Parental correlates in child and adolescent physical activity: a meta-analysis

Christopher A Yao* and Ryan E Rhodes

Abstract

Objective: Physical activity (PA) has a profound impact on health and development in children. Parental behaviors (i.e., modeling and support) represent an obvious important factor in child PA. The purpose of this paper was to provide a comprehensive meta-analysis that overcomes the limitations of prior narrative reviews and quantitative reviews with small samples.

Methods: Ten major databases were used in the literature search. One-hundred and fifteen studies passed the eligibility criteria. Both fixed and random effects models with correction for sampling and measurement error were examined in the analysis. Moderator analyses investigating the effects of child’s developmental age, study design, parental gender, measurement of child PA, and quality rating were performed.

Results: Based on the random effects model, the results showed that parental modeling was weakly associated with child PA (summary $r = .16$, 95% CI .09-.24) and none of the proposed moderators were significant. Separate analyses examining the moderating effects of parental gender and boys’ PA found that that father-son PA modeling ($r = .29$, 95% CI .21-.36) was significantly higher compared to mother-son PA ($r = .19$, 95% CI .14-.23; $p < .05$). However, parental gender did not moderate the relationship between parental modeling and girls’ PA ($p > .05$). The random effects model indicated an overall moderate effect size for the parental support and child PA relationship (summary $r = .38$, 95% CI .30-.46). Here, the only significant moderating variable was the measurement of child PA (objective: $r = .20$, 95% CI .13-.26; reported: $r = .46$, 95% CI .37-.55; $p < .01$).

Conclusions: Parental support and modeling relate to child PA, yet our results revealed a significant degree of heterogeneity among the studies that could not be explained well by our proposed moderators.

Keywords: Preschool, Childhood, Adolescence, Physical activity, Parental support, Parental role modeling, Parental behaviours, Meta-analysis, Review

It has been widely acknowledged by health researchers that participation in regular physical activity (PA) is linked to various health benefits and prevention of chronic disease. In spite of the overwhelming evidence that supports an association between PA and health, much of the populace does not commensurate with the national recommendations. Particularly, many children in North America are insufficiently active to reap the health benefits associated with regular PA. A recent Canadian national survey estimated that 9% of boys and 4% of girls between the ages of six to nineteen met the current recommendations [1]. Likewise, data from the United States showed that more than half of the children surveyed were insufficiently active [2]. At this juncture, intervention efforts to improve child PA levels have produced very modest results [3]. Thus moving forward, it will be crucial to properly identify the key correlates in child and adolescent PA to further the planning and development of PA interventions [4].

Presently, a total of 14 review papers [5-18] and three reviews of reviews [19-21] have been published in this area. From these reviews, parental modeling of PA and parental support of child PA have emerged as major themes. However, many of these reviews have discordant findings. For instance, 12 review papers examining the relationship between parent and child PA have shown discordant results.
variable results [5-9,12-14,16,19-21]. Three of the 12 reviews do not support a link between parent PA and child PA [14,20,21], while eight reviews have suggested the association as inconclusive [5-7,9,12,13,17,19]. Unlike the findings for parental modeling and child PA, parental support has emerged as a consistent correlate of child and adolescent PA in a number of narrative reviews [6-9,11,12,14,16,18-21]. The more striking absence in this theme is the limited quantitative synthesis in order to provide a point-estimate of the parental support-PA relationship. Only one meta-analysis has examined parental support (r = .23), but it is several years old and was restricted to three studies [8].

Another pertinent issue that surrounds parental support as a correlate of child PA has been how support has been defined and measured. Parental support has often been measured as an omnibus of various support behaviours and has no consistent set of behaviours [22]. In some cases, researchers have grouped and measured multiple support behaviours as tangible (e.g., providing transportation, financial support) and intangible forms of support (e.g., praise and encouragement). Through these forms of measurement, it is unclear to which specific individual support behaviours may be important in child PA. A more comprehensive synthesis of these support factors is needed.

Finally, prior reviews on this topic have been restricted to very specific age-ranges, which reduces our understanding to whether modeling and support vary across the developmental spectrum. No prior meta-analyses have explored the parental correlates according to developmental stages (i.e., preschool, childhood, and adolescence). A meta-analysis is necessary to consolidate and clarify the overall information.

With these limitations in mind, the aim of this meta-analysis was to provide a cohesive and comprehensive examination of the parental correlates, and potential moderators, of child PA. Here, the five postulated moderators included the child’s developmental age, method in which child PA is measured (objective or reported), geographical location of the sample population, study design, and quality of the study. Moreover, we investigated the possibility of intergenerational gender interactions between parent and child behaviours. It was hypothesized that overall parental PA would have a negligible to small correlation with child and adolescent PA, explaining the prior inconsistencies among the narrative reviews; whereas overall parental support will have a small to medium correlation. Among the individual support behaviours, it was postulated that a small effect size will be found for the various support behaviours and child PA. Our analysis of intergenerational gender interactions between parental and child PA was considered exploratory.

**Methods**

**Eligibility criteria**

To ensure transparency and complete reporting, the protocols for this study were in accordance to the recommendations put forth by the PRISMA statement for conducting systematic reviews and meta-analyses [23]. Studies were included if: 1) children were between 2.5 and 18.0 years; 2) an assessment of parental/family support, individual parental support behaviour(s), or parental PA as the independent variable; 3) a measurement of children’s PA as the dependent variable; and 4) an effect size illustrating the relationship between independent and dependent variables or the availability of statistics to calculate an effect size (e.g., means and standard deviation). Studies were excluded from the review if: 1) social support measures consolidated parental sources with teachers, peers, or friends; 2) the study was qualitative; and 3) not published in English.

PA was defined as “any bodily movement produced by skeletal muscles that results in energy expenditure” [24]. This definition encompassed both structured (e.g., organized sports, lessons) and unstructured PA (e.g., leisure-time PA, play). Encouragement to be active, parent–child co-activity, praising the child’s activity, watching the child be active, informing the child that they are performing well, telling the child that PA is beneficial, and providing transportation to PA venues were classified as parental support behaviours. Other behaviours such as supplying the child with PA equipment and financial support, and enrolling the child in PA programs were classified as individual parent support behaviours.

**Search strategy**

Publications from January 1970 to November 2014 were systematically reviewed for this paper (Figure 1). Ten databases were used to locate relevant articles: EBSCO (Academic Search Complete, Academic Search Premier, CINAHL, Health Source, MEDLINE, PsycINFO, Social Sciences, SPORTDiscus), PubMed, and ISI Web of Science. The following key terms were used: physical activity, exercise, sport, adolescent, youth, children, preschool, parental support, parental physical activity, role modeling, parental influence, and parental correlates. One author conducted the search and manually cross-referenced studies to ensure saturation of the literature. The eligibility criteria and search strategy followed a protocol used in previously published meta-analyses and reviews [25,26]. The reference sections of reviews and individual studies were carefully inspected to locate any additional publications.

**Screening**

Using the inclusion criteria previously established by both reviewers, one reviewer initially screened citations
based on the title and abstract. Potentially relevant abstracts were selected and the full article was located if it was deemed suitable for the study. A full consensus by the two reviewers was required in order for the studies to be included in the analysis.

**Data abstraction**

Information regarding authors, publication year, country, sample (number of participants, age, gender), study design (cross-sectional/prospective), measurement tools (i.e., PA and social support measures), reliability of the measures, parental gender, and reported effect sizes, were abstracted onto a Word document. Once the coded data was entered, the file was imported into the Comprehensive Meta-Analysis version 2 program for further analyses [27].

**Analyses**

Based on the hypothesized moderators, the studies included in the analysis were categorized and coded by developmental age (preschool 2–5.4 yrs, childhood 5.5-12.4 yrs, adolescence 12.5-18 yrs), geographical location (Australia & New Zealand, Asia, Canada, Europe, USA), study design (cross-sectional, prospective), type of PA measure used to determine child PA (objective: accelerometer, pedometer, heart rate monitor; reported), and quality (high, moderate, low). Upon further investigation of previous meta-analyses and reviews, some of the studies included did not appropriately categorize effect sizes that represented the overall effect sizes for parental-child PA variables. For instance, samples only examining girls’ or boys’ PA were previously amalgamated into overall child associations rather than conducted in separate analyses. In our analyses, the correlates for boys, girls, and mixed samples were abstracted, categorized, and analyzed separately.

In the case that more than one type of PA measure was reported (ex. overall PA levels versus moderate to vigorous PA), the variable that best reflected the national
recommendations for PA (i.e., moderate to vigorous PA) was incorporated into the analysis. Studies that incorporated a family support measure were included in the analysis.

To assess the potential risk of bias and methodological quality, each study was critically appraised using an adapted version of Downs and Black's [28] 22-item assessment tool. This modified tool is comparable to the Cochrane Collaboration's instrument for assessing risk of bias and has been used in several published reviews [25,26,29]. For the purposes of this study, items from the original checklist pertaining to experimental studies and items that were not applicable to this study were excluded. The adapted version utilized a 14-point scoring scheme, where each item was scored one point based on a yes (1) or no (0) response. Studies scoring 12–14 points were deemed high-quality studies, 8–11 points were regarded as moderate-quality studies, and lower quality studies were below 7 points. Studies that scored 4 points or less were excluded.

