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Parent-child associations in accelerometer-measured physical activity: A systematic review and meta-analysis

Rimi
rimi.pavlovic@pef.uni-lj.si

University of Ljubljana, Faculty of education
Miha Matjašič
University of Ljubljana, Faculty of education
Gregor Jurak
University of Ljubljana, Faculty of sports
Vesna Štemberger Vučko
University of Ljubljana, Faculty of education
Vedrana Sember
University of primorska, Faculty of health sciences

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Abstract

Background

Children's physical activity (PA) is shaped by interacting influences across home and school, yet evidence on parent-child resemblance in accelerometer-measured PA remains heterogenous. This systematic review and meta-analysis synthesized associations between accelerometer-measured moderate-to-vigorous physical activity (MVPA) in school-aged children (6–12 years) and their parents and examined whether associations differed by specific parent-child dyads.

Methods

Databases PubMed, Scopus, Web of Science, and EBSCOhost were searched until June 2025. Eligible studies included healthy children and at least one parent, accelerometer-measured MVPA in both, and reported or derivable parent-child correlations. Random-effects meta-analyses with Hartung-Knapp adjustment were conducted using Fisher's z-transformed correlations and back-transformed to Pearson's r. Risk of bias was assessed using the NIH/NHLBI tool.

Results

Seven cross-sectional studies from five countries contributed 4533 parent-child dyads and 16 dyad-specific effects. The pooled parent-child MVPA association was small but statistically significant (r = 0.21, 95% CI 0.12–0.31), with substantial heterogeneity (I^2 = 79%) and a wide prediction interval (-0.11 to 0.50). Same-gender dyads tended to show larger point estimates than cross-gender dyads, although subgroup estimates were imprecise and father-focused evidence was comparatively sparse.

Conclusions

Overall, parent and child MVPA showed modest positive association with considerable context dependence. These findings can inform PA promotion by indicating that family context is a relevant correlate of children's MVPA, while highlighting the need for longitudinal, father-inclusive studies using harmonized accelerometer protocols to clarify sources of heterogeneity and the pathways underlying parent-child MVPA associations.

Trial registration:

The study was registered at the International Prospective Register for Systematic Reviews (PROSPERO) under the identification code CRD42024549340.

BACKGROUND

Physical activity (PA) is a cornerstone of a healthy lifestyle in childhood and adolescence[1–3]. Regular engagement in PA during earlier stages of life is associated with a wide range of short- and long-term benefits, including improved cardiovascular and musculoskeletal health, healthier body composition, enhanced psychological functioning, better academic outcomes, and higher overall quality of life[1, 3]. These benefits extend well into adulthood, as PA habits established in early life often track across the lifespan, influencing positive health outcomes and less risk for chronic diseases[4].

Although the benefits of PA are well established, a large proportion of children aged 5–17 years globally do not achieve the recommended at least 60 minutes of daily moderate-to-vigorous PA (MVPA)[5]. Across 57 countries/jurisdictions in the Global Matrix 4.0 study, the average grade for overall PA corresponded to roughly 27–33% of children meeting the recommendation, while accelerometer-based studies report that around 36% of 10-12-year-old children meet the guideline[6]. In addition, longitudinal data in PA levels in school children indicates downward trend as children enter adolescence[6, 7]. Parallelly, screen-based sedentary behaviours (television viewing, computer/phone use, and video gaming) steadily increase[6, 8, 9]. The COVID-19 pandemic has further aggravated this trend, with clear evidence indicating persistent reductions in children's PA levels even after lockdowns came to an end[10, 11].

Children's PA is shaped by a wide range of determinants spanning individual, social, and environmental levels[12–14]. Existing evidence highlights a dynamic interaction between individual characteristics, social relationships[15–18], and environmental contexts operating across multiple levels[19, 20], within which the family environment occupies a central position in pre-adolescents in the broader socio-ecological framework[21, 22]. Understanding these influences are essential for designing effective interventions and policies that promote active lifestyles from early childhood[23].

Given the central role of the family in this period, parental influence stands out. Active parents tend to have more physically active children, though associations vary by age, gender, and time spent together[24–28]. Parental support especially encouragement, monitoring, and transport is linked to higher MVPA[29–31], with children aged 6–10 especially responsive to maternal modeling[26, 32]. Despite this, findings on parent-child PA resemblance remain mixed[8, 33], and paternal roles are less explored. Evidence exists that paternal and their son's sedentary behaviours are significantly associated[34]. Contextual factors such as maternal employment, family structure (single vs two-parent households, children living across multiple homes and number of siblings), and screen use add further complexity[10, 17, 35, 36].

Nevertheless, findings vary across studies: studies differ in the strength and statistical significance of parent-child resemblance, and patterns appear to vary by child age, parent-child dyad (mother vs father), and the behaviour examined (MVPA vs sedentary time)[8, 33, 34]. These inconsistencies reinforce the need

for meta-analytic synthesis based on objective measures.

Although parental and children PA have been widely investigated, more objective evidence, like accelerometer-based, is comparatively scarce and methodologically heterogeneous, limiting comparability across studies. This meta-analysis (MA) synthesizes accelerometer-measured parent-child PA associations and examines moderation by child and parent gender. The findings aim to clarify the magnitude and variability of parent-child resemblance and to inform more targeted PA interventions in youth.

