Check for updates

RESEARCH ARTICLE

REVISED Moderate and vigorous physical activity show intensity specific familial and interpersonal association patterns in 9–12-year-olds: A cross-sectional DE-PASS study

[version 4; peer review: 2 approved]

Previous titled: Moderate and vigorous physical activity show distinct familial and interpersonal association patterns in 9–12-year-olds: A cross-sectional DE-PASS study

Flávio Ferreira[1], Kieran Dowd[2], Alan Coffey[2], Greet Cardon[3], Evelien Iliano[3], Jan Dygrýn[4], Jana Pelclová[4], António Labisa Palmeira[1,5,6], Eco J. C. de Geus[7]

[1]Lusófona University of Humanities and Technologies Faculty of Physical Education and Sport, Lisbon, Lisbon, Portugal
[2]Department of Sport and Health Sciences, Technological University of the Shannon Midlands Midwest Faculty of Science and Health, Athlone, County Westmeath, Ireland
[3]Department of Movement and Sports Sciences, Ghent University Faculty of Medicine and Health Sciences, Ghent, Flanders, Belgium
[4]Palacky University Olomouc Faculty of Physical Culture, Olomouc, Olomouc Region, Czech Republic
[5]Lusófona University of Humanities and Technologies Research Center on Sports Physical Education Exercise and Health, Lisbon, Lisbon, Portugal
[6]University of Porto Research Centre for Training Innovation and Intervention in Sport, Porto, Porto District, Portugal
[7]Department of Biological Psychology, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands

v4 **First published:** 28 Oct 2025, **5**:331
https://doi.org/10.12688/openreseurope.21538.1

Second version: 10 Mar 2026, **5**:331
https://doi.org/10.12688/openreseurope.21538.2

Third version: 08 Jul 2026, **5**:331
https://doi.org/10.12688/openreseurope.21538.3

Latest published: 02 Sep 2026, **5**:331
https://doi.org/10.12688/openreseurope.21538.4

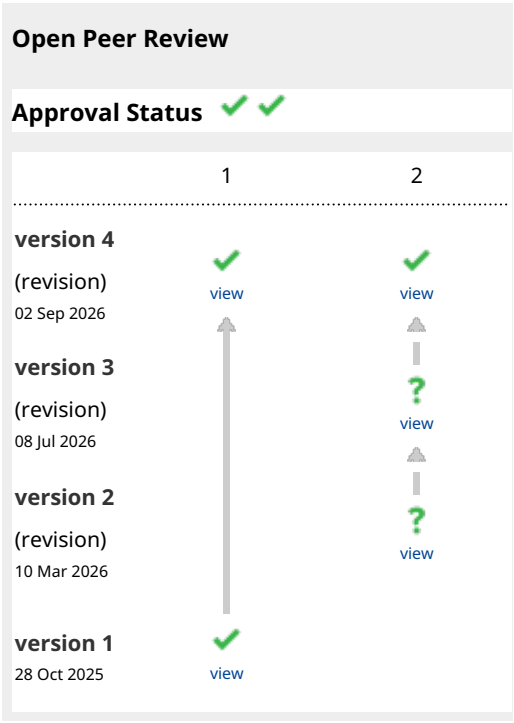
Abstract

Background

Research on children's physical activity often examines interpersonal associations but commonly aggregates MPA and VPA into a single MVPA outcome. This approach may obscure intensity-specific association patterns, particularly in intergenerational analyses.

Methods

This cross-sectional study used harmonized data from the European DE-PASS project, including children aged 9–12 years and one of their



parents. Waist-worn accelerometry was used to assess MPA and VPA. Perceived parental, peer, and teacher support were measured using validated questionnaires. Intensity-specific associations between parent and child physical activity and between interpersonal support variables and children's activity were examined, including sex-stratified and socioeconomic sensitivity analyses.

Results

Parent–child associations differed by activity intensity. Parent–child resemblance was numerically larger for MPA than for VPA, although the difference between intensities was not statistically significant when formally compared; associations involving VPA were weaker and less consistent. Parental co-participation support showed a weak positive association (which did not survive correction for multiple testing) with children's MPA, whereas peer and teacher support showed limited or no associations with children's activity at either intensity. Sex-stratified analyses indicated similar MPA associations across boys and girls, while associations for VPA were not observed among girls. Aggregating MPA and VPA into MVPA may obscure these intensity-specific patterns.

Conclusions

These findings indicate that interpersonal associations with children's physical activity differ by intensity and support examining MPA and VPA as intensity-specific outcomes in intergenerational analyses. Family-based approaches focusing on MPA may represent a pausible direction for future longitudinal and intervention research, while different strategies may be needed to address VPA.

Plain Language Summary

This study looked at how parents, friends, and teachers might influence how active children aged 9 to 12 are in their daily lives. Physical activity is very important for children's growth and health. Doctors and health organizations recommend at least an hour of activity each day, yet most children around the world are not reaching this level. Being active helps children control their weight, strengthen their bones and muscles, and reduce the risk of health problems later in life.

Researchers in Belgium, Czechia, and Ireland asked 181 families to take part. Both children and their parents wore activity trackers for eight days to measure how much moderate activity (like walking or playing outside) and vigorous activity (like running or sports) they did. Children also filled in questionnaires about how much support children felt from parents, friends, and teachers.

The results showed that children were more active when their parents

1. **Aysegul Simsek**, Marmara University, İstanbul, Turkey
2. **Darko Jekauc**, KarlsruheInstitute of Technology, Karlsruhe, Germany

Any reports and responses or comments on the article can be found at the end of the article.

were active, especially for moderate activities. For example, if parents often walked or cycled, children were more likely to do the same. Vigorous activity, such as sports, showed weaker links to parents' behaviour and was only slightly connected to friends' encouragement. Teacher support was not found to make a difference in this study.

These findings suggest that the best way to help children be more active is through family involvement, especially when parents take part in activities with their children. Friends' influence may become more important as children get older, but for this age group, parents are the strongest role models. This knowledge can help shape programs that aim to get children moving more often and more effectively.

Keywords
Accelerometry; Physical activity intensity; Interpersonal Support; Parental modelling

This article is included in the COST Actions gateway.

Corresponding author: Flávio Ferreira (flavio_ferreira931@hotmail.com)

Author roles: Ferreira F: Conceptualization, Data Curation, Formal Analysis, Methodology, Writing – Original Draft Preparation; **Dowd K**: Investigation, Writing – Review & Editing; **Coffey A**: Investigation, Writing – Review & Editing; **Cardon G**: Investigation, Writing – Review & Editing; **Iliano E**: Investigation, Writing – Review & Editing; **Dygrýn J**: Investigation, Writing – Review & Editing; **Pelclová J**: Investigation, Writing – Review & Editing; **Labisa Palmeira A**: Conceptualization, Validation, Writing – Review & Editing; **de Geus EJC**: Investigation, Supervision

Competing interests: No competing interests were disclosed.

Grant information: This article/publication is based upon work from COST Action CA19101 Determinants of Physical Activities in Settings (DE-PASS), supported by COST (European Cooperation in Science and Technology). The content of this article reflects only the authors' views, and the European Community is not liable for any use that may be made of the information contained therein. COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.
The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Copyright: © 2026 Ferreira F *et al*. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

How to cite this article: Ferreira F, Dowd K, Coffey A *et al.* **Moderate and vigorous physical activity show intensity specific familial and interpersonal association patterns in 9–12-year-olds: A cross-sectional DE-PASS study [version 4; peer review: 2 approved]** Open Research Europe 2026, **5**:331 https://doi.org/10.12688/openreseurope.21538.4

First published: 28 Oct 2025, **5**:331 https://doi.org/10.12688/openreseurope.21538.1

REVISED **Amendments from Version 3**

Revision includes title slightly changed followed by discussion part revised with new paragraph included as Because parental VPA was low and with a high frequency of values at or near zero, its restricted variance and the resulting tied ranks reduce the reliability of the parent–child VPA correlation and the statistical power of the formal intensity comparison; the non-significant difference should be interpreted with this limitation in mind rather than as evidence of equivalent resemblance. Conclusion part added with a plausible direction for future longitudinal or invertention research since parental VPA is distributed differently from children's, but more targeted studies are needed to fully corroborate this.

Any further responses from the reviewers can be found at the end of the article

Introduction

Physical activity is essential for healthy growth and development in childhood. The World Health Organization 2020 guidelines recommend that children and adolescents aged 5 to 17 years accumulate at least 60 minutes per day of moderate to vigorous physical activity (MVPA), with muscle and bone strengthening at least three times per week (Bull *et al.*, 2020). Despite this, over 80% of children and adolescents worldwide fall short of these targets, increasing risk for obesity, cardiometabolic disorders, and suboptimal skeletal accrual during key developmental years (Guthold *et al.*, 2020). Identifying associations with physical activity remains important for informing intervention development and policy, recognizing that these factors operate across individual, interpersonal, school, and environmental levels (Kolovelonis *et al.*, 2024).

Within social ecological frameworks, children's physical activity is understood to reflect the combined contribution of intrapersonal, interpersonal, environmental, and policy level factors (Sallis *et al.*, 2000). At the interpersonal level, support from parents, peers, and teachers has been examined as a correlate of children's physical activity. Parental support shows consistent associations with child physical activity in questionnaire-based studies, although effect sizes are often attenuated when activity is assessed via device-based measures (Yao & Rhodes, 2015). When both parent and child activity are measured using accelerometry, associations with parental support are typically small, with correlation coefficients around 0.2 (Sarker *et al.*, 2015; Trost & Loprinzi, 2011). Peer support has also been associated with physical activity in pre-adolescents and adolescents, although findings vary by age group, measurement approach, and activity context (Khan *et al.*, 2020). Teacher support has been shown to increase school time physical activity in intervention settings, but its independent association with total daily activity measured by accelerometry is often weak or non-significant (Sallis *et al.*, 2002; Sheridan *et al.*, 2014).

At the family level, parent and child physical activity are frequently associated. Studies using both self-reported and device-based measures consistently report positive correlations between parent and child activity levels (Bringolf Isler *et al.*, 2018). These associations are often discussed in literature in terms of parental modelling, broadly defined as the co-occurrence of parental and child activity behaviors within the family context (Bois *et al.*, 2005). However, parent–child resemblance in physical activity may arise from multiple sources, including shared routines, shared environments, and genetic relatedness. Evidence from genetically informed designs indicates that a substantial proportion of parent–child similarity in physical activity is attributable to genetic and shared environmental factors, limiting causal interpretation of behavioral pathways in observational studies (de Geus *et al*., 2023).