Effect sizes included in the analysis were further corrected for sample size and attenuated for potential measurement error. Correction of measurement error procedures was based on the reported reliabilities of the measures found in the study. In the case that the reliability of the measure was not detailed, an \( r_{xy} = .70 \) was used. Based on previous publications, this reliability has been identified as a conservative, yet acceptable estimate for reliability [30]. For accelerometer measures that have obtained 4–9 days of data, the recommended reliability estimate of .80 was used [31]. No subsequent correction procedures were conducted for effect sizes derived from structural equation models or hierarchical linear models as these forms of analyses account for measurement error.

Both fixed and random effects models were used to determine the overall effect sizes for both uncorrected and corrected effect sizes. However, only corrected effect sizes from the random effects model will be discussed. The strength of the correlation was categorized based on Cohen's recommendations [32]. According to these guidelines, a correlation of .09 or less was considered as a null effect, .10 a small effect, .30 a medium effect, and .50 a large effect. In addition to the overall effect sizes, 95% confidence intervals were calculated. To determine heterogeneity among the effect sizes, a Q-statistic and \( I^2 \) was computed. The Q-statistic identifies whether the observed variance in effect sizes is no greater than that expected by sampling error alone, whereas the \( I^2 \) denotes the dispersion. For the purposes of this study, \( I^2 \) values of 25 were categorized as having a low dispersal, 50 as a moderate dispersal, and 75 as a high dispersal. Moderator analyses investigating the effects of child’s developmental age, study design, parental gender, measurement of child PA, and quality rating were performed using the corrected r's with fixed and random effects models. A minimum of 4 studies was required in each moderator analysis to deem it as a valid moderator. To identify the correlations between the intergenerational relationships between parent and child, separate analyses were used to examine whether the parents' gender moderated boys’ and girls’ PA. To assess the extent of publication bias in our samples, Rosenthal's classic fail-safe N [33] and Duval and Tweedie's Trim and Fill procedures [34,35] were conducted. All data was analyzed in February 2013 using Comprehensive Meta-Analysis.

Results
A total of 2,293 potentially relevant citations were identified in the initial search. The screening procedures resulted in a total of 112 studies, with 11 studies extracted from the reference listing of the included articles (see Figure 1). Table 1 describes the characteristics of the 115 independent samples included for the investigation. Details of the included studies are presented in Tables 2,3,4,5,6 and 7. Duplicated studies were not included in the analysis.

Table 1 Descriptive statistics of 112 studies investigating parental factors and child and adolescent physical activity (n = 115 independent samples)

| Characteristic                        | Samples n (%) |
|---------------------------------------|---------------|
| Geographical location                 |               |
| Asia                                  | 4 (3)         |
| Australia & New Zealand               | 11 (10)       |
| Canada                                | 8 (7)         |
| Europe                                | 31 (27)       |
| South America                         | 2 (2)         |
| United States                         | 59 (51)       |
| Study design                          |               |
| Cross-sectional                       | 94 (82)       |
| Prospective                           | 21 (18)       |
| Physical activity measurement         |               |
| Objective                             | 31 (27)       |
| Self-report                           | 84 (73)       |
| Quality rating                        |               |
| High                                  | 18 (16)       |
| Moderate                              | 84 (73)       |
| Low                                   | 13 (11)       |
| Developmental age                     |               |
| Preschool (2-5.4 yrs)                 | 14 (12)       |
| Childhood (5.5-12.4 yrs)              | 54 (47)       |
| Adolescence (12.5-19.0 yrs)           | 47 (41)       |
| Study, country | Sample (number, gender, mean age) | Design | Parental PA measure | Child PA measure | Results |
|---------------|----------------------------------|--------|----------------------|------------------|---------|
| Alderman et al. (2010) [36] USA | N = 70 43 m, 26 f 4-6 yrs at baseline; 5-15 yrs at follow-up | PRO (1-9 yrs) | Parent self-report | Parent report | Children’s MVPA & parental PA: r = .44, p < .05 at baseline; r = .08, p < .05 at follow-up. |
| Ammouri et al. (2007) [37] USA | N = 284 98 m, 186 f 15.3 yrs | CS | Parent self-report | Child report | Adolescents’ PA & parental PA: β = .019 |
| Berge et al. (2014) [38] USA | N = 200 80 m, 120 f 14.2 yrs | CS | Parent self-report | Child self-report | Adolescents’ MVPA & parental MVPA: β = .11, p < .05 (resident parent) |
| Dempsey et al. I(1993) [39] USA | N = 71 36 m, 35 f 10.2 yrs | CS | Parent self-report | Child self-report | Children’s MVPA & parent’s MVPA: β = -.17 |
| Dowda et al. (2011) [40] USA | N = 369 179 m, 194 f 4.2 yrs | CS | Parent self-report | Accelerometer (2 wks) | Children’s MVPA & parent’s PA: β = .002 |
| Dzewaltowski et al. (2008) [41] USA | N = 57 18 m, 37 f 12.4 yrs | CS | Child reported (adapted from the YRBSQ) | Child self-report | Children’s MVPA & parental PA: b = .22 |
| Fredricks & Eccles (2005) [42] USA | N = 364 184 m, 180 f Ages 7.0-11.0 yrs at baseline | PRO (1 yr) | Parent self-report | Child self-report | Children’s sports PA & parents’ PA: r = .05 at baseline; r = .04 at follow-up |
| Heitzler et al. (2007) [43] USA | N = 720 352 m, 368 f 14.7 yrs | CS | Parent self-report | Accelerometer (7 d) | Adolescents’ MVPA & parental PA: r = .07 |
| Hendrie et al. (2011) [44] Australia | N = 106 51 m, 55 f 8.3 yrs | CS | Parent self-report | Parent report | Children’s MVPA & parental PA: r = .145; partial r = .145 |
Table 2 Studies and effect sizes of parental modeling and child and adolescent physical activity (k = 36) (Continued)

| Study                        | N    | Country          | Study Design | Measures                          | Effect Size | Reference |
|------------------------------|------|------------------|--------------|-----------------------------------|-------------|-----------|
| Hennessy et al. (2010) [45]  | USA  | 76               | CS           | Parent self-report                | -.06        |           |
| Keresztes et al. (2008) [46] | Hungary | 548            | CS           | Child report                      | .41         |           |
| Labree et al. (2014) [47]    | Netherlands | 1943        | CS           | Parent report                      | .17         |           |
| Lei et al. (2004) [48]       | Taiwan | 798            | CS           | Child report                      | -.02        |           |
| Loprinzi et al. (2010) [49]  | Australia | 156         | CS           | Parent self-report                | .06         |           |
| Loprinzi et al. (2013) [50]  | USA  | 176             | CS           | Parent report                      | .24         |           |
| McMurray et al. (1993) [51]  | USA  | 1253            | CS           | Parent report                      | .01         |           |
| Moore et al. (1991) [52]     | USA  | 100             | CS           | Accelerometer (5 d)               | .66         |           |
| Mota (1998) [53]             | Portugal | 45           | CS           | Parent self-report                | .17         |           |
| Østbye et al. (2013) [54]    | USA  | 208             | CS           | Parent report                      | .15         |           |
| Patnode et al. (2010) [55]   | USA  | 294             | CS           | Parent self-report                | .00         |           |