METHODS

Present MA followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[37] The study was registered at the International Prospective Register for Systematic Reviews (PROSPERO) under the identification code CRD42024549340.

Literature Search

Two reviewers (RP and VS) independently searched the databases PubMed, Scopus, Web of Science and EBSCOhost, between May and June 2024 and from March to May 2025. Additional searches were conducted in June 2025. References lists of the existing systematic reviews used in this article have also been considered. The PROSPERO database was also searched for any unpublished or ongoing MA. Titles and abstracts of the retrieved studies and additional sources were screened by the two reviewers (RP and VS), with a third and fourth reviewer (MM and GJ) mediating any disagreements until a consensus was reached. The abstracts were screened using the following search string: (physical activity OR activity OR “energy expenditure” OR exercise) AND (accelerometry OR accelerometers OR MET OR “24-hour movement behaviours” OR 24-hour movement behaviours OR 24 HMB) AND (determinants OR factor) AND (children OR schoolchildren OR “primary school children” OR “elementary school children”) AND (family OR sibling OR parent OR mother OR father OR brother OR sister). All articles from the initial search were stored in Mendeley reference management software & researcher network (Elsevier, Amsterdam, Netherlands), removing duplicate references.

Inclusion Criteria

The present study aimed to systematically examine the influence and interrelationships of selected determinants on PA. Accordingly, eligible studies were required to be published in English as articles in peer-reviewed scientific journals, conference proceedings, or doctoral dissertations. The target population comprised children aged 6 to 14 years and their parents or caregivers, with no documented socio-economic disadvantages. Studies reporting gender-specific results were also included. No restrictions were imposed regarding year of publication. Only studies involving healthy participants were considered.

Eligible studies employed cross-sectional, cohort, longitudinal, or randomized controlled trial designs and reported accelerometer-measured PA outcomes for all relevant participants (children, siblings, and/or parents). Accelerometry data were required for children and at least one parent, with PA quantified as MVPA and assessed over a minimum of four consecutive days. Finally, studies were required to report statistical correlations between the MVPA levels of children and those of their parents or siblings. The meta-analysis primarily included cross-sectional studies, as this design typically provided comparable measures of association amenable to quantitative synthesis. Statistical significance was defined as $p < 0.05$.

Data Extraction and Statistical Analysis

Two reviewers (VS and RP) independently extracted data, and a third reviewer (MM) verified entries. Extracted items included study descriptors (country, sample sizes, children’s age), accelerometer characteristics (device model and wear location, epoch/sampling, wear protocol and validity criteria), MVPA operationalisation (cut-points/processing where reported), and the type of association effect size (e.g., Pearson’s *r*, Spearman’s ρ, or *r* derived from unadjusted R^2 with sign taken from β). Where needed, authors were contacted to obtain bivariate correlations and dyad-specific sample sizes. For MA, correlation coefficients were transformed to Fisher’s z and pooled using a random-effects model with between-study variance estimated by Restricted maximum likelihood (REML). Confidence intervals were computed using the Hartung–Knapp adjustment. Pooled effects were back transformed and presented as Pearson’s r. Heterogeneity was quantified using Q, I^2, and τ^2, and a 95% prediction interval was reported. Prespecified subgroup analyses were conducted by parent–child dyad (e.g., mother-daughter, father-son). As a sensitivity check for non-independence of multiple effects per study, we fitted a multilevel meta-analytic model with random effects for study (and effect within study), showing similar estimates.

Risk of bias and quality assessment in individual studies

Study-level risk of bias with quality assessment was assessed with the NIH/NHLBI 14-item National Institutes of health's study quality assessment[38], specifically designed for observational cohort and cross-sectional studies. We also chose this tool because it is used widely and transparent, (clear domains for participation/selection, measurement validity, and reporting). Three reviewers (RP, VS and VŠ) appraised studies independently and resolved disagreements by consensus. Earlier, we specified how to code items that are less applicable to cross-sectional accelerometer studies (e.g., assessor blinding and follow-up/attrition considered not applicable; temporality items considered in the context of single-time-point measurement). Item judgments were later visualized using ROBVIS visualization tool[39].

Reporting quality and external validity

For all included studies, we extracted predefined descriptors (country, design, sample sizes, children age, model of the devices and wear location, sampling/epoch information, wear protocol and validity criteria, derived variables and the effect size metric used for synthesis (e.g., Pearson's *r*, Spearman's ρ, or *r* derived from unadjusted R^2). These features were summarized narratively to inform external validity and reporting clarity (without scoring) and are presented in the results.

RESULTS

Study selection and characteristics

We searched electronic databases and screened records in two stages. After removing duplicates, titles/abstracts were screened for relevance, and potentially eligible articles were retrieved for full-text review against predefined inclusion criteria. Ultimately, 7 studies (see Fig. 1) meeting the pre-specified eligibility criteria were included in quantitative MA. Even though different study designs could match the inclusion criteria, all the included studies had the cross-sectional design. No studies, investigating sibling's correlations that would fit inclusion criteria were found.