The intensity of physical activity is associated with distinct health outcomes. Moderate intensity physical activity (MPA, 3.0–5.9 metabolic equivalents) is linked to weight management, glycemic regulation, and lipid metabolism, whereas vigorous intensity physical activity (VPA, $\geq$ 6.0 metabolic equivalents) provides additional benefits for cardiorespiratory fitness and musculoskeletal health (Herrmann *et al.*, 2024; Poon *et al.*, 2021; WHO, 2020). Regular participation in MPA is consistently associated with reductions in adiposity and improvements in metabolic risk factors, while VPA and interval-based activity elicit greater gains in aerobic capacity and glucose control (Gallardo Gómez *et al.*, 2024; Mendes *et al.*, 2019; Syeda *et al.*, 2023). High impact activities characteristic of VPA, such as running and jumping, stimulate osteogenesis and support the accrual of peak bone mass, a key determinant of fracture risk later in life (Chevalley & Rizzoli, 2022; Miao *et al.*, 2025; Ng *et al.*, 2023).

Accurate assessment of activity intensity is therefore essential. Waist worn accelerometry provides time resolved measurement of physical activity that can be classified into intensity bands using validated cut points (Evenson *et al.*, 2008). In contrast, self-report instruments are subject to recall error and social desirability bias and show only modest agreement with accelerometer derived estimates of activity (Duncan *et al.*, 2005).

Most research examining associations with children's physical activity aggregates MPA and VPA activity into a single MVPA construct, as highlighted in the meta-analysis by Petersen et al. (2020). This practice may obscure intensity specific association patterns. Evidence from studies that separate activity by intensity indicates that parent–child resemblance is typically stronger for MPA than for VPA, while associations involving VPA are weaker and more variable (Petersen *et al.*, 2020). These differences suggest that MPA and VPA may represent distinct behavioral constructs rather than interchangeable components of a single outcome. Notably, VPA confers substantially greater health benefits per minute of activity compared with MPA, including stronger associations with reductions in all-cause mortality (Biswas *et al.*, 2025). Despite this, intensity specific associations remain underexplored, particularly in studies that combine device-based measures of physical activity with questionnaire-based assessments of interpersonal factors.

Children aged 9 to 12 years represent a developmental stage characterized by increasing autonomy alongside continued dependence on family and school environments (Yao & Rhodes, 2015). During this period, children's physical activity patterns occur primarily within the home and school contexts, while peer related activity becomes more prominent but remains variable. Empirical evidence indicates that parent–child associations in physical activity are more consistently observed at this age than peer or teacher associations, although the strength and nature of these associations vary by activity intensity and measurement approach (Li-juan *et al.*, 2017).

The present study draws on a subset of data from the European COST Action DE-PASS (Determinants of Physical Activities in Settings), which aims to identify and measure factors associated with physical activity behaviors across the lifespan and in different settings. One DE-PASS working group focused specifically on children aged 9 to 12 years and developed harmonized protocols for device based physical activity assessment and questionnaire-based measurement of interpersonal factors across participating countries (Palmeira *et al.*, 2024). These procedures were designed to ensure methodological consistency and cross-national comparability. While the broader DE-PASS project addresses multiple research questions, the present study focuses on an intensity specific analysis that has not been examined in the main consortium outputs.

In this study, accelerometry was used to quantify daily MPA and VPA in children and their parents, and validated questionnaires were used to assess perceived parental, peer, and teacher support (Palmeira *et al.*, 2024). Analyses focused on describing intensity specific associations between child and parent physical activity and between interpersonal support measures and child physical activity outcomes. The aims were to compare the strength of associations for MPA and VPA, to examine whether interpersonal support variables differed in their associations across activity intensities, and to assess whether separating MPA and VPA provided clearer insight than aggregated MVPA. In addition, sex stratified analyses were conducted to examine whether associations between parent and child MPA and VPA differed between boys and girls. Further analyses examined whether these associations differed by household socioeconomic context, as indicated by financial indicators.

Methods

Study design and setting

This cross-sectional study was conducted in primary schools across three European countries (Belgium, Czechia, and Ireland) between September 2023 and October 2024. Ethical approval for this study was obtained independently in each participating country. In Ireland, approval was obtained from the Research Ethics Committee of the Technological University of the Shannon (Ref. 20221201). In Belgium, approval was granted by the Ethics Committee of Ghent University (Ref. 2023-106). In Czechia, approval was provided by the Ethics Committee of the Faculty of Physical Culture, Palacký University Olomouc (Ref. No. 90/2023). All procedures were conducted in accordance with the Declaration of Helsinki, and written informed consent was obtained from parents/guardians and assent from children prior to participation. All procedures followed the DE-PASS Proof-of-Concept Standard Operating Procedures (SOP), and the reporting adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (von Elm *et al.*, 2007) (In supplementary 2).

Participants

Children aged 9–12 years without diagnosed mental or physical conditions likely to alter habitual PA were eligible, provided their primary caregiver (the parent or guardian most familiar with their daily routines) also consented to participate. Recruitment was school-based (both public and private) in collaboration with school principals, initiated by a researcher-led presentation to the parent community; interested families returned signed consent forms prior to data collection.

Data collection procedures

From each family, one study child, one primary caregiver, and one sibling (aged 8–17 years) were invited to participate, provided written informed consent (caregiver and siblings aged ≥18 years) and assent (children and younger siblings)

were obtained. Families were allocated anonymized ID codes to ensure confidentiality and facilitate data linkage across measures. All procedures were approved by local ethics committees prior to implementation.

At the scheduled data collection session, families attended a face-to-face meeting with trained researchers, usually hosted in the school environment. During this visit, general family information was collected, and children's height and weight were measured following standardized anthropometric protocols. Both the study child and primary caregiver completed validated determinant questionnaires, with assistance provided if required. To capture device-based physical activity behaviors, accelerometers were distributed to the study child, one sibling, and the primary caregiver, along with an accelerometer diary to record wear times, removals, and structured physical activity. Participants were instructed to wear the devices for eight consecutive days. Families received a study care pack containing all instructions, consent forms, and return materials. Reminder text messages were sent to caregivers on days three, four, and eight to support compliance and timely return of devices and documentation. Returned data were checked for completeness before entry into the centralized DE-PASS database.

Accelerometer protocol

Participants wore an ActiGraph wGT3X-BT monitor (ActiGraph Corp., Pensacola, FL) affixed to a latex-free elastic belt at the right hip for eight days, removing it only for water-based activities or sleep. The ActiGraph devices were initialized using the ActiLife 6.13.4 software to sample at a 30 Hz rate. All family members received an illustrated diary and optional SMS reminder on days three and four to reinforce wear compliance. Devices were initialized with a delayed start (03:00 on the second day) and programmed for automatic stop after eight days. Unique DE-PASS ID codes were entered during initialization to ensure correct data linkage.

Upon return, raw.agd and .gt3x files were downloaded following the DE-PASS folder structure and naming convention. Data were processed with a 10-s epoch, three-axis acceleration, step count, light sensor and inclinometer channels. For children, non-wear was defined by the Troiano algorithm (Troiano *et al.*, 2008) as ≥ 60 minutes consecutive zero counts with allowance for up to 2 minutes nonzero interruptions. Valid days required ≥ 480 minutes of wear time, with ≥ 3 valid weekdays and ≥ 1 valid weekend day required to meet the inclusion criteria. For parents, non-wear time was defined as ≥ 60 minutes consecutive zero counts. Files were examined for MPA and VPA in ActiLife using the Evenson *et al.* (2008) cut-points for children and the Troiano *et al.* (2008) cut-points for parents. Average daily MPA and VPA were calculated across valid days. This protocol was adapted from Decelis *et al.* (2014). All downloaded data were securely stored in GDPR-compliant institutional servers following DE-PASS protocols, with dual verification and password-protected master ID linkage files.

Support assessment protocol

Both parents and children completed questionnaires. The child survey was an adapted version of the Parental Encouragement and Support for Children's PA scale (PEACH; Ommundsen *et al.*, 2008). The parent survey comprised socio-demographic items from the Health Behaviour in School-aged Children questionnaire (HBSC; Roberts *et al.*, 2009) filled by the parent. Both questionnaires followed the adaptation procedure described by Palmeira *et al.* (2024) and were delivered on paper. Children PEACH questionnaire yielded three subscales: parental support, peer support and teacher support. Responses were recorded on a four-point Likert scale (1 = Hardly ever or never to 4 = Every day). The original version of the instrument demonstrated good internal consistency (Cronbach's α = .72–.89) and acceptable test–retest reliability (ICC = .65–.80) as reported in (Palmeira *et al.*, 2024).

Missing or incomplete questionnaires were first addressed on site by the researcher's; any forms still unfinished or unreturned prompted a follow-up phone call. Instruments that remained incomplete after these recovery steps were excluded from analysis in accordance with the SOP.

Statistical methods

Participants with no valid child and parent accelerometry data or no corresponding child questionnaire data were removed from further analyses. Questionnaire responses for parental, peer, and teacher support were coded on an ordinal scale (1 = "Hardly ever or never" to 4 = "Every day"), and subscale scores were initially computed as the mean of their respective items (five for parental support and three each for peer and teacher support). Item-level missingness was minimal (no questionnaire item had more than two missing responses); where a contributing item was missing, the subscale score was computed from the remaining items, and all analyses used pairwise deletion. Given the low internal consistency observed for parental and teacher support, analyses focusing on these constructs relied on individual items rather than composite scores. MPA and VPA data were transformed (square root) to normalize data and Shapiro–Wilk tests were used to assess the normality of each variable's distribution, while Levene's test was used to assess equality of variances, as recommended by Field (2013). The distribution of VPA remained non-normal after square root

transformation. Average daily MPA and VPA (minutes per day) were calculated by dividing the total accumulated minutes by the number of valid observation days.