Mean r = .135

Note: CS = Cross-sectional; MVPA = Moderate to vigorous physical activity; VPA = Vigorous physical activity; PA = Physical activity; IPAQ = International Physical Activity Questionnaire; PAEC-Q = Physical Activity and Exercise Questionnaire; ICC = Intraclass correlation coefficient; α = Cronbach’s alpha.
| Study                                      | N     | Sex | Measurement                  | Correlation | Notes |
|-------------------------------------------|-------|-----|------------------------------|-------------|-------|
| Perusse et al. (1989) [56] Canada         | 1610  |     | Parent self-report, 3-day activity record | r = .09, p < .05 | n = 1039 |
|                                           |       |     | Child self-report, 3-day activity record | .91         |       |
| Pfeiffer et al. (2009) [57] USA           | 331   | 169 m, 162 f | Parent self-report, Accelerometer (8–10 d) | r = −.04 | .05 |
|                                           |       |     | Child self-report, Accelerometer (8–10 d) | .80*        |       |
| Poest et al. (1989) [58] USA              | 514   | 269 m, 245 f | Parent self-report | r = .28, p = .045 | .40 |
|                                           |       |     | Teacher report, 3-day activity record | .70*        |       |
| Polley et al. (2005) [59] USA             | 87    |     | Parent self-report | r = .70* |       |
|                                           |       |     | Child self-report | .70*        |       |
| Ruiz et al. (2011) [60] USA               | 106   | 52 m, 54 f | Accelerometer (7 d) | r = .739, p < .0001 | .59 |
|                                           |       |     | Accelerometer (7 d) | .80*        |       |
| Rutkowski et al. (2012) [61] USA          | 94    | 56 m, 28 f | Parent self-report, IPAQ | r = −.23, p < .05 | .29 |
|                                           |       |     | Child self-report, PACE + MVPA | .06         |       |
|                                           |       |     | Adolescents’ PA (exercise) & parental PA: r = .09, p < .05 (n = 1039) | .10         |       |
| Sallis et al. (1988) [62] USA             | 33    | 13 m, 20 f | Parent self-report | r = .53, p < .01 | .70 |
|                                           |       |     | Child’s MPA & parents’ PA: r = .739, p < .0001 | .59         |       |
|                                           |       |     | Children’s VPA & parents’ PA: r = −.07, p > .05 | .05         |       |
| Singh et al. (2009) [63] USA              | 68288 | Age range: 6–17 yrs | Parent report | r = .24* | .34 |
|                                           |       |     | Parent report MVPA | .70*        |       |
|                                           |       |     | Organized sports participation | .70*        |       |
| Trost et al. (2003) [64] USA              | 380   | 171 m, 209 f | Parent self-report | r = .24* | .34 |
|                                           |       |     | Child self-report | .79         |       |
|                                           |       |     | Adolescents’ PA & parental PA: r = .05, p = .28 | .06         |       |
|                                           |       |     | *controlled for other covariates |       |       |
| Vella et al. (2014) [65] Australia        | 4042  | 2069 m, 1973 f | Parent self-report, MVPA | OR = 1.03, 95% CI 1.01–1.05, p < .05; r = .01 | .01 |
|                                           |       |     | Parent report MVPA | .70*        |       |
|                                           |       |     | *controlled for other covariates |       |       |
| Study                        | Design | Country   | N   | Gender | Age | Assessment                              | Measure                          | Effect Size | CI          | Note                                      |
|-----------------------------|--------|-----------|-----|--------|-----|-----------------------------------------|----------------------------------|-------------|-------------|-------------------------------------------|
| Welk et al. (2003) [66] USA | CS     | USA       | 994 | 505 m, 489 f | 10.0 yrs | Parent self-report Child self-report | Children's PA & parent PA: r = .28 |            | .38          | (82% respondents mothers)                |
| Williams & Mummery (2011) [67] Australia | CS     | Australia | 295 | 111 m, 184 f | 15.1 yrs | Parent report Child self-report | Adolescents' MVPA & parents' MVPA: adjusted OR = 0.59, 95% CI 0.29-1.20 | - .29      |             | (67% respondents mothers)               |
| Zecevic et al. (2010) [68] Canada | CS     | Canada    | 102 | 54 m, 48 f | 3.8 yrs | Parent self-report Parental report | Children's PA & parental PA habits: OR = 1.620, p < .10, r = .1874 | .27         |             | (96% respondents mothers)               |
| Zhao & Settles (2014) [69] USA | CS     | USA       | 1514 | 763 m, 751 f | 11.8 yrs | Parent self-report Parent report | Children's MPA & parental PA: β = -.15, p < .05, Children's VPA & parental PA: β = -.09 | -.17        |             | Mean β = -.12                           |
| Ziviani et al. (2005) [70] Australia | CS     | Australia | 50  | 26 m, 24 f | 7.7 yrs | Parent self-report | Children's PA & parents' PA: β = .23 | .28         |             | Mean r = .135                           |
| Ziviani et al. (2008) [71] Australia | CS     | Australia | 59  | 26 m, 33 f | 8.9 yrs | Parent self-report | Children's PA (weekday) & parents' PA: r = .06 | .16         |             |                                           |

Note: *reliability not reported; APARQ = Adolescent Physical Activity Recall Questionnaire; CLASS = Children's Leisure Activities Study Survey; CS = cross-sectional; d = days; f = female; FATS = Fargo Activity Timesampling Survey; GLTEQ = Godin Leisure-Time Exercise Questionnaire; IPAQ = International Physical Activity Questionnaire; PRO = prospective; m = male; MPA = moderate physical activity; MVPA = moderate-to-vigorous physical activity; OSRAC-P = Observational System for Recording Physical Activity in Children-Preschool Version; PA = physical activity; PAEC-Q = Physical Activity and Exercise Questionnaire for Children; SAPAC = Self-Administered Physical Activity Checklist; SQUASH = Short Questionnaire to Assess Health-Enhancing Physical activity; VPA = vigorous physical activity.
| Study, country                      | Sample (number, gender, mean age) | Design | Parental support measure | Child physical activity measure | Results | Corrected effect size |
|------------------------------------|-----------------------------------|--------|--------------------------|-------------------------------|---------|-----------------------|
| Barr-Anderson et al. (2010) [72] USA | N = 73 18 m, 55 f 10.1 yrs       | CS     | Child report             | Child self-report             | Children’s MVPA and perceived parental support: $\beta = .17, p < .05$ | .24     |
|                                    |                                   |        | Parental Support – aggregated measure (encouragement, coactivity, transportation, watching, inform) | Adapted GLTEQ Hard/strenuous test-retest .63 | Moderate test-retest .52 | |
| Davison et al. (2012) [73] USA     | N = 767 392 m, 375 f Age range: 6.0-12.0 yrs & 13.0-19.0 yrs | CS     | Parent report            | Parental support – aggregated measure (logistic support, modeling, co-activity, encouragement) | .70*    | Children’s MVPA & parental support: $r = .20, p < .01$ (n = 355) | .27     |
|                                    |                                   |        |                          | $\alpha = .78$ | 13.5 yrs | Adolescent’s MVPA & parental support: $r = .36, p < .01$ (n = 412) | .49     |
| Dowda et al. (2011) [40] USA       | N = 369 175 m, 194 f 4.2 yrs      | CS     | Parent report            | Accelerometer (2 wk)          | Children’s MVPA & parental support: $\beta = .28$ | .34     |
|                                    |                                   |        | Parental support – aggregated measure (encourage, coactivity, transportation, watching child, providing information) | $\alpha = .80^*$ Direct observation (OSRAC-P) | Inter-observer .91 | |
| Hagger et al. (2009) [74] 4 countries: UK, Estonia, Finland, Hungary | N = 840 380 m, 460 f Age range: 13.2-15.0 yrs | PRO (5 wks) | Child report | Parental support – aggregated measure (provision of opportunities, choices, and options to be active) | Child self-report | Children’s MVPA (UK; n = 210) & parental support: $r = .47, p < .01$ | .55     |
|                                    |                                   |        |                          | UK $\alpha = .96$ | Estonian $\.68$ | Children’s MVPA (Estonia; n = 268) & parental support: $r = .36, p < .01$ | .45     |
|                                    |                                   |        |                          | Estonian $\alpha = .94$ | Finland $\.67$ | Children’s MVPA (Finland; n = 127) & parental support: $r = .41, p < .01$ | .51     |
|                                    |                                   |        |                          | Finland $\alpha = .96$ | Hungary $\.67$ | Children’s MVPA (Hungary; n = 235) & parental support: $r = .20, p < .01$ | .26     |
| Hamilton & White (2008) [75] Australia | N = 423 172 m, 251 f 13.5 yrs     | CS     | Child report             | Parental support – aggregated measure (co-activity, watch, encouragement, praise, transportation) | .70*    | Adolescents’ MVPA & parental support: $r = .37, p < .001$ | .53     |
| Study                | Sample Size | Country   | Measurement | Effect Size | Description |
|---------------------|-------------|-----------|-------------|-------------|-------------|
| Heitzler et al.     | N = 3114    | USA       | Parent report | Parental support – aggregated and individually reported (coactivity, watching child, & transportation) | Test-retest .65 |
|                     | Age range: 9.0-13.0 yrs |           | Child self-report | OR = 1.65, 95% CI 1.45-1.88, p < .001 |
| Heitzler et al.     | N = 720     | USA       | Child report | Parental support – aggregated measure (encouragement, coactivity, watch, praise) α = .80 | Accelerometer (7 d) .80* |
|                     | 352 m, 268 f | 14.7 yrs |             |             | Adolescents' MVPA & parental support: r = .19, p < .05 |
| Hendrie et al.      | N = 106     | Australia | Parent report | Parental support – aggregate measure (watching, transportation) α = .79 (92% respondents mothers) | Child self-report CLASS .70* |
|                     | 51 m, 55 f  | 8.3 yrs  |             |             | Children's MVPA & parental support: r = .16; r = .18 when controlled for parent demographic factors |
| Hennessy et al.     | N = 76      | USA       | Parent report | Parental support | Accelerometer (5 d) .70* |
|                     | 26 m, 50 f  | 9.1 yrs  | Logistical support | α = .67 |
| Kim & Cardinal      | N = 1347    | Korea     | Child report | Parental support – aggregated measure (e.g., encouragement) test-retest .83 | Child self-report GLTEQ Test-retest .86 |
|                     | 943 m, 404 f | 16.4 yrs |             |             | Adolescent PA & parental support: r = .19, p < .01 |
| Labree et al.       | N = 1943    | Netherlands | Parent report | Parental support α = .64 (respondents predominantly mothers) | Parent report .70* |
|                     | 970 m, 973 f | 8.4 yrs  |             |             | Children's PA & parental support: r = .21, p < .05 |
| Langer et al.       | N = 421     | USA       | Parent report | Parental support – aggregated measure (encouragement, co-activity, transportation, watch) α = .77 (93% respondents mothers) | Accelerometer (7 d) .80* |
|                     | 213 m, 208 f | 6.9 yrs  |             |             | Children's MVPA & parental support: r = .20, p < .001 |
| Lawman & Wilson     | N = 181     | USA       | Child report | Parental support – aggregated measure α = .89 | Accelerometer (7 d) .80* |
|                     | 72 m, 109 f | 13.3 yrs |             |             | Adolescent's MVPA & parental support: r = .09 |
### Table 3: Studies and effect sizes for parental support and child and adolescent physical activity (k = 34) (Continued)