Studies included in MA (see Table 1) were conducted across three continents: Oceania, North America and Europe - all were caried out in countries as high-income economies. Specifically, studies were conducted in Australia[40], USA[25, 41], Canada[42], UK[11, 33] and Czech Republic[29]. Across studies, sample sizes varied considerably. Sample sizes ranged from 45 to 1,328, yielding a total of 4,719 children. The number of parents ranged from 45 to 1,358, while the number of parents-child dyads ranged from 45 to 1,328. Children's ages spanned from 6 to 12 years. Age was reported heterogeneously, including mean ± standard deviation, age ranges, or school year classifications (e.g., Year 6; 10–11 years). Using reported means or midpoints of age ranges where exact means were unavailable, the average child age across studies was approximately 9.9 years, indicating that the evidence predominantly reflects late childhood to early adolescence. All included studies examined parental PA, explicitly considering both mothers' and fathers' PA as key determinants.

Table 1
Descriptive statistics of the main characteristics of studies included in the review

Study ID (Year, Country)	Design	Children N	Parents N	Dyads N	Children Age (mean ± SD / range)	Determinant(s)	Device model(s) & wear location(s)**	Sampling / Epoch length	Wear protocol (days, hrs, exclusions)	Wear-time validity criteria
Fraysse et al., 2019; Australia	Cross-sectional	1261	1358	1077	12.0 ± 0.4 y	Parental PA (mother, father); age range not reported	GENEActiv; non-dominant wrist	60 s	8 consecutive days; remove for swimming	≥ 10 h/day; ≥ 4 days
Fuemmeler et al., 2011; USA	Cross-sectional	45	90	45	Boys 10.6 ± 0.63; Girls 10.6 ± 0.76 y	Parental PA (mother, father); aged: 40.6-mothers, 42.8 fathers	ActiGraph 7164; waist above right hip	60 s	4 consecutive days; remove bathing/swimming	≥ 10 h/day; ≥ 3 days
Garriguet et al., 2017; Canada	Cross-sectional (national survey, CHMS)	1328	1328	1328	Mean 8.4 (8.3–8.6) y	Parental PA (mother, father); mean age 39.1	Actical; right hip	Not reported	7 consecutive days	≥ 10 h/day; ≥ 4 days
Jago et al., 2010; UK	Cross-sectional	340	340	340	10–11 y	Parental PA (mother, father); age range not reported	Children and parents: ActiGraph GT1M; waist/right hip	Children 10 s; Parents 60 s	7 consecutive days	≥ 10 h/day; ≥ 3 days
Sigmundová et al., 2024; Czech Republic	Cross-sectional	381	593	381	6–10 y	Parental PA (mother, father); age range not reported	ActiGraph wGT3X-BT; non-dominant wrist |	Raw 100 Hz; ENMO via GGIR (epoch not specified)	7 consecutive days; 24 h wear	≥ 16 h/day; ≥ 3 weekdays + ≥ 1 weekend
Shifflett et al., 2025; USA	Cross-sectional (RCT baseline)	68	68	68	9.25 y (± 1.78)	Parental PA (mother, father) 38 ± 7.11	GENEActiv; non-dominant wrist	Not reported	7 consecutive days	≥ 16 h/day; ≥ 3 days
Salway et al., 2022; UK	Cross-sectional (two waves)	1296 children (of those 393 in wave 1)	1296 parents (of those 393 in wave 1)	1296 (of those 393 in wave 1)	(10–11 y)	Parental PA (mother, father); age range 35–49	ActiGraph wGT3X-BT; hip	10 s	5–7 days per wave	3 days or more (two weekdays, one weekend day)

MVPA-moderate to vigorous physical activity (MPA-moderate PA; VPA-vigorous PA); LMVPA-Light-to-moderate-to-vigorous physical activity; LPA-light physic

*Treated as r.

**Only daytime wearing locations were observed and listed in the table

Substantial methodological heterogeneity was observed in device models, wear locations, and data processing procedures. The most frequently used devices were ActiGraph accelerometers in four studies (models 7164, GT1M, and wGT3X-BT) (Actigraph LLC; Florida, US), followed by GENEActiv (Activinsights, Cambridge, United Kingdom) and Actical devices (Phillips - Respironics, Oregon, USA), each in two studies. Epoch lengths ranged from 10 seconds to 60 seconds, while one study analysed raw acceleration data sampled at 100 Hz, processed using the ENMO metric via the GGIR package. In two studies, epoch length was not explicitly reported.

The primary outcome across all studies was MVPA, consistently expressed as minutes per day. Several studies additionally reported sedentary behaviour (SB), light physical activity (LPA), moderate (MPA) and vigorous physical activity (VPA), or counts per minute (CPM). One study further distinguished light-to-moderate-to-vigorous PA (LMVPA). All outcomes were treated as continuous variables and were derived from raw mechanical acceleration. Devices were worn at the wrist (3 studies) or hip (4 studies). Wear protocols varied across studies, ranging from 4 to 8 consecutive days, with most studies requiring device removal during bathing or swimming. Valid wear-time criteria also differed, but most studies defined a valid day as ≥ 10 hours of wear time, with a minimum of 3 to 4 valid days. Studies using 24-hour protocols applied more stringent criteria (≥ 16 h/day), and one study additionally required at least one weekend day. Effect sizes used for pooling were predominantly Pearson's correlation coefficients (r). One study reported Spearman's ρ, which was treated as equivalent to r for the purpose of synthesis. In two studies, bivariate correlation coefficients (r) and corresponding sample sizes (n) were obtained directly from the authors to ensure methodological comparability.

