PMC, motivational regulations, PA, and BMI



Note. Representation of the standardized coefficients (ß) and standard errors (SE) as estimated in the full model. Black and grey values refer to direct and indirect relations, respectively. Solid and dashed arrows indicate significant and non-significant relations, respectively. *p < .05; **p < .01. Latent variables are represented with circles and measured variables are represented with squares. Parceled items – perceived motor competence (PMC1-PMC3) and physical activity (PA1-PA4). PMC1 = items 9 ,12, 17, 20; PMC2 = items 8, 10-11, 15; PMC3 = items 13, 14, 16, 18, 19; PA1 = items 5, 6; PA2 = items 4, 9; PA3 = items 1, 7; PA4= items 3,8. Factor loadings (λ): Intrinsic motivation: λ_{BREQ1} = .682; λ_{BREQ5} = .637; λ_{BREQ9} = .717; Identified regulation: λ_{BREQ2} = .543; λ_{BREQ6} = .653; λ_{BREQ10} = .381; Introjected regulation: λ_{BREQ3} = .580; λ_{BREQ7} = .756; External regulation: λ_{BREQ4} = .441; λ_{BREQ8} = .747; λ_{BREQ12} = .772; λ_{PMC1} = .697; λ_{PMC2} = .743; λ_{PMC3} = .775; λ_{PA1} = .558; λ_{PA2}= .712; λ_{PA3}= .562; λ_{PA4}= .665.

Highlights

- The mediation role of children's perceived motor competence in the relation between their actual motor competence and physical activity is evidenced.
- The association between children's perceived motor competence and physical activity is mediated by intrinsic motivation.
- The examination of the role of the motivational regulations in between the children's perceived motor competence-physical activity relation into the conceptual model of motor development requires further research.
- Results suggest that it is not only important to build and develop children's actual and perceived motor competence, but also to foster their intrinsic motivation to promote children's physical activity engagement.

The role of motivation into the conceptual model of motor development in childhood

Declarations of interest: none.

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