| Study                      | Participants | Design | Measure(s) | Effect Size | p | Notes |
|----------------------------|--------------|--------|------------|-------------|---|-------|
| Lei et al. (2004)          | Taiwan       | CS     | Child report | Parental support: r = .12, p < .001 | .17 | Children’s MVPA & parental support: r = .12, p < .001 |
| N = 798                    |              |        | Age range: 12–18 yrs | 7-day PA survey | .75 |
|                            |              |        |             | Parent report | .70* |
|                            |              |        |             | Parental support – aggregated measure (encourage, co-activity, transportation, watch, inform) | .70 |
|                            |              |        |             | test-retest .81 | .70* |
| Loprinzi & Trost (2010)    | Australia    | CS     | Parent report | Parent report: β = .16, p < .05 | .12 | Children’s PA (at home) & parental support: β = .16, p < .05 |
| N = 156                    |              |        | 75 m, 81 f 3.7 yrs | PAEC-Q (PA at home) | .70* |
|                            |              |        | Parental support - aggregated measure (encourage, co-activity, transportation, watch, inform) | Accelerometer (2 d) | .70* |
|                            |              |        |             | (PA during daycare) | .70* |
|                            |              |        | Mean β = .09 |             |     |
| Loprinzi et al. (2013)     | USA          | CS     | Parent report | Parent report: β = .29, p < .05 | .40 | Children’s MVPA & parental support: β = .29, p < .05 |
| N = 176                    |              |        | 82 m, 94 f 4.0 yrs | PAEC-Q | .70* |
|                            |              |        | Parental support - aggregated measure (encourage, co-activity, transportation, watch, inform) | | .70* |
|                            |              |        | α = .75 (85% respondents mothers) |             |     |
| Ommundsen et al. (2006)    | Norway       | CS     | Child report | Child self-report: r = .40, p < .001 | .57 | Children’s PA & parental support: r = .40, p < .001 |
| N = 760                    |              |        | 379 m, 381 f 9.0 & 15 yr olds | PEACH | .70* |
|                            |              |        | Parental support - aggregated measure (encouragement, co-activity) |             |     |
|                            |              |        | α = .70 (85% respondents mothers) |             |     |
| Østbyte et al. (2013)      | USA          | CS     | Parent report | Accelerometer (7 d) | .34 | Children’s PA & parental support: r = .26, p < .05 |
| N = 208                    |              |        | 116 m, 92 f 2.5 yrs | Parental support – aggregated measure | .80* |
|                            |              |        | α = .75 (all mothers) |             |     |
| Patnode et al. (2010)      | USA          | CS     | Child reported aggregate measures (encouragement, watch) | Accelerometer (7 d) | .19 | Adolescents’ MVPA & parental support: r = .15, p < .05 |
| N = 294                    |              |        | 149 m, 145 f 15.4 yrs | α = .76 | .80* |
|                            |              |        | Parent report | Accelerometer (8–10 d) | .05 | Children’s MVPA & family support: r = .04 |
| Pfeiffer et al. (2009)     | USA          | CS     | Parent report | Parental support – aggregated measure (encouragement, co-activity, transportation, watch, inform) | .80* |
| N = 331                    |              |        | 169 m, 162 f 4.3 yrs | .81 (94% respondents mothers) | .80* |
|                            |              |        |             |             |     |
| Study | Sample Size | Measure | Sample Description | Outcome | Correlation | Notes |
|-------|-------------|---------|--------------------|---------|-------------|-------|
| Prochaska et al. (2002) [81] USA | N = 138 | Child report | 48 m, 90 f, 12.1 yrs | Activity monitor (5 d) | r = .12 | Children’s PA (monitor) & parental support: r = .15 |
| Schaben et al. (2006) [82] USA | N = 1995 | Child report | 1033 m, 962 f, 14.7 yrs | Child self-report | r = .31 | Adolescents’ MVPA (middle school) & parental support: r = .31 |
| Schary et al. (2012) [83] USA | N = 195 | Parent report | 90 m, 105 f, 4.0 yrs | Parent report | r = .32, p < .001 | Children’s PA & parental support: r = .32, p < .001 |
| Taylor et al., (2002) [84] USA | N = 509 | Child report | 231 m, 278 f, Age range: 12–18 yrs | Child self-report & parent report | r = .43, p < .001 (<85th percentile BMI); partial r = .13, p = .45 (>85th percentile BMI) | Adolescents’ PA & family support: partial r = .43, p < .001 (<85th percentile BMI); partial r = .13, p = .45 (>85th percentile BMI) |
| Trost et al. (2003) [64] USA | N = 380 | Parent report | 171 m, 209 f, 14.0 yrs | Child self-report | r = .48 | Adolescents’ PA & parental support: β = .24 |
| Verloigne et al. (2014) [85] Australia | N = 134 | Parent report | 66 m, 68 f, 14.1 yrs | Accelerometer (4 d) | r = .03 | Adolescent MVPA & logistic support: r = .02 |
| Study Authors and Year | Location | N | Gender | Child Physical Activity | Parental Support | Children's PA & Parental Support | Adolescents' MVPA & Parental Support | Adjusted for Other Variables |
|------------------------|----------|---|--------|-------------------------|------------------|----------------------------------|---------------------------------------|------------------------------|
| Welk et al. (2003) [66] | USA      | 994 | 565 m, 489 f | 10.0 yrs | Child report | Parental support – aggregated measure (encouragement, involvement, facilitation) | Child self-report | PAQ-C | .70* | Adolescents' MVPA & parental support: .95 | OR = 7.38, 95% CI 2.98-18.29* | *adjusted for other variables |
| Williams & Mummery (2011) [67] | Australia | 295 | 111 m, 184 f | 15.1 yrs | Parent report | Parental support – aggregated measure (encouragement, watch, transportation, inform, co-activity) | Adolescent PARQ | .70* | Children's PA & parental support: .41 | OR = 2.18, p < .10; r = .2976 |
| Zecevic et al. (2010) [68] | Canada | 102 | 54 m, 48 f | 3.8 yrs | Parent report | Parental support – aggregated measure (encouragement, co-activity, transportation, watch, inform) | Parental report | .70* | Children's PA & parental support: .55 | Adolescent's MVPA & parental support: .55 | r = .43, p < .01 |
| Zhang et al. (2012) [86] | USA | 285 | 142 m, 143 f | 13.4 yrs | Child report | Parental support – aggregated measure (encouragement, co-activity, transportation, praise) | PAQ-C | .70* | Children's PA & parental support: .70 | r = .51 |