Synthesized results of parent-child associations

In the forest plot (see Fig. 2), a total of 16 effect sizes were displayed across all rows, with dyad-specific counts ranging from *k* = 1 to *k* = 3. Mother-focused dyads (mother-daughter, mother-son) each contributed *k* = 2 effect sizes; father-son contributed *k* = 2; father-daughter contributed *k* = 2; the aggregated parent-child categories by child gender (parent-daughter, parent-son) contributed *k* = 3 each; and the top-level father-child and mother-child categories each contributed *k* = 1. Parent-child dyad contributed one (k = 1) effect size. Individual study weights ranged from 4.6% to 8.1%, indicating relatively even influence with no single study dominating the model; as expected under inverse-variance weighting, studies with larger weights exhibited narrower 95% CIs (greater precision), whereas smaller-weighted studies displayed wider 95% CIs.

A random-effects MA with Hartung-Knapp adjustment was performed. Effect sizes were Fisher's *z*-transformed correlations (ZCOR), analysed with inverse-variance weights that incorporate within- and between-study variance; pooled estimates were back-transformed to Pearson's *r* (COR) for presentation. The pooled correlation between parents' and children's MVPA was r = 0.21 (95% CI 0.12–0.31). Between-study heterogeneity was I^2 = 79% with τ^2 = 0.02 (p < 0.01). The prediction interval was − 0.11–0.50, indicating the range in which the true effect of a comparable new study would be expected to fall. Interpreted as variance accounted for, the point estimate corresponds to r^2 ≈ 4.40% (bounds implied by the CI ≈ 1.4%-9.6%).

Heterogeneity within dyads ranged from I^2 = 0% (father-daughter; no detectable between-study variability) to I^2 = 93% (mother-daughter). Across pooled dyad estimates, 95% CI widths ranged from 0.07 (parent-child) to 1.99 (mother-daughter). Of the nine pooled dyad estimates, four (mother-child; father-daughter; father-son; parent-child) had 95% CIs that did not include zero; the remaining pooled dyads' 95% CIs included zero. Within-dyad spread of the primary (study-level) estimates was as follows: father-daughter correlations were r = 0.30 (95% CI 0.13–0.45) and r = 0.33 (0.08–0.54); father-son was r = 0.46 (0.24–0.63); mother-daughter were r = 0.27 (0.16–0.37) and r = 0.67 (0.50–0.79); mother-son were r = 0.11 (-0.14-0.35) and r = 0.28 (0.14–0.42); parent-daughter were r = 0.08 (-0.07-0.23), r = 0.26 (0.23–0.29), and r = -0.10 (-0.28-0.08); and parent-son were r = 0.04 (-0.11-0.20), r = 0.19 (0.16–0.22), and r = 0.13 (-0.10-0.35). The relative contribution of subgroup diamonds to the overall model was father-daughter 10.6%, father-son 4.7%, mother-daughter 11.7%, mother-son 11.1%, parent-daughter 20.5%, parent-son 19.5%, father-child 6.0%, mother-child 7.8%, and parent-child 8.1%. For clarity, in this forest plot squares denote individual study estimates with area proportional to weight, horizontal lines depict 95% CIs, grey diamonds represent pooled dyad effects (centre = pooled r, width = 95% CI), the red diamond depicts the overall pooled effect, and the horizontal bracket beneath it marks the prediction interval.

An additional exploratory subgroup analysis examined whether accelerometer wear location (hip vs. wrist) moderated the parent-child MVPA association; results did not indicate a significant subgroup difference (see figure S1 in the additional files section).

Risk of bias and quality assessment

Throughout the seven studies, reporting on sampling and methods was generally clear. Overall risk of bias was judged as low in two studies and moderate in five (Fig. 3). Most studies clearly stated their research question and target population and applied similar inclusion and exclusion criteria. Measurement of both exposure (parent MVPA) and outcome (child MVPA) was consistently strong, relying on accelerometers with largely well-described and broadly comparable protocols, and the primary outcomes were minutes per day of MVPA. However, key limitations related to selection and design features: participation at the dyad level was variably reported and, in several studies, below 50% or not fully documented, which may limit representativeness and contributed to moderate risk in most studies and high risk in two studies. Almost no studies provided a formal sample size or power justification, even though all clearly reported final sample sizes. Because all designs were cross-sectional, temporality and timeframe were judged as moderate, exposure was typically measured only once, blinding of outcome assessors was not reported, and key confounders were only partially controlled for. For MA comparability, effect sizes were Pearson's r in four studies, Spearman's ρ in one study (treated as r), and author-provided correlations in two studies. Overall, the evidence base is characterized by high-quality accelerometer-measurement but moderate risk of selection and confounding bias.

DISCUSSION

Present MA demonstrates a clear, significant yet weak association between parents and children's MVPA (r = 0.21, 95% CI 0.12–0.31), with substantial between-study heterogeneity (I^2 = 79%). In practical terms, higher parent MVPA was associated with higher child MVPA, indicating that parental PA is a relevant correlate of children's activity behaviour[43]. Even though parent-child association explains only about 4–5% of the variance in children's (age range from 6 to 12 years old) MVPA, a small-to-moderate effect is meaningful because movement habits are shaped gradually and they cumulate over time rather than by any single dominant influence[21, 44]. Based on this, parents should not be treated as a determinant of children's PA but as one educational context among several that jointly shape participation in movement (e.g., family, school, peers, and community), which is consistent with contemporary pedagogical thinking and socio-ecological approaches to children's PA[45].