To identify potential socioeconomic confounders, bidirectional associations between each support variable, PA outcome (MPA and VPA minutes/day, % of total) and a set of candidate covariates were examined. Candidates were screened via point-biserial correlation using Tabachnick & Fidell, 2007 recommendations (full results in supplementary 1, socioeconomic questions in Table 1); only variables showing $p < .05$ associations with both an independent (support or Parent MPA and VPA) and a dependent (child MPA and VPA) variable were retained for a complementary sensitivity analysis. The primary adjustment set was specified a priori as child age, child sex, country, parent sex, and parental education, with parental education chosen as a widely used indicator of family socioeconomic status in children's physical activity research (Ziegeldorf *et al.*, 2024), given their established role as potential confounders (Carson *et al.*, 2020; Rodríguez-Rodríguez *et al.*, 2020). Associations were then re-estimated as partial correlations, with and without these covariates, to assess whether they altered the estimates.

Table 1. Demographic, Socioeconomic, and Accelerometry-Derived Physical Activity Characteristics of child–parent Dyads.

Characteristic	Child (N = 172)	Parent (N = 172)
Demographics		
Age, mean (SD), years	10.9 (1.6)	42.3 (5.8)
Country of origin, n (%)		
Belgium	59 (34.3)	
Czechia	67 (39.0)	
Ireland	46 (26.5)	
Sex, n (%)[#]		
Male	86 (50.0)	40 (23.3)
Female	83 (48.3)	129 (75.0)
Education ≥ Bachelor's, n (%)	—	123 (71.5)
Socioeconomic		
Cars owned, n (%)		
0	—	3 (1.7)
1	—	44 (25.6)
2	—	110 (64.0)
≥3	—	8 (4.7)
Own room, n (%)		
Yes	133 (77.3)	—
No	34 (19.8)	—
Travels abroad, n (%)		—
None	18 (10.5)	
Once	75 (43.6)	
Twice	46 (26.7)	
>Twice	28 (16.3)	
Computers, n (%)		
0	—	4 (2.3)
1	—	32 (18.6)
2	—	41 (23.8)
>2	—	90 (52.3)
Dishwasher, n (%)	—	No 14 (8.1) Yes 153 (89.0)

Table 1. *Continued*

Characteristic	Child (N = 172)	Parent (N = 172)
Bathrooms, n (%)		
1	80 (46.5)	
2	55 (32.0)	
>2	32 (18.6)	
Physical Activity, mean (SD)		
MPA, minutes/day	33.3 (10.5)*	42.87 (16.4)*
MPA (% total PA)	4.0 (1.3)	4.9 (1.9)*
VPA, minutes/day	18.8 (10.8)	4.5 (8.3)
VPA (% total PA)	2.2 (1.2)	0.5 (0.9)
Social Support		
Peer support, mean (SD)	2.8 (0.8)	—
Parental support items, mean (SD)		—
Take you to exercise	2.8 (1.0)	—
Watch you take part in exercise	3.0 (1.0)	—
Exercise or play sports with you	3.1 (0.9)	—
Tell you to exercise	2.8 (1.0)	—
Tell you that exercise is good for your health	2.8 (1.1)	—
Teacher support items, mean (SD)		—
Talk about exercise in lessons	3.0 (1.0)	—
Organize or play games apart from PE	3.2 (0.9)	—
Tell you to exercise or play sports	2.5 (0.9)	—

*Statistically significant difference between Male and Female. **Note:** Totals aren't 100% since some entries were blank.
#Three participants did not answer.

Descriptive statistics (means, standard deviations, and ranges for continuous variables; frequencies and percentages for categorical variables) characterized the sample and key measures. Correlations involving Support as the independent variable were calculated using Spearman's rank-order coefficient, and those with Parent MPA and VPA as the independent variable used Pearson's product-moment coefficient; for any variables that violated normality or homoscedasticity assumptions required by Pearson's method, Spearman's coefficient was applied instead. To formally test whether the parent–child association differed by intensity, the two dependent, non-overlapping correlations (parent–child MPA versus parent–child VPA) were compared using Steiger's (1980) test and Zou's (2007) confidence interval, implemented in the cocor package (v1.1.4; Diedenhofen & Musch, 2015), with a non-parametric bootstrap (10,000 resamples) as confirmation. Spearman coefficients were used for both intensities, given the non-normal distribution of parental VPA.

Internal consistency of each support subscale in this study was assessed using McDonald's omega (ω) (McDonald, 1999), which revealed variable internal consistency. McDonald's omega was acceptable for peer support (ω = .70) but lower for parental support (ω = .51) and teacher support (ω = .38). Since teacher and Parental support dimensions cannot be used as a single determinant, individual questions were used for the correlation analysis. Analyses were organized as primary (the parent–child physical activity associations), secondary (analyses stratified by sex and the socioeconomic sensitivity analyses), and exploratory (the associations of individual support items and the analyses excluding outliers). For the family of support item correlations, p values were adjusted for multiple comparisons using the Benjamini-Hochberg false discovery rate procedure.

Post-hoc analyses were conducted by removing outliers from the parent–child MPA and VPA dataset, defined as values falling outside the mean $\pm$ 2 standard deviations. This approach aimed to normalize the distribution and explore whether excluding extreme cases (e.g. parents with exceptionally high VPA) would change the association patterns. All relevant variables were reanalyzed using the square root transformation procedures previously described.

Data on MVPA was not included in the present analyses, as this study was designed to focus specifically on distinguishing between MPA and VPA. Analyses of MVPA will be conducted in future work.

Primary analyses were conducted in JASP version 0.19.2; the comparison of dependent correlations was performed in R version 4.4.1 (R Core Team, 2024). A two-tailed $\alpha = .05$ was applied throughout.

Results

Descriptive statistics

There were originally 181 dyads, resulting in a final sample size of 172 after removing dyads that did not meet the eligibility criteria (Figure 1). Sample characteristics and accelerometry outcomes for the 172 child–parent dyads included in the final analysis are presented in Table 1. Owing to item-level and accelerometer missingness, exact sample sizes varied slightly across correlations (pairwise deletion): individual correlations were based on 169 to 172 dyads, and covariate-adjusted partial correlations on 163 to 165 dyads. A sensitivity power analysis was conducted using G*Power version 3.1.9.7 for a Two-Tailed Point biserial model reaching 80% for $|\rho| = 0.19$. While children were closely matched in age as a design feature, parents likewise showed relatively low age variability. The sample showed a balanced distribution across countries, child sex was evenly represented, whereas the parental sample was predominantly female. The overall group is highly educated and of a high socioeconomic status. In terms of normality, Parent VPA in minutes and % were not normally distributed, even after transformation, which remained right skewed. In terms of sex differences, they were only observed in accelerometer determined MPA in both child and parents.

Correlation analysis

Pearson correlation analyses between parent and child PA (Table 2) demonstrated small to moderate positive associations across corresponding intensity levels (e.g., Parent MPA minutes were associated with children MPA, but Parent VPA was not associated with children MPA). When controlling for child sex, the correlation between child MPA minutes and parental VPA minutes became significant ($\rho = .156$, 95% CI [0.004, 0.295], $p = .043$). Although parent–child resemblance was numerically larger for moderate than vigorous activity, a formal comparison of the two dependent correlations indicated the difference was not statistically significant (% of total activity: $\Delta\rho = .16$, 95% CI [−.01, .34], $p = .06$, bootstrap $p = .07$; minutes/day: $\Delta\rho = .08$, $p = .39$).

Adjustment for the tested confounders did not alter the statistical significance of the associations. Recomputing the parent–child associations with the prespecified covariate set left these conclusions unchanged: resemblance at

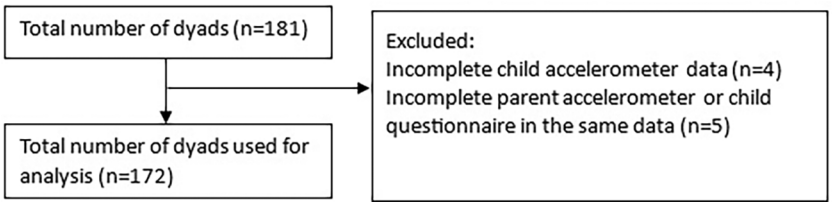


Figure 1. Dyads flow chart.

Table 2. Pearson correlation matrix depicting associations between parent and child MPA and VPA metrics.

	Parent MPA (minutes)	Parent MPA (%)	Parent VPA (minutes)[a]	Parent VPA (%)[a]
Child MPA (minutes)	**.298** [.154, .429] < .001	**.253** [.107, .389] < .001	.146 [−.005, .290] .058	.141 [−.010, .285] .068
Child MPA (%)	**.291** [.147, .423] < .001	**.342** [.202, .468] < .001	.032 [−.119, .181] .682	.045 [−.106, .194] .559
Child VPA (minutes)	.092 [−.059, .239] .233	.030 [−.121, .180] .698	**.240** [.093, .377] .002	**.230** [.082, .367] .003
Child VPA (%)	.091 [−.060, .238] .239	.081 [−.071, .228] .295	**.198** [.049, .338] .010	**.197** [.048, .338] .010

[a]Spearman correlation.
Note: Results are presented as correlation coefficients with corresponding 95% confidence intervals and p-values.

Table 3. Spearman correlations between child-reported social support (parental, peer, teacher) and children's MPA and VPA outcomes.

	Peer Support	(Parent) Take you to exercise	(Parent) Watch you take part in exercise	(Parent) Exercise or play sports with you	(Parent) Tell you to exercise	(Parent) Tell you that exercise is good for your health	(Teacher) Talk about exercise in lessons	(Teacher) Organize or play games apart from PE	(Teacher) Tell you to exercise or play sports
Child MPA (minutes)	.035 [–.127, .194] .649	.104 [–.059, .255] .173	.007 [–.166, .145] .929	.122 [–.014, .267] .110	.012 [–.135, .162] .872	.061 [–.077, .207] .424	–.068 [–.221, .088] .375	–.137 [–.273, .004] .074	–.025 [–.178, .124] .745
Child MPA (%)	.039 [–.117, .184] .614	.017 [–.145, .168] .824	–.109 [–.266, .050] .154	**.159** [.022, .309], .037	–.031 [–.176, .121] .686	–.013 [–.151, .131] .867	–.098 [–.246, .057] .201	–.037 [–.182, .113] .632	–.025 [–.166, .112] .748
Child VPA (minutes)	.011 [–.147, .163] .889	.024 [–.134, .180] .757	–.009 [–.160, .148] .907	.117 [–.033, .263] .125	–.022 [–.176, .118] .775	.011 [–.131, .167] .883	.020 [–.141, .168] .799	–.096 [–.240, .052] .210	.014 [–.148, .168] .857
Child VPA (%)	-.003 [–.162, .141] .969	-.035 [–.187, .124] .651	–.058 [–.207, .100] .448	.140 [–.014, .288] .067	–.034 [–.184, .112] .662	–.035 [–.170, .114] .650	.011 [–.151, .163] .886	–.044 [–.192, .111] .568	.018 [–.135, .171] .816

Note: Results are presented as correlation coefficients with corresponding 95% confidence intervals and p-values.