Note: *reliability not reported; CLASS = Children's Leisure Activities Study Survey; CS = cross-sectional; d = day; f = female; GLTEQ = Godin Leisure-Time Exercise Questionnaire; m = males; MVPA = moderate to vigorous physical activity; PA = physical activity; PAQ = Physical Activity Questionnaire; PAQ-C = Physical Activity Questionnaire for Older Children; PARQ = Physical Activity Recall Questionnaire; PEACH = Personal and Environmental Associations with Children's Health; PAEC-Q = Physical Activity and Exercise Questionnaire for Children; PRO = prospective; OSRAC-P = Observational System for Recording Physical Activity in Children-Preschool Version; wk = week.
| Study, country | Sample (number, gender, mean age) | Design | Parental PA measure | Child PA measure | Results | Corrected effect size |
|---------------|-----------------------------------|--------|---------------------|-----------------|---------|----------------------|
| Aarnio et al. (1997) Finland | N = 3254 1557 m, 1697 f 16.0 yrs | CS | Parent self-report | Child self-report | Girls’ PA (n = 1130) & fathers’ PA: r = .046, p < .01 Girls’ PA (n = 1123) & mothers’ PA: r = .101, p < .01 | .07 |
| Anderssen & Wold (1992) Norway | N = 904 498 m, 406 f 13.3 yrs | CS | Child report | Child self-report | Girls’ PA & fathers’ PA: r = .14, p < .01 Girls’ PA & mothers’ PA: r = .14, p < .01 | .14 |
| Anderssen et al. (2006) Norway | N = 380 191 m, 189 f 13.3 yrs | PRO (8 yrs) | Parent self-report | Child self-report | Girls’ PA & fathers’ PA: β = .09 Girls’ PA & mothers’ PA: β = .05 | .12 |
| Bastos et al. (2008) Brazil | N = 857 411 m, 446 f Age range: 10–19 yrs | CS | Child report | Child self-report | Girls’ MVPA & fathers’ PA: r = -.08 Girls’ PA & mothers’ PA: r = -.05 | -.11 |
| Bogaert et al. (2003) Australia | N = 59 29 m, 30 f 8.6 yrs at baseline | PRO (1 yr) | Parent self-report | Parent report Bouchard activity record | Girls’ MVPA & mothers PA: r = .44, p = .03 | .47 |
| Campbell et al. (2001) Canada | N = 153 77 m, 76 f 13.5 yrs at baseline | PRO (12 yrs) | Parent self-report | Child self-report | Girls’ MVPA & fathers’ PA: r = .001 Girls’ MVPA & mothers’ PA: r = .008 | .00 |
| Davison et al. (2001) USA | N = 197 All females 5.4 yrs at baseline 7.3 at follow-up | PRO (2 yrs) | Parent self-report | Parent report | Girls’ PA & fathers’ PA: r = -.03 at baseline Girls’ PA & mothers’ PA: r = .09 at baseline | -.05 |
| Davison et al. (2003) USA | N = 180 All females 9.0 yrs | CS | Parent report Explicit modeling | PA measures as a composite score of CPA-short, an activity checklist, and PACER | Girls’ & fathers’ explicit modeling: r = .23, p < .01 | .36 |
| Deflandre et al. (2001) France | N = 80 36 m, 44 f Age range: 11–16 yrs | CS | Child report | Child self-report | Girls’ MVPA & fathers’ PA: r = .30 Girls’ MVPA & mothers’ PA: r = .16 | .43 |
| Deflandre et al. (2001) France | N = 48 26 m, 22 f 17.0 yrs | CS | Child report | Heart rate monitor (7 d) | Girls’ MVPA & mothers PA: r = .35 Girls’ MVPA & mothers’ PA: r = .21 | .11 |
## Table 4: Studies and effect sizes for parental modeling and girls' physical activity moderated by parental gender (k = 62) (Continued)

| Study                        | Sample Size | Method | Outcome Measure | Effect Size   | Effect Size Details                             | Study Type | Gender Modulated | Effect Size Gender Modulated |
|------------------------------|-------------|--------|-----------------|---------------|-------------------------------------------------|------------|------------------|-------------------------------|
| Eriksson et al. (2008)       | N = 1124    | CS     | Baeke Questionnaire | Child self-report | Girls' PA (sports) & fathers' PA: crude OR = 2.2, 95% CI 1.1-4.2 |           |                  |                               |
|                              | 553 m, 571 f |        |                 |               |                                                 |            |                  |                               |
|                              | 120 yrs     |        |                 |               |                                                 |            |                  |                               |
| Fogelholm et al. (1999)      | N = 271     | CS     | Parent self-report | Child self-report | Girls' VPA & fathers' PA: r = .24, p < .01 |           |                  |                               |
|                              | 143 m, 128 f|        |                 |               |                                                 |            |                  |                               |
|                              | 9.6 yrs     |        |                 |               |                                                 |            |                  |                               |
| Fuemmeler et al. (2011)      | N = 45      | CS     | Accelerometer (3 d) | Accelerometer (3 d) | Girls' MVPA (weekend) & fathers' PA: r = .37 |           |                  |                               |
|                              | 23 m, 22 f  |        |                 |               |                                                 |            |                  |                               |
|                              | 9.9 yrs     |        |                 |               |                                                 |            |                  |                               |
| Hinkley et al. (2012)        | N = 705     | CS     | Parent self-report | Accelerometer (8 d) | Girls' PA & father's MPA: OR = 1.01, 95% CI 1.00-1.02 |           |                  |                               |
|                              | 366 m, 262 f|        |                 |               |                                                 |            |                  |                               |
|                              | 4.5 yrs     |        |                 |               |                                                 |            |                  |                               |
| Jacobi et al. (2011)         | N = 630     | CS     | Parent self-report | Accelerometer (3 d) | Girls' MVPA (weekend) & fathers' PA: r = .37 |           |                  |                               |
|                              | 317 m, 313 f|        |                 |               |                                                 |            |                  |                               |
|                              | Age range 8–18 yrs | | | | | | | |
| Jago et al. (2014)           | N = 822     | CS     | Accelerometer (5 d) | Accelerometer (5 d) | Girls' MVPA & fathers' MVPA: β = .07 |           |                  |                               |
|                              | 436 m, 386 f|        |                 |               |                                                 |            |                  |                               |
|                              | 6.0 yrs     |        |                 |               |                                                 |            |                  |                               |
| Kahn et al. (2008)           | N = 12812   | PRO    | Parent self-report | Child self-report | Girls' MVPA & mothers' MVPA: β = .13, p < .0001 |           |                  |                               |
|                              | 5575 m, 7237 f |      |                 |               |                                                 |            |                  |                               |
|                              | Age range: 10–18 yrs | | | | | | | |
Table 4 Studies and effect sizes for parental modeling and girls’ physical activity moderated by parental gender (k = 62) (Continued)

| Study | N | Country | Gender | Age | Parental Measure | Child Measure | Effect Size | P Value | Notes |
|-------|---|---------|--------|-----|------------------|---------------|-------------|---------|-------|
| Madsen et al. (2009) | 2379 | USA | All females | 9-10 yrs followed to 18-19 yrs | Parent self-report | Child self-report | 0.13 | <0.05 | Girls’ MVPA & child reported fathers’ PA (yr 3): r = 0.13, p < 0.05 |
| | | | | | Adolescent report | HAQ | 0.20 | | |
| Martin-Matillas et al. (2011) | 2260 | Spain | All females | 63 m, 37 f | Accelerometer (7-9 d) | Accelerometer (8-9 d) | 2.37 | 1.70-3.29 | 0.001 |
| Moore et al. (1991) | 100 | USA | All females | 9.6 yrs | Parent self-report | Child self-report | 2.0 | 0.9-4.4 | 0.33 |
| Nichols-English et al. (2006) | 133 | USA | All females | 989 m, 931 f | Child report | Child self-report | 1.6 | 1.1-2.1 | 0.01 |
| O’Loughlin et al. (1999) | 1920 | Canada | All females | 148 yrs | Parent self-report | Child self-report | 1.63 | 1.1-2.1 | 0.01 |
| Ohta et al. (2010) | 339 | Japan | All females | | Parent self-report | Child self-report | 1.63 | 1.1-2.1 | 0.01 |

Mean r = 0.13

Girls’ MVPA & child reported mothers’ PA (yr 9): r = 0.16, p < 0.05

Mean r = 0.14

Girls’ PA & mothers’ PA: OR = 2.37, 95% CI 1.70-3.29, p < 0.001

Mean r = 0.14

Girls’ PA & mothers’ PA: OR = 1.63, 95% CI 1.1-2.1, p < 0.01

Mean r = 0.06

Girls’ VPA & mothers’ VPA: r = 0.16

Mean r = 0.06

Girls’ PA & mothers’ PA: OR = 1.63, 95% CI 1.1-2.1, p < 0.01

Mean r = 0.06

Girls’ PA & mothers’ PA: OR = 1.63, 95% CI 1.1-2.1, p < 0.01
### Table 4
Studies and effect sizes for parental modeling and girls’ physical activity moderated by parental gender ($k = 62$) (Continued)