The pooled estimate is broadly consistent with previous studies identifying parental modelling and support as important pathways linking parent and child PA levels[25–28], while also aligning with reports of modest or context-dependent parent-child resemblance when methodological approaches and social environments differ[8, 33]. Importantly, by relying exclusively on accelerometer-measured PA, the present MA provides a more robust and conservative estimate of this association than prior syntheses based predominantly on self-reported data[46]. In practice, objective based data can reveal patterns that differ from self-reports, which is important for rational planning and evaluation of school PA interventions[47].

The wide prediction interval (-0.11 to 0.50) underscores that the true association in future, comparable studies could range from negligible to moderate. This variability should not be interpreted as weakness of the evidence, but rather as a reflection of the inherently multilevel and context-dependent nature of children's PA, which is shaped by interactions between individual characteristics, family environments, schools, neighbourhoods, and broader social norms[13, 48]. These findings are especially relevant, as they highlight the interconnected roles of family and school environments in shaping children's movement behaviours. Schools and especially physical education, represent a key setting in which family-related differences in PA may be either reinforced or lessened through instructional practices, curricular structures, and teacher-student interactions[49, 50].

From a public-health perspective, even effects of this magnitude may be meaningful at the population level, given that PA confers substantial benefits across cardiometabolic, musculoskeletal, psychological, and educational domains and tends to track into adulthood.[1, 3, 4] This is particularly relevant in light of persistent evidence that a large proportion of children fail to achieve the recommended minimum of 60 minutes of MVPA per day[5, 51–54], with further declines during adolescence and increasing engagement in sedentary behaviours[6, 8, 9], trends that were amplified during COVID-19 era[10, 11]. School is one of the few systems that reaches (mostly) all children regardless of the family background, these macro-level trends in physical inactivity connect directly to the micro-level of school-based PA[55].

The association appears stronger within same-gender parent-child dyads than in cross-gender dyads, suggesting that gender-specific modelling and identification may play an important role in shaping children's PA behaviours. These patterns echo observational reports that children may model activity from the same-gender parent and respond to gender-specific support and opportunities[26, 29, 31, 32]. However, wide CIs in several dyads-particularly those involving fathers-necessitate caution. Rather than indicating weak paternal influence, these imprecise estimates likely reflect the limited number of father-focused effects and uneven dyad representation across studies. Associations between parent and child PA differed across dyads, indicating that these relationships are sensitive to contextual and relational influences such as family routines, opportunities for co-participation, and socio-cultural gender norms[25, 29, 56, 57]. For instance, Slovenian studies highlight that mothers often serve as the key architects of family lifestyle routines, including PA practices[58]. Consistent with this, those findings highlight the salience of maternal support in children's sport socialization[59] and suggest that mother-child PA associations may be particularly pronounced in device-based data[34].

Importantly, no eligible accelerometer-based studies examine sibling-sibling or sibling-child MVPA associations, limiting conclusions to parent-child dyads. Given siblings shared environments and time together, future studies should incorporate sibling dyads alongside parents to better capture family-level influences on PA.

These results have several implications. They support family-involved strategies to promote MVPA, given that parent PA and support-encouragement, monitoring, and transport-are linked with child MVPA[29–31]. The variability captured by the prediction interval suggests that parental modelling alone is unlikely to be sufficient; multicomponent approaches that address peers, schools, neighbourhoods, and broader social norms are warranted[23, 48]. In educational terms, this underscores the potential of school-based strategies to complement family influences, particularly through physical education programmes that emphasise inclusive participation, positive movement experiences, and the development of physical literacy[60–62]. By providing opportunities for movement (e.g. whole-of-school approach[63]) and reinforcing positive attitudes toward PA, school-based PA may help buffer children against disparities arising from differences in family activity patterns[64, 65].

Developmental considerations appear relevant. Although subgroup analyses by age (< 11 vs. ≥11 years) did not reach statistical significance, the observed trend toward slightly stronger associations in younger children is consistent with evidence of age-related declines in PA[6] and with developmental theory suggesting that younger children are more dependent on parental structure and opportunities, whereas adolescents are increasingly influenced by peers and autonomous choices[66, 67]. Interventions may therefore benefit from tailoring family components to developmental stage and from explicitly fostering opportunities for shared parent-child participation in PA[68, 69].

Given evidence of age-related declines in PA[34] and possible heightened responsiveness to maternal modelling in middle childhood[26, 32], interventions might consider developmentally tailored family components and opportunities for co-participation. Despite indications that father-child and father-son associations may be particularly relevant, paternal influences remain underrepresented in the evidence base, limiting the precision of estimates and constraining interpretation. Future studies would benefit from designs that ensure balanced recruitment of mothers and fathers and from protocols that enable simultaneous accelerometer wear in parents and children, allowing more direct examination of shared timing and contexts of activity[33, 34, 40, 42].