Open Research Europe 2026, 5:331 Last updated: 01 OCT 2026

the moderate intensity remained significant (for example, MPA percentage partial ρ = .31, p < .001), and resemblance at the vigorous intensity remained significant although attenuated (partial ρ = .17 to .19, p < .05). A sex-stratified sub-analysis was conducted. Among boys, correlation patterns closely mirrored those observed in the overall sample. Among girls, correlations for MPA were consistent with those observed in the overall and boys' analyses; however, the association between child VPA and parent VPA was not statistically significant across any of the four parent–child combinations. The full correlation matrix with partial correlations can be found in supplementary 1. Associations between child-reported social support and PA (Table 3) were generally nonexistent to weak. After adjusting for child sex, some additional significant associations emerged. The correlation between the item 'Exercise or play sports with you' and child MPA % increased (ρ = 0.188, 95% CI [0.041, 0.337], p = 0.014). Furthermore, new significant associations with 'Exercise or play sports with you' were observed for child MPA minutes (ρ = 0.167, 95% CI [0.022, 0.301], p = 0.030), and child VPA % (ρ = 0.157, 95% CI [0.004, 0.299], p = 0.041). After Benjamini-Hochberg correction across the support item analyses, none of these associations remained significant (the smallest adjusted p value was .85), indicating that the item level findings should be interpreted as exploratory.

When controlling for socioeconomic determinants, specifically questions "Cars owned" and "Bathrooms", the results were similar, with some already marginally significant values losing significance. The complete correlation matrix with partial correlations is available in supplementary 1.

Removing outlier cases did not materially change the parent–child PA correlations. However, after outlier removal, peer support showed a new, weak significant correlation with child VPA minutes (ρ = .171, 95% CI [0.006, 0.327], p = .049).

Discussion

This study examined intensity-specific associations between parent and child physical activity and between interpersonal support and children's physical activity, using device based measured MPA and VPA. Consistent with the primary aim, associations varied by activity intensity. Parent–child associations were significant for both intensities, with parental MPA showing a close-to-moderate correlation with child MPA and a weaker association for VPA. Although the point estimate was larger for moderate activity, a formal comparison of these dependent correlations showed the difference between intensities was not statistically significant (Δρ = .16, 95% CI [−.01, .34], p = .06); the data therefore indicate familial resemblance at both intensities without establishing that it is significantly stronger for MPA. This pattern is consistent with previous accelerometer-based findings reporting stronger parent–child resemblance for MPA than for VPA (Sigmundová *et al.*, 2024) and is consistent with the interpretation that MPA and VPA may represent distinct intensity-specific constructs.

The observed parent–child associations should be interpreted as evidence of familial similarity rather than as evidence of parental influence. As discussed by de Geus (2023), parent–offspring correlations in physical activity reflect a mixture of shared environmental exposure and genetic relatedness, and observational designs cannot disentangle these sources of resemblance. The present findings therefore indicate co-occurrence of parent and child activity patterns within families, but do not allow inference regarding behavioral transmission or modelling mechanisms. This interpretation is consistent with genetically informed research showing that both genetic and shared environmental factors contribute to variation in physical activity during childhood, while the relative contribution of specific pathways cannot be isolated without family-based or twin designs (de Geus, 2023).

MPA, such as walking or casual play, is more accessible for co-participation or co-occurrence within family routines (Gustafson & Rhodes, 2006), and adults are more likely to engage in it themselves (Trost *et al.*, 2003; Yao & Rhodes, 2015). In contrast, parental VPA in the present study showed a non-normal distribution with a high proportion of values close to zero, while child VPA was normally distributed. This adult–child mismatch in the empirical distribution of VPA is consistent with the interpretation that VPA and MPA behave as intensity-specific behavioral and statistical constructs in intergenerational analyses, rather than interchangeable components of a single MVPA metric. Because parental VPA was low and with a high frequency of values at or near zero, its restricted variance and the resulting tied ranks reduce the reliability of the parent–child VPA correlation and the statistical power of the formal intensity comparison; the non-significant difference should be interpreted with this limitation in mind rather than as evidence of equivalent resemblance. Aggregating parental MPA and VPA into MVPA may therefore introduce noise and obscure intensity-specific associations, which may help explain attenuated or inconsistent findings in studies relying on MVPA or broader physical activity composites (Petersen *et al.*, 2020). In the present study, this distributional pattern persisted even after removing potential outliers, suggesting that combining parental VPA with normally distributed parental MPA could attenuate associations and reduce statistical power, and may yield less interpretable results than intensity-specific analyses.

Sex-stratified analyses indicated that associations between parental and child MPA were broadly comparable across boys and girls, whereas associations between parental and child VPA were not statistically significant among girls. These findings are consistent with previous reports of sex-specific differences in parent–child physical activity associations, particularly for higher-intensity activity (Li-juan *et al.*, 2017). However, these results should be interpreted cautiously. The parental sample consisted predominantly of mothers, which may have limited the ability to detect associations related to paternal activity, particularly for VPA. In addition, the low prevalence of parental VPA further constrains inference regarding sex-specific patterns for VPA.

The analytical distinction between MPA and VPA has implications beyond statistical considerations. VPA appears to confer disproportionate health benefits per unit time compared with MPA, including stronger associations with reduced all-cause mortality and cardiometabolic risk (Biswas *et al.*, 2025). Aggregating MPA and VPA into a single MVPA outcome may therefore obscure associations relevant to the most health-efficient activity intensity. The present findings support analyzing MPA and VPA separately when examining familial and interpersonal associations, particularly in studies relying on accelerometer-derived measures, not only for analytical reasons but also because MPA and VPA are associated with different health outcomes.

In line with the first aim concerning interpersonal support, perceived parental support in the form of co-participation showed a weak positive association (which did not survive correction for multiple testing, and should therefore be regarded as exploratory) with children's MPA. This finding aligns with previous work identifying shared activity as a consistent correlate of child physical activity (Pyper *et al.*, 2016). MPA may be more feasible for co-participation due to lower physical demands, fewer safety concerns, and better alignment with adult fitness levels (Sun *et al.*, 2013). While this association does not imply causation, it suggests that shared moderate-intensity activities are a salient feature of the family context in this age group. At the same time, prior work indicates that parental support alone may be insufficient to overcome broader environmental or motivational barriers to activity, highlighting the need for multilevel approaches (Trost *et al.*, 2003).

In terms of examining associations between peer support and children's VPA, it was not supported in the primary analyses. Peer support was not significantly associated with VPA in this sample of 9- to 12-year-olds. This finding is consistent with evidence suggesting that peer associations with physical activity become more prominent later in adolescence (Beets *et al.*, 2010; Davison & Jago, 2009). A post hoc exploratory analysis conducted after removal of extreme VPA values revealed a weak association between peer support and child VPA. However, this result should be interpreted cautiously given its exploratory nature, sensitivity to data exclusion, small sample size and possibility of false positives ($\alpha = 5\%$). Overall, the findings suggest that peer support is not a major correlate of VPA at this developmental stage.

In the present study, teacher support was not associated with children's PA at any intensity. Although intervention studies report increases in PA following structured teacher-led programmes (e.g., Eather *et al.*, 2013), evidence from observational research is inconsistent. The meta-analysis by Lin *et al.* (2024), based largely on correlational designs, found small and frequently non-significant associations between school or teacher support and PA, with stronger relationships observed for peer and family support. Similarly, the review by Wright *et al.* (2024) indicated that associations between educator behaviors and MVPA varied according to the type and measurement of support, with limited consistency across studies. In a synthesis of recess correlates, Zhu *et al.* (2025) reported that adult social or organizational factors were less consistently related to PA than environmental or individual characteristics.

These findings are compatible with the null associations observed in the current multi-country sample and suggest that, in non-intervention contexts, teacher support may not be a robust correlate of children's PA. Taken together, the findings indicate that interpersonal associations with children's physical activity vary by intensity and context. Parent–child resemblance is more consistently observed for MPA than for VPA, while peer and teacher support show limited associations in this age group. These results underscore the importance of distinguishing between activity intensities when examining familial and interpersonal correlates and highlight the need to distinguish association from mechanism in observational research.

Limitations

This study has several limitations that should be considered when interpreting the findings. The cross-sectional design precludes causal inference and does not allow conclusions about the directionality of the observed associations. Parent–child resemblance in physical activity may reflect a combination of shared environments and genetic relatedness, and the present design cannot disentangle these sources of similarity or isolate specific behavioral pathways, such as parental

modelling. Datasets belong to the DE-PASS consortium and raw data can't be shared without reasonable request to the consortium.

The sample was drawn primarily from European countries and consisted largely of families from higher socioeconomic backgrounds, with mothers comprising the majority of participating parents. This sample composition may limit the generalizability of the findings to families from different cultural, socioeconomic, or family structures, and may also have reduced variability in socioeconomic indicators, limiting the ability to detect differences or stratified patterns related to socioeconomic context. In addition, the predominance of mothers in the parental sample may have constrained the ability to detect sex-specific parent–child associations, particularly those related to paternal activity patterns.

Although the study focused on interpersonal factors, other contextual factors, such as the built environment, neighborhood characteristics, and school-level policies were not included. In addition, children were recruited from a limited number of schools, in some cases from the same classes, raising the possibility of clustering effects, particularly for teacher support variables. Because school-level identifiers were not available due to data protection constraints, it was not possible to formally account for clustering in the analysis. Country was, however, included as a covariate, which partially accounts for variation between countries, although residual clustering at the school or class level could not be modelled, and associations involving teacher support in particular should be interpreted with this lack of independence in mind.

While the parental, peer, and teacher support instruments have demonstrated acceptable reliability in previous research, the internal consistency of the parental and teacher support subscales was suboptimal in the present sample. Consequently, analyses relied on individual questionnaire items rather than composite scores, which may have limited the ability to capture the full breadth of these interpersonal constructs. Several factors may have affected measurement accuracy, including the age of the participants, the sample size, and the risk of social desirability in child self-report. These issues should be considered when interpreting the findings. Although procedures described in the Methods were implemented to minimize bias, they cannot fully eliminate it.