| Study                        | Country       | Sample Size | Gender Distribution | Age Range | Measure of Parental Modeling | Measure of Child Activity | Effect Size | Effect Size Measure | Significance | Significance Measure | r (p) | Comments |
|------------------------------|---------------|-------------|---------------------|------------|------------------------------|----------------------------|-------------|---------------------|--------------|----------------------|-------|----------|
| Pahkala et al. (2007)        | Finland       | N = 558     | 294 m, 264 f        | 13.0 yrs   | Parent self-report           | Child self-report           | .10*        | .70*                | .19          | .70*                 | .17   |          |
| Raudsepp (2006)              | Estonia       | N = 329     | 168 m, 161 f        | 13.8 yrs   | Parent self-report           | Child self-report           | .15         | .70*                | <.05        | .70*                 | .32   |          |
| Shropshire & Carroll (1997)  | UK            | N = 924     | 468 m, 454 f        | 13.0 yrs   | Child report                 | Child self-report           | .23         | .70*                | <.01        | .70*                 | .47   |          |
| Siegel et al. (2011)         | Mexico        | N = 1004    | 490 m, 514 f        | 9–18 yrs   | Child report                 | Child self-report PAQ       | .23         | α = .72             | .05        | .70*                 | .26   |          |
| Sigmund et al. (2008)        | Czech Republic| N = 192     | 109 m, 89 f         | 8–13 yrs   | Parent report                | IPAQ                        | .15         | .70*                |             | .70*                 | .19   |          |
| Toftegaard-Stockel et al.    | Denmark       | N = 6356    | 3190 m, 3166 f      | 12–16 yrs  | Child report                 | Child self-report           | .11         | .70*                | .11          | .70*                 | .16   |          |
| Trost et al. (1997)          | USA           | N = 202     | 92 m, 110 f         | 10–11 yrs  | Child report                 | Child report                | .22         | .70*                | .21          | .70*                 | .31   |          |
| Mean r = .13                 |               |             |                     |            |                              |                            |             |                     |             |                     |       |          |
| Girls’ MPAs & mothers’ PA:  |               |             |                     |            |                              |                            |             |                     |             |                     |       |          |
| β = .186, p < .05            |               |             |                     |            |                              |                            |             |                     |             |                     |       |          |
| Girls’ MVPA (9–10 yrs) & boys’ PA: β = .148, p < .05 | | | | | | | | | | | | |
| Mean r = .14                 |               |             |                     |            |                              |                            |             |                     |             |                     |       |          |
| Mean r = .13                 |               |             |                     |            |                              |                            |             |                     |             |                     |       |          |
| Girls’ MVPA (9–10 yrs) & mothers’ PA: β = .151, p < .05 | | | | | | | | | | | | |
| Study                          | N (F:M) | Age | Measure | Gender | Effect Size | CI        | Girls’ VPA & fathers’ PA: r | CI        | Girls’ MPA & fathers’ PA: r | CI        | Mean r | CI         |
|-------------------------------|---------|-----|---------|--------|-------------|-----------|----------------------------|-----------|---------------------------|-----------|---------|-------------|
| **Trost et al.** (1999) [116] USA | N = 198 |     | CS Child report | Accelerometer (7 d) | | | | | | | | |
| 95 m, 103 f | 11.4 yrs | | | | | | | | | | | |
| Trost et al. | 116 | USA | CS | Child report | Accelerometer (7 d) | | | | | | | |
| | 95 m, 103 f | 11.4 yrs | | | | | | | | | | | |
| Wagner et al. (2004) [117] France | N = 2852 |     | CS Parent self-report | Child self-report | | | | | | | | |
| 1421 m, 1431 f | 12.0 yrs | | | | | | | | | | | |
| Wagner et al. (2004) | 117 | France | CS | Parent self-report | Child self-report | | | | | | | |
| | 1421 m, 1431 f | 12.0 yrs | | | | | | | | | | | |
| Yang et al. (1996) [118] Finland | N = 635 |     | PRO (12 yrs) Child report | Child self-report | | | | | | | | |
| 316 m, 319 f | 9.0 yrs at baseline | | | | | | | | | | | |
| Yang et al. (1996) | 118 | Finland | PRO (12 yrs) | Child report | Child self-report | | | | | | | |
| | 316 m, 319 f | 9.0 yrs at baseline | | | | | | | | | | | |
| | N = 648 | | | | | | | | | | | |
| | 321 m, 327 f | 12.0 yrs at baseline | | | | | | | | | | | |
| | N = 598 | | | | | | | | | | | |
| | 286 m, 312 f | 15.0 yrs at baseline | | | | | | | | | | | |
| **Note.** *reliability not reported; 7DPAR = 7-Day Physical Activity Recall; CPA = Children’s Physical Activity-Short Scale; CS = cross-sectional; d = day; f = female; HAQ = Habitual Activity Questionnaire; IPAQ = International Physical Activity Questionnaire; m = male; MAQ = Modifiable Activity Questionnaire; MAQ-A = Modifiable Activity Questionnaire for Adolescents; MPA = moderate physical activity; MP = moderate to vigorous physical activity; PA = physical activity; PACER = Progressive Aerobic Cardiovascular Endurance Run; PAQ = Physical Activity Questionnaire; PDPAR = Previous Day Physical Activity Recall; PRO = prospective; VPA = vigorous physical activity. **
Table 5: Studies and effect sizes for parental modeling and boys' physical activity moderated by parental gender (k = 49)

| Study, country            | Sample (number, gender, mean age) | Design | Parental PA measure | Child PA measure | Results | Corrected effect size |
|---------------------------|-----------------------------------|--------|---------------------|------------------|---------|----------------------|
| Aarnio et al. (1997) [87] Finland | N = 3254 1557 m, 1697 f 16.0 yrs | CS     | Parent self-report  | Child self-report | Boys' PA (n = 1120) & fathers' PA: r = .012, p < .01 | .02 |
| Anderssen & Wold (1992) [88] Norway | N = 904 498 m, 406 f 13.3 yrs | CS     | Child report        | Child self-report | Boys' PA & fathers' PA: r = .17, p < .001 | .23 |
| Anderssen et al. (2006) [89] Norway | N = 380 191 m, 189 f 13.3 yrs at baseline | PRO (8 yrs) | Parent self-report | Child self-report | Boys' PA & fathers' PA: β = .10 | .13 |
| Bastos et al. (2008) [90] Brazil | N = 857 411 m, 446 f Age range: 10–19 yrs | CS     | Child report        | Child self-report | Boys' PA & fathers' PA: r = −.02 | −.03 |
| Campbell et al. (2001) [92] Canada | N = 153 77 m, 76 f 13.5 yrs at baseline | PRO (12 yrs) | Parent self-report | Child self-report | Boys' MVPA & fathers' PA: r = .05 | .05 |
| Deflandre et al. (2001) [95] France | N = 80 36 m, 44 f Age range: 11–16 yrs | CS     | Child report        | Child self-report | Boys' MVPA & fathers' PA: r = .56 | .80 |
| Deflandre et al. (2001) [96] France | N = 48 26 m, 22 f 17.0 yrs | CS     | Child report        | Heart rate monitor (7 d) | Boys' MVPA & fathers' PA: r = −.11 | −.16 |
| Eriksson et al. (2008) [97] Sweden | N = 1124 553 m, 571 f 12.0 yrs | CS     | Baeke Questionnaire | Child self-report | Boys' PA (sports) & fathers' PA: crude OR = 3.2, 95% CI 1.5-6.6 | .61 |
| Fogelholm et al. (1999) [98] Finland | N = 271 143 m, 128 f 9.6 yrs | CS     | Parent self-report  | Child self-report | Boys' VPA & fathers' PA: r = .08 | .11 |

Note: All studies used either child report or parent self-report for measuring PA. Corrected effect sizes are provided where available.
Table 5: Studies and effect sizes for parental modeling and boys' physical activity moderated by parental gender (k = 49) (Continued)

| Study                  | N   | Design | Measure | Effect Size | Boys' MVPA (weekend) & fathers' PA: OR = 1.99, 95% CI 1.40-2.84, p < .001 | Boys' MVPA (weekday) & fathers' PA: OR = 2.0, 95% CI 1.1-1.93, p < .05 |
|------------------------|-----|--------|---------|-------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Fuemmeler et al. (2011) [99] USA | 45  | CS     | Accelerometer (3 d) | .70* | Boys' MVPA (weekend) & fathers' PA: r = .43, p < .05 | Boys' MVPA (weekday) & fathers' PA: r = .38, p < .01 |
|                        | 23 m, 22 f |        |         |              | Mean r = .453                                                               | Boys' MVPA (weekend) & mothers' PA: r = .10 |
|                        | 9.9 yrs |        |         |              |                                                                             | Boys' MVPA (weekday) & mothers' PA: r = .09, r = .13 |
| Jacobi et al. (2011) [101] France | 630 | CS     | Parent self-report MAQ | .70* | Boys' PA & mothers' PA: r = .18 | Boys' PA & mothers' PA: r = .18 |
|                        | 317 m, 313 f | Age range 8–18 yrs |     |              | Mean r = .107                                                               | Boys' PA & mothers' PA: r = .18 |
| Jago et al. (2014) [102] UK | 822 | CS     | Accelerometer (5 d) | .70* | Boys' MVPA & fathers' MVPA: β = .10 | Boys' MVPA & mothers' MVPA: β = .06 |
|                        | 436 m, 386 f | Age range 6.0 yrs |     |              | .14                                                                        | .09 |
| Kahn et al. (2008) [103] USA | 12812 | PRO (1 yr) | Parent self-report | .70* | Boys' MVPA & mothers' PA: β = .085, p < .0001 | Boys' MVPA & mothers' PA: β = .085, p < .0001 |
|                        | 5575 m, 7237 f | Age range 6.0 yrs |     |              | .12                                                                        | .12 |
| Martin-Matillas et al. (2011) [105] Spain | 2260 | CS     | Child report Health Behaviour in School Children | .70* | Boys' PA & fathers' PA: OR = 1.99, 95% CI 1.40-2.84, p < .001 | Boys' PA & mothers' PA: OR = 1.99, 95% CI 1.40-2.84, p < .001 |
|                        | 1157 m, 1103 f | Age range 10–18 yrs |     |              | .38                                                                        | .38 |
| Moore et al. (1991) [52] USA | 100  | CS     | Accelerometer (7–9 d) | .80* | Boys' PA & fathers' PA: OR = 3.1, 95% CI 1.1-1.93, p < .05 | Boys' PA & mothers' PA: OR = 2.0, 95% CI 1.1-1.93, p < .05 |
|                        | 63 m, 37 f | Age range 4–7 yrs |     |              | .52                                                                        | .52 |
| O'Loughlin et al. (1999) [107] Canada | 1920 | CS     | Child report | .70* | Boys' PA (sports) & fathers' PA: OR = 2.0, 95% CI 1.4-2.9 | Boys' PA (sports) & fathers' PA: OR = 2.0, 95% CI 1.4-2.9 |
|                        | 989 m, 931 f | Age range 9–13 yrs |     |              | .38                                                                        | .38 |
| Pahkala et al. (2007) [109] Finland | 558  | CS     | Parent self-report | .70* | Boys' PA & fathers' PA: r = .07, p = .28 | Boys' PA & mothers' PA: r = .10, p = .13 |
|                        | 294 m, 264 f | Age range 13.0 yrs |     |              | .10                                                                        | .14 |
| Study                        | N       | Measure     | Effect Size | Significance | Boys' PA & fathers' PA | Boys' PA & mothers' PA | Mean r     |
|------------------------------|---------|-------------|-------------|--------------|------------------------|------------------------|------------|
| Raudsepp (2006) [110] Estonia | 329     | Child-report | r = .38, p < .001 |             | Boys' MVPA & father's explicit modeling: | r = .38, p < .001 |            |
| Shropshire & Carroll (1997) [111] UK | 924     | Child-report | r = .35, p < .01  |             | Boys' MVPA & mother's explicit modeling: | r = .35, p < .01 |            |
| Shropshire & Carroll (1997) [111] UK | 924     | Child-report | r = .38, p < .001 |             | Boys' PA & father's PA: r = .19 | Boys' PA & mother's PA: r = .11 |            |
| Siegel et al. (2011) [112] Mexico | 1004    | Child-report | r = .27  |             | Boys' MVPA 9–10 yrs & father's PA: β = .239, p < .05 | Boys' MVPA 9–10 yrs & mother's PA: β = .160, p < .05 |            |
| Sigmund et al. (2008) [113] Czech Republic | 192     | Child-report | r = .16  |             | Boys' MVPA 9–10 yrs & father's PA: r = .39, p < .001 | Boys' MVPA 9–10 yrs & mother's PA: r = .08 |            |
| Toftegaard-Stockel et al. (2011) [114] Denmark | 6356    | Child-report | r = .23  |             | Boys' MVPA 9–10 yrs & father's PA: r = .39, p < .001 | Boys' MVPA 9–10 yrs & mother's PA: r = .08 |            |
| Trost et al. (1997) [115] USA | 202     | Child-report | r = .05  |             | Boys' MVPA 9–10 yrs & father's PA: r = .39, p < .001 | Boys' MVPA 9–10 yrs & mother's PA: r = .08 |            |
| Trost et al. (1999) [116] USA | 198     | Child-report | r = .05  |             | Boys' MVPA 9–10 yrs & father's PA: r = .39, p < .001 | Boys' MVPA 9–10 yrs & mother's PA: r = .08 |            |
| Wagner et al. (2004) [117] France | 2852    | Child-report | r = .14  |             | Boys' MVPA 9–10 yrs & father's PA: r = .39, p < .001 | Boys' MVPA 9–10 yrs & mother's PA: r = .08 |            |
Table 5 Studies and effect sizes for parental modeling and boys' physical activity moderated by parental gender (k = 49) (Continued)