Strengths and limitations

Strengths of this MA include a comprehensive search strategy and the exclusive use of accelerometer-measured PA, ensuring objective and comparable measurement across studies.[46] Pooling effects by specific parent–child dyads (e.g., mother–daughter, father–son), rather than aggregating across parents, provides more nuanced insight into potential gender-specific associations[56]. The use of a random-effects model with Hartung–Knapp adjustment further strengthens inference by yielding conservative uncertainty estimates under substantial between-study heterogeneity[70, 71].

By focusing on family-related correlates of PA in primary school-aged children, this review also addresses a relatively underexplored area and includes evidence from multiple geographical regions[46, 72].

Several limitations also should be noted. Only a small number of studies met the inclusion criteria, and dyad representation was uneven-particularly for father-focused and father-son effects limiting subgroup analyses and precision of some estimates. Parental age was not reported in all the studies (only 4 of them reported parental age range), which is limiting sample description and prevents examining parent age (a life-stage marker) as a potential source of heterogeneity in children's MVPA[73]. No eligible accelerometer-based studies of siblings were identified. Therefore, conclusions are limited to parent-child associations and sibling effects remain underexamined. Most studies were conducted in high-income countries, and dyad-level participation was reported, potentially constraining generalizability[74, 75].

There were few studies reporting detailed information on cultural context and gender-role arrangements within families, although sociocultural circumstances can shape children's PA and parental support in gender-specific ways[76, 77]. This limits interpretation of differences by parental gender, as maternal and paternal roles in structuring opportunities may vary across cultural contexts[77].

Considerable heterogeneity was observed, likely reflecting differences in study design, accelerometer protocols, and contextual factors such as seasonality and climate, which are known to influence children's PA[78]. While accelerometry enhances internal validity[79]. it also restricted the pool of eligible studies,

excluding relevant evidence using other designs. The focus on MVPA alone precludes conclusions about light-intensity activity or sedentary behaviour.

All included studies were cross-sectional, preventing causal inference and leaving residual confounding possible[80, 81]. Finally, restrictions to healthy samples, English-language publications, and a 6-14-year age range may limit generalizability[82, 83].

CONCLUSIONS

Accelerometer-measured MVPA shows a robust but modest association between parents and children, with considerable contextual variability. These findings reinforce the view that parental PA represents one relevant, but not dominant, influence within a broader socio-ecological system shaping children's activity behaviours. Future studies should prioritize balanced recruitment of mothers and fathers, standardized and synchronized accelerometer protocols (including weekdays/weekends and seasons), and longitudinal or quasi-experimental designs that can disentangle modelling from co-participation and support pathways. Embedding family components within multi-level interventions-spanning homes, schools, and neighbourhoods-appears a rational direction to help more children meet international MVPA guidelines[5, 51].

Abbreviations

LPA - light physical activity

LMVPA - light to moderate to vigorous physical activity

MA - meta-analysis

MPA - moderate physical activity

MVPA - moderate to vigorous physical activity

NIH - National Institutes of Health

PA - physical activity

PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses

REML - restricted maximum likelihood

SB - sedentary behaviour

VPA - vigorous physical activity

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

Specific intellectual contributions to this work are described through the 'methods' section. All authors read and approved the final manuscript.