Finally, although the sample size was sufficient to detect moderate associations, the study was underpowered to identify very weak associations. Some secondary analyses, including stratification by sex and socioeconomic indicators, were exploratory in nature and should therefore be interpreted cautiously. In addition, the restricted age range limits the applicability of the findings to other developmental stages, particularly adolescence, where peer and school correlates of physical activity may operate differently.

Conclusions

This study underscores the importance of distinguishing between physical activity intensities when examining interpersonal associations with children's activity. Associations between parent and child physical activity varied by intensity, with more consistent parent–child resemblance observed for MPA than for VPA. In contrast, peer and teacher support showed limited or no associations with children's physical activity in this age group.

The findings further demonstrate that aggregating MPA and VPA into a single MVPA construct may obscure intensity-specific association patterns and may reduce interpretability in intergenerational analyses. Examining MPA and VPA as intensity-specific outcomes may potentially provides clearer insight into how familial and interpersonal factors co-occur with children's activity behaviors.

Future research should prioritize longitudinal designs and refined, validated measurement instruments that distinguish clearly between MPA and VPA, to better characterize how intensity-specific associations evolve across developmental stages. From an applied perspective, these findings suggest that family-based approaches focusing on MPA of daily family routines may be a plausible direction for future longitudinal or invertention research since parental VPA is distributed differently from children's, but more targeted studies are needed to fully corroborate this.

Extended data

Open Science Framework. DE-PASS MPA and VPA cross-sectional supplementary data. OSF, https://osf.io/qc8g2/?view_only=2ec73bad89674857859d142f4e6f7d7c (Ferreira *et al.*, 2025)

This project contains the following extended data:

- Supplementary 1 (Correlation matrices: partial correlations with socioeconomic covariates).

- Supplementary 2 (STROBE checklist). Aggregate data underlying the reported analyses (descriptive statistics and correlation matrices) are openly available in the repository above. Individual-level DE-PASS data are governed by the DE-PASS consortium and are not held by the authors; access may be requested from the DE-PASS committee upon reasonable request.

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC BY 4.0).

References

Beets MW, Cardinal BJ, Alderman BL: **Parental social support and the physical activity-related behaviors of youth: a review.** *Health Educ Behav.* 2010; **37**(5): 621, 20729347–644.
Publisher Full Text

Biswas RK, Ahmadi MN, Bauman A, *et al.*: **Wearable device-based health equivalence of different physical activity intensities against mortality, cardiometabolic disease, and cancer.** *Nat Commun* 2025; **16**: 8315.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Bois JE, Sarrazin PG, Brustad RJ, *et al.*: **Elementary schoolchildren's perceived competence and physical activity involvement: the influence of parents' role modelling behaviours and perceptions of their child's competence.** *Psychol Sport Exerc.* 2005; **6**(4): 381–397.
Publisher Full Text

Bringolf-Isler B, Schindler C, Kayser B, *et al.*: **Objectively measured physical activity in population-representative parent-child pairs: parental modelling matters and is context-specific.** *BMC Public Health.* 2018; **18**(1): 1024.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Bull FC, Al-Ansari SS, Biddle S, *et al.*: **World Health Organization 2020 guidelines on physical activity and sedentary behaviour.** *Br J Sports Med.* 2020; **54**(24): 1451–1462.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Carson V, Langlois K, Colley R: **Associations between parent and child sedentary behaviour and physical activity in early childhood.** *Health Rep.* 2020; **31**(2): 3–10.
PubMed Abstract | **Publisher Full Text**

Chen H, Sun H, Dai J: **Peer support and adolescents' physical activity: the mediating roles of self-efficacy and enjoyment.** *J Pediatr Psychol.* 2017; **42**(5): 569, 28158660–577.
Publisher Full Text

Chevalley T, Rizzoli R: **Acquisition of peak bone mass.** *Best Pract Res Clin Endocrinol Metab.* 2022; **36**(2): 101616.
PubMed Abstract | **Publisher Full Text**

Davison KK, Jago R: **Change in parent and peer support across ages 9 to 15 yr and adolescent girls' physical activity.** *Med Sci Sports Exerc.* 2009; **41**(9): 1816–1825.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Decelis A, Jago R, Fox KR: **Physical activity, screen time and obesity status in a nationally representative sample of maltese youth with international comparisons.** *BMC Public Health.* 2014; **14**: 664.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Duncan SC, Duncan TE, Strycker LA: **Sources and types of social support in youth physical activity.** *Health Psychol.* 2005; **24**(1): 3–10.
PubMed Abstract | **Publisher Full Text**

Eather N, Morgan PJ, Lubans DR: **Social support from teachers mediates physical activity behavior change in children participating in the Fit-4-Fun intervention.** *Int J Behav Nutr Phys Act.* 2013; **10**: 68.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

von Elm E, Altman DG, Egger M, *et al.*: **The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies.** *PLoS Med.* 2007; **4**(10): e296.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Evenson KR, Catellier DJ, Gill K, *et al.*: **Calibration of two objective measures of physical activity for children.** *J Sports Sci.* 2008; **26**(14): 1557–1565.
PubMed Abstract | **Publisher Full Text**

Ferreira F, Dowd K, Coffey A, *et al.*: DE-PASS MPA and VPA cross-sectional supplementary data. [Dataset]. *Open Science Framework.* 2025.
Reference Source

Gallardo-Gómez D, Salazar-Martínez E, Alfonso-Rosa RM, *et al.*: **Optimal dose and type of physical activity to improve glycemic control in people diagnosed with type 2 diabetes: a systematic review and meta-analysis.** *Diabetes Care.* 2024; **47**(2): 295–303.
PubMed Abstract | **Publisher Full Text**

de Geus EJC: **Genetic Pathways Underlying Individual Differences in Regular Physical Activity.** *Exerc Sport Sci Rev.* 2023; **51**(1): 2–18.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Gustafson SL, Rhodes RE: **Parental correlates of physical activity in children and early adolescents.** *Sports Med.* 2006; **36**(1): 79, 16445312–97.
Publisher Full Text

Guthold R, Stevens GA, Riley LM, *et al.*: **Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants.** ***Lancet Child Adolesc.*** *Health.* 2020; **4**(1): 23–35.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Herrmann SD, Willis EA, Ainsworth BE, *et al.*: **adult compendium of physical activities: a third update of the energy costs of human activities.** *J Sport Health Sci.* 2024, 2024; **13**(1): 6–12.
PubMed Abstract | **Publisher Full Text**

Khan SR, Uddin R, Mandic S, *et al.*: **Parental and peer support are associated with physical activity in adolescents: Evidence from 74 countries.** *Int J Environ Res Public Health.* 2020; **17**(12): 4435.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Kolovelonis A, Syrmpas I, Marcuzzi A, *et al.*: **DE-PASS Best Evidence Statement (BESt): determinants of adolescents' device-based physical activity and sedentary behaviour in settings: a systematic review and meta-analysis.** *BMC Public Health.* 2024; **24**(1): 1706.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

L. bP T, Brønd JC, Kristensen PL, *et al.*: **Resemblance in accelerometer-assessed physical activity in families with children: the Lolland-Falster Health Study.** *The international journal of behavioral nutrition and physical activity* 2020; **17**(1): 161.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Li-juan W, Jiancui W, Su-zhe S: **Parental influence on the physical activity of Chinese children: do gender differences occur?** *Eur Phys Educ Rev.* 2017; **23**(1): 110–126.
Publisher Full Text

Lin H, Chen H, Liu Q, *et al.*: **A meta-analysis of the relationship between social support and physical activity in adolescents: the mediating role of self-efficacy.** *Front Psychol.* 2024; **14**:1305425.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

McDonald RP: Test theory: a unified treatment. Lawrence Erlbaum Associates,1999.

Mendes R, Sousa N, Themudo-Barata JL, *et al.*: **High-intensity interval training versus moderate-intensity continuous training in middle-aged and older patients with type 2 diabetes: a randomized controlled crossover trial of the acute effects of treadmill walking on glycemic control.** *Int J Environ Res Public Health.* 2019; **16**(21): 4163.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Miao T, Li X, Zhang W, *et al.*: **Effects of high-impact jumping versus resistance exercise on bone mineral content in children and adolescents: a systematic review and meta-analysis.** *PeerJ.* 2025; **13**: e19616.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Ng CA, Gandham A, Mesinovic J, *et al.*: **Effects of moderate- to high-impact exercise training on bone structure across the lifespan: a systematic review and meta-analysis of randomized controlled trials.** *J Bone Miner Res.* 2023; **38**(11): 1612–1634.
PubMed Abstract | **Publisher Full Text**

Ommundsen Y, Page A, Ku PW, *et al.*: **Cross-cultural, age and gender validation of a computerised questionnaire measuring personal, social and environmental associations with children's physical activity: the European Youth Heart Study.** *Int J Behav Nutr Phys Act.* 2008; **5**: 29.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Palmeira AL, Jelsma JGM, Sousa-Sá E, *et al.*: **Determinants of Physical Activities in Settings (DE-PASS): approach for selecting the core**

measures for determinants of physical activity behaviours in 9–12 old children. *J Sports Sci.* 2024; **42**(21): 2021–2028.
PubMed Abstract | Publisher Full Text | Free Full Text

Petersen TL, Møller LB, Brønd JC, *et al.*: **Association between parent and child physical activity: a systematic review.** *Int J Behav Nutr Phys Act.* 2020; **17**(1): 67.
PubMed Abstract | Publisher Full Text | Free Full Text

Poon ET, Wongpipit W, Ho RS, *et al.*: **Interval training versus moderate-intensity continuous training for cardiorespiratory fitness improvements in middle-aged and older adults: a systematic review and meta-analysis.** *J Sports Sci.* 2021; **39**(17): 1996–2005.
PubMed Abstract | Publisher Full Text

Pyper E, Harrington DW, Manson H: **The impact of different types of parental support behaviours on child physical activity, healthy eating, and screen time: a cross-sectional study.** *BMC Public Health.* 2016; **16**(1): 568.
PubMed Abstract | Publisher Full Text | Free Full Text

Roberts C, Freeman J, Samdal O, *et al.*: **The Health Behaviour in School-aged Children (HBSC) study: methodological developments and current tensions.** *Int J Public Health.* 2009; **54** Suppl 2(Suppl 2): 140–150.
PubMed Abstract | Publisher Full Text | Free Full Text