| Study                        | N     | Age at Baseline | Child Report | Child Self-report | Boys' PA (cohort 1) & fathers' PA: r | Boys' PA (cohort 2) & fathers' PA: r | Boys' PA (cohort 3) & fathers' PA: r | Mean r |
|------------------------------|-------|-----------------|--------------|-------------------|---------------------------------------|---------------------------------------|---------------------------------------|--------|
| Yang et al. (1996) [118]     | 635   | 9 yrs           | PRO (12 yrs) | .70*              | .21                                   | .27                                   | .21                                   | .19    |
|                              | 316 m, 319 f |               |              |                   |                                       |                                       |                                       |        |
|                              | 321 m, 327 f |               |              |                   |                                       |                                       |                                       |        |
|                              | 648   | 12 yrs          |              |                   |                                       |                                       |                                       |        |
| Yao and Rhodes (2015)        | 648   | 15 yrs          | PRO (12 yrs) | .70*              | Boys' PA (cohort 1) & mothers' PA: r | .19                                   | Boys' PA (cohort 2) & mothers' PA: r | .08    |
|                              | 598   |                 |              |                   |                                       |                                       |                                       |        |
|                              | 286 m, 312 f |              |              |                   |                                       |                                       |                                       | .07    |

Note. *reliability not reported; 7DPAR = 7-Day Physical Activity Recall; CS = cross-sectional; d = days; f = females; IPAQ = International Physical Activity Questionnaire; m = males; MAQ = Modifiable Activity Questionnaire; MAQ-A = Modifiable Activity Questionnaire for Adolescents; MPA = moderate physical activity; MVPA = moderate to vigorous physical activity; PA = physical activity; PAQ = Physical Activity Questionnaire; PDPAR = Previous Day Physical Activity Recall; PRO = prospective; VPA = vigorous physical activity.
| Study, country                  | Sample (number, gender, mean age) | Design | Parental support measure | Child physical activity measure | Results                                                                 | Corrected effect size |
|--------------------------------|-----------------------------------|--------|--------------------------|--------------------------------|--------------------------------------------------------------------------|------------------------|
| Anderson et al. (2007) [119] USA | N = 100 47 m, 53 f 13.4 yrs        | CS     | Child report             | Accelerometer (4 d)             | Children’s MPA & encouragement: \( r = -0.06 \)                          | 0.05                   |
|                                |                                   |        | Encouragement            |                                | Children’s VPA & encouragement: \( r = 0.11 \)                          |                        |
|                                |                                   |        |                          |                                | **Mean \( r = 0.03 \)**                                                 |                        |
| Anderson et al. (2009) [120] USA | N = 391 207 m, 184 f 9.9 yrs        | CS     | Child report             | Child self-report              | Children’s MVPA & encouragement: \( r = 0.39 \)                          | 0.56                   |
|                                | N = 948 370 m, 578 f 13.6 yrs      |        | Encouragement            | PAQ-C                          | Adolescents’ MVPA & parental encouragement: \( r = 0.25 \)              |                        |
|                                |                                   |        |                          | Child self-report              | **Mean \( r = 0.36 \)**                                                 |                        |
| Arredondo et al. (2006) [121] USA | N = 812 390 m, 422 f 6.0 yrs       | CS     | Parent report            | Parent report                  | Children’s PA & monitoring: \( \beta = 0.19, p < .001^* \)              | 0.27                   |
|                                |                                   |        | Monitoring               |                                | Children’s PA & praise: \( \beta = 0.13, p < .001^* \)                  | 0.19                   |
|                                |                                   |        |                          | Reinforcement/praise           | **Adjusted for parent’s age, marital status, employment, & education**  |                        |
|                                |                                   |        |                          |                                | **Mean \( r = 0.27 \)**                                                 |                        |
| Beets et al. (2006) [122] USA   | N = 363 174 m, 189 f 12.3 yrs      | CS     | Child report             | Child self-report              | Children’s MVPA & providing transportation: \( \beta = 0.28 \)          | 0.40                   |
|                                |                                   |        | Encouragement            | Youth risk behavior            | Children’s MVPA & praise: \( \beta = 0.36 \)                            | 0.51                   |
|                                |                                   |        |                          | surveillance survey            | **Mean \( r = 0.36 \)**                                                 |                        |
|                                |                                   |        |                          |                                | **Mean \( r = 0.25 \)**                                                 |                        |
| De Bourdeaudhuij et al. (2005) [123] Belgium | N = 5563 (normal weight) 14.8 yrs | CS     | Child report             | Child self-report              | Children’s PA & encouragement: \( r = 0.25 \) (normal weight); \( r = 0.26 \) (overweight) | 0.35                   |
|                                | N = 515 (overweight & obese) 14.6 yrs |        | Encouragement            | Study developed questionnaire   | **Mean \( r = 0.25 \)**                                                 |                        |
Table 6: Studies and effect sizes for individual parental support behaviours (k = 64) (Continued)

| Study | Sample Size | Country | Design | Parental Support |.Validation |Outcome Measures | Effect Size |
|-------|-------------|---------|--------|------------------|------------|------------------|-------------|
| Dowda et al. (2011) | 369 | USA | CS | Parent report | Accelerometer (2 wk) | Children’s MVPA & PA equipment: \( \beta = .17 \) | .22 |
| Fredricks & Eccles (2005) | 364 | USA | PRO (1 yr) | Parent report | Child self-report | Children’s PA (sport) & encouragement: \( r = .33 \), p < .001 (baseline); \( r = .31 \), p < .001 (follow-up) | .45 |
| Gubbels et al. (2011) | 2026 | Netherlands | PRO (2 yrs) | Parent report | Parent report | Children’s PA & encouragement: \( \beta = .06 \), p < .05 | .09 |
| Heitzler et al. (2006) | 3114 | USA | CS | Parent report | Child self-report | Children’s organized PA & transportation: OR = 1.21, 95% CI 1.11-1.33, p < .001 | .12 |
| Hendrie et al. (2011) | 106 | Australia | CS | Parent report | Child self-report | Children’s organized PA & co-activity: OR = 1.08, 95% CI 1.02-1.13, p < .001 | .01 |
| Hennessy et al. (2010) | 76 | USA | CS | Parent report | Accelerometer (5 d) | Children’s PA & monitoring: \( \beta = -.13 \) | -.17 |
| Hohepa et al. (2007) | 3471 | New Zealand | CS | Child report | Child report | Adolescents’ PA & encouragement: \( r = .38 \) (juniors); \( r = .41 \) (seniors) | .56 |