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Figures

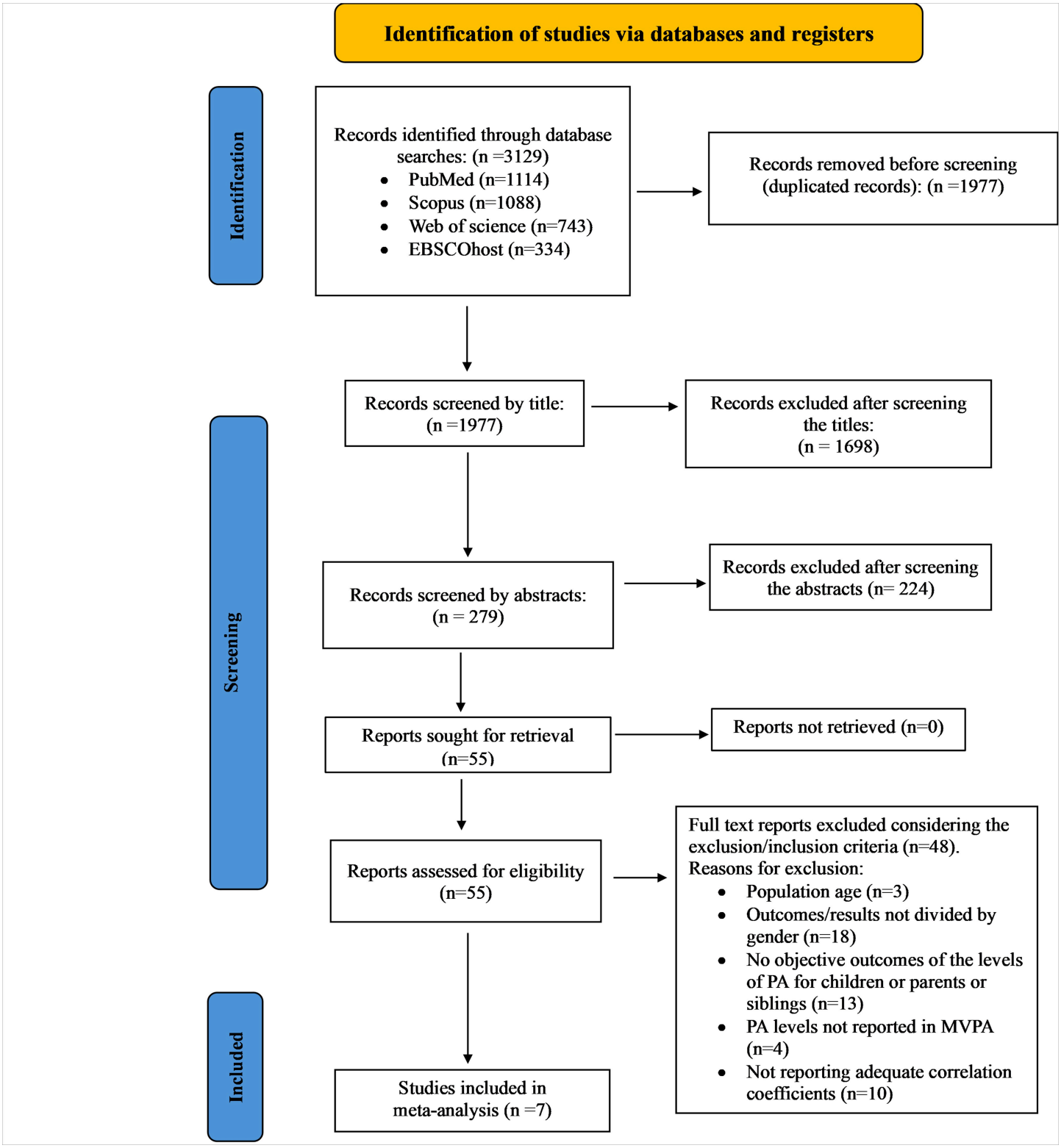


Figure 1

PRISMA flow diagram of the study selection process. The chart illustrates the identification, screening, eligibility, and inclusion of studies for systematic review and meta-analysis.

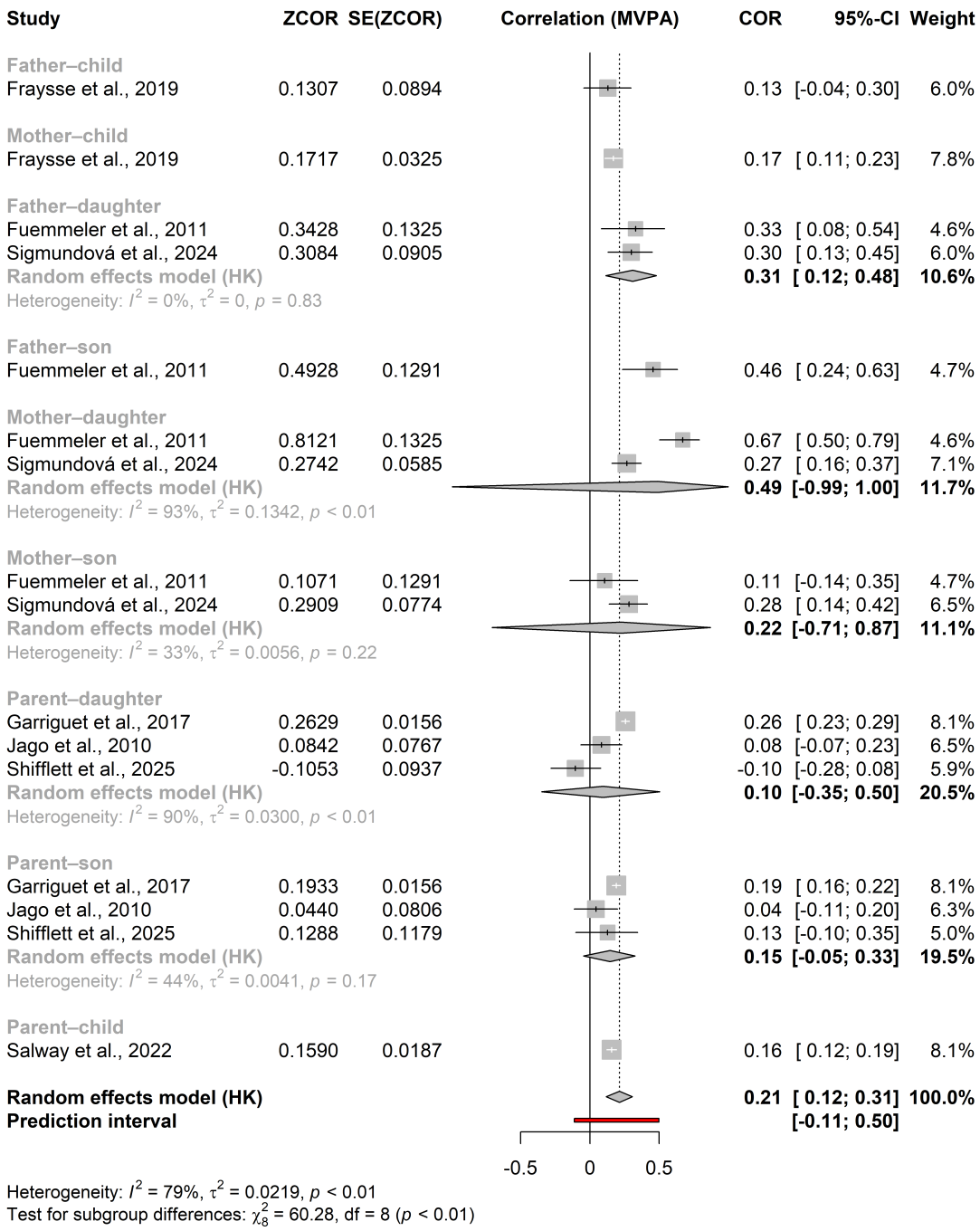


Figure 2

Forest plot of the meta-analysis of all the included studies.