Rodríguez-Rodríguez F, Huertas-Delgado FJ, Barranco-Ruiz Y, *et al.*: **Are the parents' and their children's physical activity and mode of commuting associated? Analysis by gender and age group.** *Int J Environ Res Public Health.* 2020; **17**(18): 6864.
PubMed Abstract | Publisher Full Text | Free Full Text

Sallis JF, Prochaska JJ: **Taylor WC: A review of correlates of physical activity of children and adolescents.** *Med Sci Sports Exerc.* 2000; **32**(5): 963–975.
PubMed Abstract | Publisher Full Text

Sallis JF, Taylor WC, Dowda M, *et al.*: **Correlates of vigorous physical activity for children in grades 1 through 12: comparing parent-reported and objectively measured physical activity.** *Pediatr Exerc Sci.* 2002; **14**(1): 30–44.
Publisher Full Text

Sarker H, Anderson LN, Borkhoff CM, *et al.*: **Validation of parent-reported physical activity and sedentary time by accelerometry in young children.** *BMC Res Notes.* 2015; **8**: 735.
PubMed Abstract | Publisher Full Text | Free Full Text

Sheridan D, Coffee P, Lavallee D: **A systematic review of social support in youth sport.** *Int Rev Sport Exerc Psychol.* 2014; **7**(1): 198–228.
Publisher Full Text

Sigmundová D, Voráčová J, Dygrýn J, *et al.*: **Parent–child associations in accelerometer–measured physical activity and sedentary behaviour: the FAMIPASS study.** *Children (Basel).* 2024; **11**(6): 710.
PubMed Abstract | Publisher Full Text | Free Full Text

Sun F, Norman IJ, While AE: **Physical activity in older people: a systematic review.** *BMC Public Health.* 2013; **13**: 449.
PubMed Abstract | Publisher Full Text | Free Full Text

Syeda USA, Battillo D, Visaria A, *et al.*: **The importance of exercise for glycemic control in type 2 diabetes.** *Am J Med Open.* 2023; **9**: 100031.
PubMed Abstract | Publisher Full Text | Free Full Text

Tabachnick BG, Fidell LS: *Using multivariate statistics.* (5th ed.). Pearson, 2007.

Troiano RP, Berrigan D, Dodd KW, *et al.*: **Physical activity in the United States measured by accelerometer.** *Med Sci Sports Exerc.* 2008; **40**(1): 181–188.
PubMed Abstract | Publisher Full Text

Trost SG, Loprinzi PD: **Parental influences on physical activity behavior in children and adolescents: a brief review.** *Am J Lifestyle Med.* 2011; **5**(2): 171–181.
Publisher Full Text

Trost SG, Sallis JF, Pate RR, *et al.*: **Evaluating a model of parental influence on youth physical activity.** *Am J Prev Med.* 2003; **25**(4): 277–282.
PubMed Abstract | Publisher Full Text

World Health Organization: 2020; *WHO guidelines on physical activity and sedentary behaviour.* Geneva: WHO: 33369898.

Wright C, Williams C, Veldman SLC, *et al.*: **Educator behaviours associated with young children's physical activity: A systematic review.** *Child: Care, Health and Development* 2024; **50**(1): e13308.
Publisher Full Text

Yao CA, Rhodes RE: **Parental correlates in child and adolescent physical activity: a meta-analysis.** *Int J Behav Nutr Phys Act.* 2015; **12**(1): 10.
PubMed Abstract | Publisher Full Text | Free Full Text

Zhou Z, Li X, Zhang Z: **The peer effect in promoting physical activity among adolescents: evidence from the China Education Panel Survey.** *Int J Environ Res Public Health.* 2023; **20**(3): 2480.
PubMed Abstract | Publisher Full Text | Free Full Text

Zhu K, Yin X, Liu Y, *et al.*: **Correlates of physical activity and sedentary behaviour in children and adolescents during school recess: A systematic review and meta-analysis.** *BMC Public Health* 2025; **25**: 23948.
PubMed Abstract | Publisher Full Text | Free Full Text

Ziegeldorf A, Schoene D, Fatum A, *et al.*: **Associations of family socioeconomic indicators and physical activity of primary school-aged children: a systematic review.** *BMC Public Health* 2024; **24**(1): 2247.
Publisher Full Text

Open Peer Review

Current Peer Review Status: ✔ ✔

Version 4

Reviewer Report 17 September 2026

https://doi.org/10.21956/openreseurope.26828.r80189

© **2026 Jekauc D.** This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

✔ **Darko Jekauc**
KarlsruheInstitute of Technology, Karlsruhe, Germany

I do not have any further comments.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I have expertise in health psychology, sport and exercise psychology, and physical activity behavior research. My work focuses on psychological determinants of physical activity, health behavior change, intention-behavior relations, and the use of observational and intensive longitudinal research designs in physical activity contexts. I also have expertise in the conceptual interpretation of behavioral associations, particularly in distinguishing correlational findings from causal mechanisms.In addition, I am familiar with questionnaire-based assessment of psychosocial determinants, accelerometer-based physical activity research at the level needed to evaluate the conceptual and behavioral interpretation of the measures, and the statistical evaluation of observational studies, including correlational analyses, regression-based approaches, moderation, confounding, and reproducibility issues.Based on this expertise, I feel able to assess the theoretical framing, relevance of the research question, interpretation of parent-child and interpersonal associations, appropriateness of the observational design, adequacy of the behavioral and psychosocial measures, and the general appropriateness of the statistical analyses and conclusions. I would not claim specialist expertise in accelerometer calibration or raw accelerometry data processing, but I am able to evaluate whether the measurement protocol and interpretation are appropriate from the perspective of physical activity and health behavior research.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 08 September 2026

https://doi.org/10.21956/openreseurope.26828.r80190

© **2026 Simsek A.** This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Aysegul Simsek
Marmara University, İstanbul, Turkey

The authors have implemented my suggestions.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Pediatric Nursing

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 3

Reviewer Report 10 July 2026

https://doi.org/10.21956/openreseurope.26500.r77122

© **2026 Jekauc D.** This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Darko Jekauc
KarlsruheInstitute of Technology, Karlsruhe, Germany

The revised manuscript has improved substantially. In particular, I appreciate the clearer distinction between primary, secondary, and exploratory analyses, the addition of a formal comparison between parent child correlations for MPA and VPA, the use of Benjamini Hochberg correction for the support item analyses, the revised covariate strategy, the clarification that the primary analyses were correlational rather than regression based, and the more cautious framing of parent child associations as familial resemblance rather than causal parental influence. Overall, the manuscript is now considerably more precise and scientifically stronger. However, I still have several reservations that should be addressed before I can consider the article fully scientifically sound.

First, the title and some parts of the abstract still seem stronger than the empirical evidence supports. The revised analyses show that parent child resemblance was numerically larger for

MPA than for VPA, but the formal comparison between intensities was not statistically significant. Therefore, the statement that moderate and vigorous physical activity “show distinct familial and interpersonal association patterns” remains somewhat too strong. A more cautious title would better reflect the results, for example by referring to “intensity specific correlates” or “intensity specific familial and interpersonal associations” rather than claiming distinct patterns.

Second, there appears to be an inconsistency in the reporting of the formal comparison of the dependent correlations. In the manuscript, the comparison for percentage of total activity is reported as Δρ = .16, 95% CI [.01, .34], p = .06. A 95 percent confidence interval that does not include zero is difficult to reconcile with a two tailed p value of .06. In the author response, the interval is reported as 95% CI [minus .01, .34], which would be consistent with the nonsignificant p value. This should be checked and corrected, because it concerns one of the central statistical results of the paper.

Third, the Plain Language Summary should be revised to align with the cautious interpretation in the main manuscript. Several statements still imply causal influence or intervention effectiveness, for example that parents are the strongest role models, that the best way to help children be more active is through family involvement, or that children were more active when their parents were active. The main manuscript now appropriately emphasizes that the study is cross sectional and cannot distinguish genetic, shared environmental, or behavioral transmission mechanisms. The Plain Language Summary should use the same level of caution and refer to associations or familial resemblance rather than influence or causal role modelling.

Fourth, the applied implications should remain cautious throughout the manuscript. The finding that parental co participation showed only a weak association with child MPA and did not survive correction for multiple testing should not be used as a strong basis for recommending family-based approaches. It would be more appropriate to state that family-based approaches focusing on MPA may be a plausible direction for future longitudinal or intervention research, rather than an implication directly supported by the present findings.

Finally, the data availability statement is improved, but full reproducibility remains only partly ensured. I understand that individual level DE PASS data are governed by the consortium and may not be directly shareable by the authors. However, aggregated descriptive statistics and correlation matrices do not allow full independent reproduction of the analyses. This does not necessarily preclude acceptance, but the limitation should be stated explicitly and transparently.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I have expertise in health psychology, sport and exercise psychology, and physical activity behavior research. My work focuses on psychological determinants of physical activity, health behavior change, intention-behavior relations, and the use of observational and intensive longitudinal research designs in physical activity contexts. I also have expertise in the conceptual interpretation of behavioral associations, particularly in distinguishing correlational findings from causal mechanisms.In addition, I am familiar with questionnaire-based assessment of psychosocial determinants, accelerometer-based physical activity research at the level needed to evaluate the conceptual and behavioral interpretation of the measures, and the statistical

evaluation of observational studies, including correlational analyses, regression-based approaches, moderation, confounding, and reproducibility issues.Based on this expertise, I feel able to assess the theoretical framing, relevance of the research question, interpretation of parent-child and interpersonal associations, appropriateness of the observational design, adequacy of the behavioral and psychosocial measures, and the general appropriateness of the statistical analyses and conclusions. I would not claim specialist expertise in accelerometer calibration or raw accelerometry data processing, but I am able to evaluate whether the measurement protocol and interpretation are appropriate from the perspective of physical activity and health behavior research.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 30 Jul 2026

Flávio Ferreira

Manuscript: "Moderate and vigorous physical activity show intensity-specific familial and interpersonal associations in 9–12-year-olds: A cross-sectional DE-PASS study" (Open Research Europe, 5-331). We thank Dr. Jekauc for the continued careful and constructive assessment, and for recognizing the improvements made in the previous revision. We have addressed each of the five remaining points below.

1. Title and abstract stronger than the evidence supports. *Reviewer's comment.* *The formal comparison between intensities was not statistically significant, so "show distinct familial and interpersonal association patterns" is too strong; a more cautious wording such as "intensity-specific" would better reflect the results.*
Response. We agree. The title now reads "Moderate and vigorous physical activity show intensity-specific familial and interpersonal associations in 9–12-year-olds," adopting the reviewer's suggested framing. In the abstract we replaced "differed by activity intensity" with "varied by activity intensity," "support treating MPA and VPA as distinct outcomes" with "support examining MPA and VPA as intensity-specific outcomes," and "show that … differ by intensity" with "indicate that … vary by intensity." Corresponding statements in the Introduction, Discussion, and Conclusion were softened from "distinct constructs" to "intensity-specific constructs" and from "supports" to "is consistent with."

2. Inconsistency in the reported confidence interval. *Reviewer's comment.* *The manuscript reports Δρ = .16, 95% CI [.01, .34], p = .06, but a CI that excludes zero is difficult to reconcile with a two-tailed p = .06; the author response reported [−.01, .34].*
Response. The correct value is Δρ = .16, 95% CI [−.01, .34], p = .06. The lower bound is negative, so the interval includes zero, consistent with the non-significant two-tailed p value.

3. Plain Language Summary should match the cautious interpretation. *Reviewer's comment.* *Several statements still imply causal influence or intervention effectiveness (for example, that parents are the strongest role models, that the best way to help children be more active is*

through family involvement, or that children were more active when their parents were active).
Response. We have revised the Plain Language Summary to use the same association-based, cautious language as the main text. We removed statements implying that parental activity makes children more active (for example, "children tended to be more active when their parents were active" and "if parents often walked or cycled, children were more likely to do the same") and replaced them with a description of familial resemblance, together with an explicit statement that the study is cross-sectional and cannot show what causes what or separate genetic, shared-environmental, and behavioral pathways. We also removed the suggestion that family involvement is "a promising way to support children's activity," reframing it as a possible direction for future research. We made most of the plain summary to match the actual current conclusion of the manuscript.

4. Applied implications should remain cautious throughout. ***Reviewer's comment.*** *Parental co-participation showed only a weak association with child MPA and did not survive correction for multiple testing, so it should not be a strong basis for recommending family-based approaches; these should be framed as a plausible direction for future research.* **Response.** We have made clearer in discussion child and parent VPA dataset differences which has direct implication in statistical analysis warrinting caution "Because parental VPA was low and with a high frequency of values at or near zero, its restricted variance and the resulting tied ranks reduce the reliability of the parent–child VPA correlation and the statistical power of the formal intensity comparison; the non-significant difference should be interpreted with this limitation in mind rather than as evidence of equivalent resemblance." In conclusion recommendations were softened and adjusted to results "From an applied perspective, these findings suggest that family-based approaches focusing on MPA of daily family routines may be a plausible direction for future longitudinal or invertention research since parental VPA is distributed differently from children's, but more targeted studies are needed to fully corroborate this ."

5. Data availability and reproducibility. ***Reviewer's comment.*** *Aggregated descriptive statistics and correlation matrices do not allow full independent reproduction of the analyses; this limitation should be stated explicitly and transparently.*
Response. We have added following limitation: "Datasets belong to the DE-PASS consortium and raw data can't be shared without reasonable request to the consortium." Also added in dataset availability that dataset can be shared when asked to the DE-PASS consortium upon reasonable request. _____ We believe these revisions address Dr. Jekauc remaining reservations while keeping the manuscript's claims closely aligned with the data. We are grateful for the reviewer's thorough and constructive input.

Competing Interests: No competing interests were disclosed.

Version 2

Reviewer Report 23 May 2026

https://doi.org/10.21956/openreseurope.24547.r72531

© 2026 Jekauc D. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

?

Darko Jekauc
KarlsruheInstitute of Technology, Karlsruhe, Germany

The manuscript addresses a relevant and timely question: whether moderate physical activity and vigorous physical activity show different familial and interpersonal association patterns in children aged 9 to 12 years. The study uses cross-sectional data from the DE-PASS project, including 172 child-parent dyads from Belgium, Czechia, and Ireland. Physical activity in both children and parents was assessed with waist-worn accelerometers, and children reported perceived support from parents, peers, and teachers. The main finding is that parent-child associations appear more consistent for moderate physical activity than for vigorous physical activity, whereas peer and teacher support show weak or no associations with children's activity. The authors conclude that moderate and vigorous physical activity should be treated as distinct outcomes rather than aggregated into MVPA.
Overall, the manuscript has scientific merit. The use of device-based measures in both children and parents is a clear strength, and the conceptual reframing away from causal "parental modeling" toward familial resemblance is appropriate. However, several aspects require revision before the article can be considered scientifically sound. The main concerns are that the central claim about MVPA aggregation is not directly tested, that differences between MPA and VPA associations are interpreted without formal statistical comparison, that many exploratory correlations are tested without sufficient control of multiplicity, and that reproducibility is only partly ensured.
Is the work clearly and accurately presented, and does it cite the current literature?
Partly.
The manuscript is generally well written, and the rationale for distinguishing MPA and VPA is clearly presented. The literature is current and relevant, including recent work on accelerometer-based physical activity, parent-child resemblance, social support, and intensity-specific health effects. The revised framing is also appropriate in recognizing that observational parent-child associations cannot be interpreted as evidence of causal parental modeling.
However, the presentation should be made more precise in several respects. First, the manuscript should consistently avoid causal language such as "influence," "modeling," or "strategies to address VPA" unless explicitly framed as speculative. The current data support associations and resemblance, not behavioral transmission or intervention effects. Second, the claim that aggregating MPA and VPA into MVPA would obscure intensity-specific patterns is too strong in the absence of an empirical MVPA analysis. This statement should either be supported by additional MVPA analyses or reformulated as a plausible methodological concern rather than a demonstrated result. Third, the distinction between familial resemblance, interpersonal support, shared environment, and behavioral influence should be maintained more consistently throughout the manuscript.
Is the study design appropriate, and does the work have academic merit?
Yes, with important limitations.
The cross-sectional design is appropriate for a descriptive and correlational study of intensity-specific associations. The use of harmonized procedures across three countries and accelerometer-based measures in both parents and children provides academic value. The

manuscript makes a useful contribution by emphasizing that MPA and VPA may not be interchangeable behavioral constructs.
Nevertheless, the academic contribution remains primarily descriptive. The study cannot explain why parent-child associations differ by intensity, nor can it disentangle shared environmental, genetic, or behavioral mechanisms. The authors acknowledge this limitation, which is important. The conclusions should remain aligned with this design and should not imply causal influence, developmental processes, or intervention efficacy.

Are sufficient details of methods and analysis provided to allow replication by others?
Partly.
The manuscript provides useful details on recruitment, eligibility criteria, accelerometer placement, wear-time criteria, epoch length, cut-points, questionnaire measures, transformation procedures, software, and general analytic strategy. These details support conceptual replication. However, full analytic replication would require additional information. The authors should report the exact sample size used in each correlation, because missing questionnaire or accelerometer data may vary across analyses. They should specify how missing questionnaire items were handled within each subscale or item-level analysis. The description of covariate selection and adjustment should be clarified, including which variables were included in each partial correlation or regression. The manuscript refers to regression models with and without covariates, but the reported results are mainly correlations and partial correlations. This inconsistency should be resolved. Either the regression models should be reported in full, or the methods should be rewritten to reflect that the primary analyses were correlational.

If applicable, is the statistical analysis and its interpretation appropriate?
Partly.
The use of Pearson and Spearman correlations is acceptable for an exploratory cross-sectional analysis. The use of confidence intervals is helpful, and the cautious interpretation of parent-child associations as familial resemblance rather than causal modeling is appropriate.
Several statistical issues need to be addressed. The most important concern is that the manuscript interprets MPA associations as stronger and more consistent than VPA associations but does not formally test whether these correlations differ. Since this comparison is central to the manuscript, the authors should statistically compare the relevant dependent correlations or use an alternative model that directly tests intensity as a moderator. For example, a long-format regression model with physical activity intensity as a within-dyad factor could test whether associations differ between MPA and VPA.
Second, the manuscript conducts many correlations across parent activity variables, child activity variables, support subscales, support items, sex-stratified analyses, socioeconomic sensitivity analyses, and outlier-excluded analyses. This creates a substantial risk of false-positive findings. The authors should clearly distinguish primary from exploratory analyses and consider correction for multiple testing or, at minimum, interpret marginal p-values very cautiously. Findings such as the weak associations emerging only after adjustment or outlier removal should not be presented as robust evidence.
Third, the central claim that MVPA aggregation obscures intensity-specific associations is not directly tested. The authors explicitly state that MVPA was not included in the present analyses. This is problematic because the title, abstract, discussion, and conclusion make a strong argument about the limitations of MVPA aggregation. The authors should add an MVPA sensitivity analysis comparing parent-child and support associations for MVPA with those for MPA and VPA separately. If they choose not to include MVPA, they should substantially weaken the claim and state that their results suggest, rather than demonstrate, that aggregation could obscure patterns.

Fourth, the covariate strategy is not optimal. Selecting socioeconomic covariates based on significant bivariate associations with both predictors and outcomes is data-driven and may produce unstable adjustment sets. A theory-driven covariate strategy would be preferable. At minimum, child age, child sex, country, parent sex, and a prespecified socioeconomic indicator should be considered. If the sample size limits the number of covariates, this should be stated clearly, and sensitivity analyses should be interpreted accordingly.
Fifth, the school-based recruitment creates potential clustering, especially for teacher support variables. The authors acknowledge that school-level identifiers were not available. This limitation should be treated as more than a minor caveat, because non-independence can affect standard errors and p-values. If country or school-level information is available, the authors should consider sensitivity analyses using country fixed effects or cluster-robust approaches. If school identifiers are unavailable, the potential impact on inference should be discussed more explicitly.
Finally, the post-hoc power analysis is of limited interpretive value. It would be more informative to focus on effect sizes, confidence intervals, and the precision of estimates. The authors should consider removing the post-hoc power statement or replacing it with a clearer discussion of detectable effect sizes and uncertainty.

Are all the source data underlying the results available to ensure full reproducibility?
Partly.
The manuscript provides an OSF link to supplementary materials, including partial correlation matrices and a STROBE checklist. This improves transparency. However, full reproducibility requires more than supplementary correlation tables. The authors should provide an anonymized analysis dataset, a codebook, and the complete analysis syntax from JASP or, preferably, R. If the full dataset cannot be shared because of ethical or data protection constraints, the manuscript should explicitly state this and describe the conditions under which data can be accessed. At present, the available materials appear insufficient to fully reproduce the reported analyses.