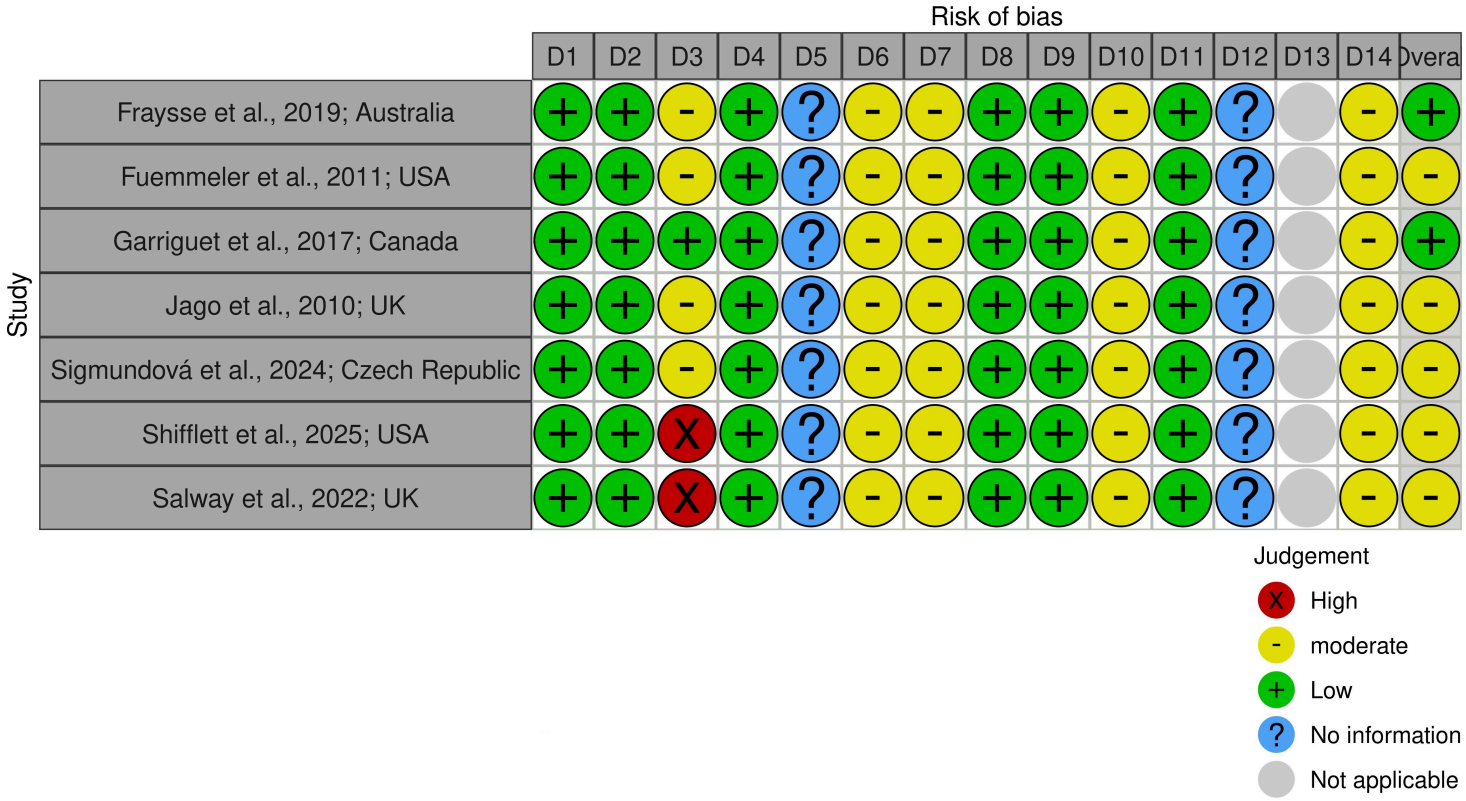


Figure 3

Risk of bias summary for included studies. The traffic light plot presents the judgements of the author for each domain across the studies that were included. The domains assessed were: **D1:** Clear description of the hypothesis/aim/objective; **D2:**Clear description of main outcomes; **D3:** Clear description of participant characteristics; **D4:** Clear description of the interventions; **D5:**Clear description of principal confounders; **D6:** Clear description of main findings; **D7:** Estimates of random variability for main outcomes; **D8:**Reported adverse events; **D9:** Characteristics of participants lost to follow-up; **D10:** Reported actual probability values; **D11:**Participants representative of the entire population; **D12:** Participants representative of those invited; **D13:** Facilities/staff representative; **D14:**Blinding of study subjects. Final, “Overall" represents the summary judgement for each individual study.

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