Are the conclusions drawn adequately supported by the results?
Partly.
The conclusion that parent-child physical activity associations differ by intensity is broadly supported by the pattern of reported correlations, although it should be strengthened by formal tests of differences between MPA and VPA associations. The conclusion that peer and teacher support show limited associations with activity in this age group is also generally supported. However, some conclusions are stronger than the data allow. The statement that MVPA aggregation obscures intensity-specific patterns is not directly supported unless MVPA is analyzed. The applied conclusion that family-based approaches focusing on MPA may be particularly relevant should be phrased more cautiously. The data show that parent-child MPA and parental co-participation are associated with child MPA, but they do not show that family-based interventions would increase MPA. This should be presented as a hypothesis for future intervention studies rather than a direct implication.

Points that must be addressed to make the article scientifically sound
The authors should either add MVPA analyses or substantially weaken all claims that MVPA aggregation obscures relevant patterns. Given that this claim is central to the manuscript, adding MVPA as a sensitivity analysis would be the preferred solution.
The authors should formally test whether parent-child associations differ between MPA and VPA. Numerical differences between correlations are not sufficient to support the central inference.
The authors should clarify the analytic hierarchy by identifying primary, secondary, and exploratory analyses. They should address multiple testing, especially for the numerous support-item correlations and post-hoc subgroup analyses.
The authors should revise the covariate strategy. A prespecified, theory-driven adjustment set

would be preferable to a data-driven selection procedure based on bivariate significance.
The authors should clarify whether regressions were conducted. If regression models were used, they should be reported. If not, references to regression models should be removed or rewritten.
The authors should improve reproducibility by providing an anonymized analysis dataset, codebook, and analysis syntax, or by explaining why this is not possible and how the data can be accessed.
The authors should revise the discussion and conclusion to avoid causal or intervention-oriented overstatement. Terms such as “influence,” “modelling,” and “family-based strategies” should be used only with explicit caution.
Recommendation
The manuscript is promising and addresses a relevant question, but it requires revision before it can be considered fully scientifically sound. My recommendation would be approval only after revision. The required revisions are feasible and mainly concern analytic precision, reproducibility, and alignment between results and conclusions.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and does the work have academic merit?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I have expertise in health psychology, sport and exercise psychology, and physical activity behavior research. My work focuses on psychological determinants of physical activity, health behavior change, intention-behavior relations, and the use of observational and intensive longitudinal research designs in physical activity contexts. I also have expertise in the conceptual interpretation of behavioral associations, particularly in distinguishing correlational findings from causal mechanisms.In addition, I am familiar with questionnaire-based assessment of psychosocial determinants, accelerometer-based physical activity research at the level needed to evaluate the conceptual and behavioral interpretation of the measures, and the statistical evaluation of observational studies, including correlational analyses, regression-based approaches, moderation, confounding, and reproducibility issues.Based on this expertise, I feel able to assess the theoretical framing, relevance of the research question, interpretation of

parent-child and interpersonal associations, appropriateness of the observational design, adequacy of the behavioral and psychosocial measures, and the general appropriateness of the statistical analyses and conclusions. I would not claim specialist expertise in accelerometer calibration or raw accelerometry data processing, but I am able to evaluate whether the measurement protocol and interpretation are appropriate from the perspective of physical activity and health behavior research.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 29 Jun 2026

Flávio Ferreira

Response to Reviewer 2 Manuscript: Moderate and vigorous physical activity show distinct familial and interpersonal association patterns in 9 to 12 year olds: A cross-sectional DE-PASS study. We thank Reviewer 2 for the thorough and constructive evaluation. We have revised the manuscript to address each point, and all changes are shown as tracked changes in the revised version.

Points that must be addressed 1. The MVPA aggregation claim *Reviewer 2:* *The claim that aggregating MPA and VPA into MVPA would obscure intensity-specific patterns is too strong in the absence of an empirical MVPA analysis. This statement should either be supported by additional MVPA analyses or reformulated as a plausible methodological concern rather than a demonstrated result.*
Response: We have reformulated these statements as a plausible methodological concern rather than a demonstrated result. In the Abstract, "would have obscured" is now "may obscure"; in the Discussion, "is likely to attenuate … yielding less valid and less interpretable results" is now "could attenuate … and may yield less interpretable results." MVPA outcomes from the DE-PASS dataset are reserved for separate, pre-planned working-group analyses and therefore could not be reported here. The argument for analysing the intensities separately now rests on their different health implications and on the markedly different empirical distributions of MPA (normal) and VPA (non-normal, with many values near zero) observed in our data. We note that the formal comparison of parent-child resemblance across intensities (Point 2) did not reach significance; we therefore do not claim that resemblance differs by intensity, and the case for analysing the intensities separately is made on distributional and health-outcome grounds rather than on a difference in the strength of resemblance.

2. Formal test of whether MPA and VPA associations differ *Reviewer 2:* *The manuscript interprets MPA associations as stronger and more consistent than VPA associations but does not formally test whether these correlations differ. The authors should statistically compare the relevant dependent correlations.*
Response: We have added a formal comparison of the two dependent, non-overlapping correlations (parent-child MPA versus parent-child VPA) using Steiger's test and Zou's confidence interval, corroborated by a non-parametric bootstrap. Because parental VPA was

non-normal, Spearman coefficients were used for both intensities. The difference between intensities was not statistically significant (percentage of total activity: difference in rho = .16, 95% CI [-.01, .34], p = .06; minutes per day: difference in rho = .08, p = .39). We have accordingly softened the central claim: the manuscript now states that parent-child resemblance was significant at both intensities and numerically larger for moderate activity, but that the two intensities did not differ significantly.

3. Analytic hierarchy and multiple testing ***Reviewer 2:*** *The authors should clearly distinguish primary from exploratory analyses and consider correction for multiple testing, especially for the numerous support-item correlations and post-hoc subgroup analyses. Findings emerging only after adjustment or outlier removal should not be presented as robust evidence.*
Response: We now state an explicit analytic hierarchy: primary (parent-child associations), secondary (sex-stratified and socioeconomic sensitivity analyses), and exploratory (associations of individual support items and outlier-excluded analyses). We apply the Benjamini-Hochberg false discovery rate correction to the family of support-item correlations. After correction, no support to activity association remained significant (smallest adjusted p = .85). The co-participation finding has been removed from the headline narrative and is now presented, together with the post-hoc peer-support finding, as exploratory.

4. Covariate strategy ***Reviewer 2:*** *Selecting socioeconomic covariates based on significant bivariate associations with both predictors and outcomes is data-driven and may produce unstable adjustment sets. A theory-driven covariate strategy would be preferable.*
Response: We have replaced the data-driven covariate selection with a prespecified, theory-based adjustment set: child age, child sex, country, parent sex, and parental education. Parental education was chosen as a widely used indicator of family socioeconomic status in children's physical activity research (Ziegeldorf et al., 2024). Re-estimating the associations with this prespecified set left the conclusions unchanged (parent-child MPA partial rho about .31 to .33, $p < .001$; parent-child VPA partial rho about .17 to .19, $p < .05$). The earlier screening is retained as a complementary sensitivity analysis.

5. Regression versus correlation ***Reviewer 2:*** *The manuscript refers to regression models with and without covariates, but the reported results are mainly correlations and partial correlations. This inconsistency should be resolved.*
Response: The primary analyses were correlational. We have revised the Methods so that the adjustment is described as partial correlations re-estimated with and without the covariates, consistent with the reported results, and the reference to regression models has been removed.

6. Reproducibility ***Reviewer 2:*** *The authors should provide an anonymized analysis dataset, a codebook, and the complete analysis syntax. If the full dataset cannot be shared because of ethical or data protection constraints, the manuscript should explicitly state this and describe the conditions under which data can be accessed.*
Response: The individual-level DE-PASS data are governed by the DE-PASS consortium and are not held by the authors; access may be requested from the DE-PASS committee. We have added a data-availability statement to this effect. We additionally provide, in the Open Science Framework repository, the aggregate values underlying the analyses (descriptive

statistics and correlation matrices, with MVPA outcomes excluded).

7. Causal and intervention language ***Reviewer 2:*** *The authors should revise the discussion and conclusion to avoid causal or intervention-oriented overstatement. Terms such as influence, modelling, and family-based strategies should be used only with explicit caution.*
Response: The revised manuscript reframes parent-child associations as familial resemblance rather than parental influence, and explicitly states that observational data cannot disentangle genetic and shared-environmental contributions to that resemblance. Applied implications are stated cautiously, using hedged language and emphasising the need for longitudinal and intervention research rather than asserting demonstrated effects, and the comparative and aggregation claims have been softened as described under Points 1 and 2.

Additional specific points Response: Exact sample size per analysis. We now report that, owing to item-level and accelerometer missingness (pairwise deletion), unadjusted correlations were based on 169 to 172 dyads and covariate-adjusted partial correlations on 163 to 165 dyads.

Response: Handling of missing questionnaire items. Item-level missingness was minimal (no item had more than two missing responses); where a contributing item was missing, the subscale score was computed from the remaining items, and all analyses used pairwise deletion.

Response: School-level clustering. We note that country was included as a covariate, which partially accounts for between-country variation, while residual clustering at the school or class level could not be modelled because identifiers were unavailable; associations involving teacher support in particular are interpreted with this in mind.

Response: Post-hoc power analysis. The post-hoc power statement has been reframed as a sensitivity power analysis describing the smallest effect detectable at the present sample size, and all estimates are reported with 95% confidence intervals.

We thank the reviewer again for these constructive comments, which we believe have substantially strengthened the manuscript, which had multiple alterations and by so had segments where wording was stale and needed improvement to meet final methods and results.

Competing Interests: No competing interests were disclosed.

Version 1

Reviewer Report 05 January 2026

https://doi.org/10.21956/openreseurope.23298.r64482

© 2026 Simsek A. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Aysegul Simsek
Marmara University, İstanbul, Turkey

The article provides evidence of shared data regarding the daily life activities of parent-child pairs. Although it is a small part of a larger project, the data obtained alone demonstrates scientific validity. The language is well written. The methodology is presented in detail and is understandable. The findings are appropriately discussed in the discussion section with support from the literature. Acceptable.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and does the work have academic merit?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Child Health and Diseases Nursing

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.