Note: PRO = Parent report only; CS = Child self-report only; \( \alpha \) = Cronbach’s alpha; \( \beta \) = correlation coefficient; \( OR \) = odds ratio; \( CI \) = confidence interval; \( \text{MVPA} \) = moderate-to-vigorous physical activity; \( \text{PA} \) = physical activity; \( \text{OSRAC-P} \) = Observation System for Rating Activity Change in Parents; \( \text{CLASS} \) = Classroom Assessment of Socioemotional Learning and Sociometry Scale.
| Study                          | Country     | N          | Gender | Age Range | Measure | Domain | r or β | p Value | Notes |
|-------------------------------|-------------|------------|--------|-----------|---------|--------|--------|---------|-------|
| Huang et al. (2011) [126]     | China       | 303        | 143 m, 160 f | 11.1 yrs | CS      | Child report | Availability of PA equipment | .14 | p < .05 | .20 |
| Klesges et al. (1984) [127]   | USA         | 14         | 7 m, 7 f | 2.8 yrs | CS      | Direct observation (FATS) | Encouragement | .20 | .70* | .29 |
| Klesges et al. (1986) [128]   | USA         | 30         | 15 m, 15 f | 2.5 yrs | CS      | Direct observation (FATS) | Encouragement | .70* | .90 | .36 |
| Klesges et al. (1990) [129]   | USA         | 222        | 122 m, 100 f | 4.4 yrs | CS      | Direct observation (CATS) | Encouragement | .32 | p < .05 | .35 |
| King et al. (2008) [130]      | USA         | 535        | 290 m, 245 f | Age range: 14–18 yrs | CS | Child report | Encouragement | .70* | .90 | .15 |
| Lawman & Wilson (2014) [79]   | USA         | 181        | 72 m, 109 f | 13.3 yrs | CS | Parent report | Availability of PA equipment | α = .61 | Monitoring | .80* | .14 |
| Loprinzi et al. (2013) [50]   | USA         | 176        | 82 m, 94 f | 4.0 yrs | CS | Parent report | Monitoring child’s PA | .70 (85% respondents mothers) | .70* | .61 | .29 |
| Loucaides et al. (2004) [131] | Cyprus      | 256        | Age range: 11.0-12.0 yrs | | CS | Child report | Encouragement | Test-retest .64 | Parent report | Availability of PA equipment | .70* | .10 |
| Yao and Rhodes (2015)         |             |            |        |           |         | Child self-report | CLASS-C | .70* | | |
|                              |             |            |        |           |         | Children’s MVPA & PA equipment | r = .14, p < .05 | .20 | |
|                              |             |            |        |           |         | Children’s PA & PA equipment: r = .32, p < .05 | .36 | |
|                              |             |            |        |           |         | Children’s PA & encouragement: r = .32, p = .648 | .35 | |
|                              |             |            |        |           |         | Adolescent’s MVPA & PA equipment: r = .09 | .13 | |
|                              |             |            |        |           |         | Adolescent’s MVPA & monitoring: r = .07 | .08 | |
|                              |             |            |        |           |         | Children’s MVPA & encouragement: r = .15 | .20 | |
|                              |             |            |        |           |         | Children’s MPA & encouragement: r = .13 | .13 | |
|                              |             |            |        |           |         | Mean r = .14 | | |
|                              |             |            |        |           |         | Adolescents MVPA & PA equipment: r = .09 | .13 | |
|                              |             |            |        |           |         | Adolescents MVPA & monitoring: r = .07 | .08 | |
|                              |             |            |        |           |         | Mean r = .08 | | |
|                              |             |            |        |           |         | Children’s MVPA & PA equipment: r = .25, p < .001 | .27 | |
|                              |             |            |        |           |         | (winter); r = .18, p < .01 (summer) | | |
|                              |             |            |        |           |         | Mean r = .22 | | |

* Significant at the .05 level
| Study                                             | N       | C / P | Behaviour / Methodology | Strategy / Measure | Effect Size | CI       | p-value | Notes                                      |
|--------------------------------------------------|---------|------|-------------------------|--------------------|-------------|---------|--------|--------------------------------------------|
| Loucaides & Jago (2006) [132] Cyprus             | 104     | CS   | Parent report           | Pedometer (5d)     | r = .10     | .14     |        | Children’s PA & equipment: r = .10 .14     |
|                                                  |         |      | PA equipment            |                    |             | .14     |        | Children’s PA & transportation: r = .17 .24|
|                                                  |         |      | Transportation          |                    | r = .17     | .24     |        | Children’s PA & watching: r = .18 .22      |
| Määttä et al. (2014) [133] Finland              | 883     | CS   | Child report            | Child self-report  | r = .19     | .25     |        | Child PA & encouragement: r = .19, p < .001 |
|                                                  |         |      | Encouragement           |                    | r = .25     | .24     |        | Child PA & Co-activity: r = .16, p < .001   |
| McKenzie et al. (1991) [134] USA                | 42      | PRO  | Direct observation      | Direct observation | r = .43     | .51     |        | Children’s PA & encouragement: r = .43, p < .01 |
|                                                  |         |      | (BEACHES)               |                    | .85         |        |        |                                             |
|                                                  |         |      | Prompts to be active    |                    |             |         |        |                                             |
| McKenzie et al. (2008) [135] USA                | 139     | CS   | Direct observation      | Direct observation | r = .53     | .62     |        | Children’s MVPA & encouragement: r = .53, p < .01 |
|                                                  |         |      | (BEACHES)               |                    | .85         |        |        |                                             |
| Millstein et al. (2011) [136] USA               | 104     | CS   | Parent report           | Parent report      | r = .14     | .18     |        | Children’s MVPA & PA equipment at home: r = .14, p < .15 |
|                                                  |         |      | Availability of PA      |                    |             | .05     |        | Children’s MVPA & providing recreation centre membership: r = .04 |
|                                                  |         |      | equipment               |                    |             | .05     |        |                                             |
|                                                  |         |      | Provision of recreation centre membership | ICC = .80 |            | .05     |        |                                             |
| Moore et al. (2008) [137] USA                   | 116     | CS   | Parent report           | Child self-report  | r = .28     | .42     |        | Adolescents’ MVPA & providing recreation centre membership: r = .28, p < .01 |
|                                                  |         |      | Availability of PA      |                    |             | .37     |        |                                             |
|                                                  |         |      | equipment               |                    |             | .37     |        |                                             |
|                                                  |         |      | ICC = .66               |                    |             | .37     |        |                                             |
|                                                  |         |      | Provision of recreation centre membership | ICC = .69 |            | .37     |        |                                             |
|                                                  |         |      | ICC = .66               |                    |             | .37     |        |                                             |
|                                                  |         |      | Child report            |                    |             | .37     |        |                                             |
|                                                  |         |      | Financial support       |                    |             | .37     |        |                                             |

Mean r = .35
| Study Authors and Year | Country | Study Design | Parental Support Behaviors | Method | Effect Size | Association | Confidence Interval | p-Value | Notes |
|------------------------|---------|--------------|-----------------------------|--------|-------------|-------------|--------------------|---------|-------|
| Moore et al. (2014)    | USA     | CS           | Child report                | Watch, praise, transportation, co-activity | OR .99, 95% CI .87-1.14; r = .004 | -01        |                     |         |       |
|                        |         |              |                             | a = .76-90                      | Children's MVPA & watching: OR .99, 95% CI .87-1.14; r = -.004 | .01        |                     |         |       |
| Mota (1998)            | Portugal| CS           | Parent self-report          | Co-activity                     | OR 1.01, 95% CI .88-1.12; r = .004 | .19        |                     |         |       |
| Nelson et al. (2005)   | USA     | PRO          | Co-activity                 | Accelerometer (7 d)             | OR 1.28, 95% CI 1.12-1.45, p < .05; r = .14 | .01        |                     |         |       |
| Østbyte et al. (2013)  | USA     | CS           | Parent report               | Accelerometer (7 d)             | OR 1.28, 95% CI 1.12-1.45, p < .05; r = .14 | .01        |                     |         |       |
| Pate et al. (1997)     | USA     | CS           | Child report                | Child self-report               | OR 1.12, 95% CI 1.00-1.26; r = .004 | .15        |                     |         |       |
| Patnode et al. (2010)  | USA     | CS           | Parent reported the provision of PA equipment | Accelerometer (7 d)             | OR 1.12, 95% CI 1.00-1.26; r = .004 | .15        |                     |         |       |
| Pfeiffer et al. (2009) | USA     | CS           | Providing PA equipment      | Accelerometer (7 d)             | OR 1.12, 95% CI 1.00-1.26; r = .004 | .15        |                     |         |       |
| Prochaska et al. (2002) | USA  | CS           | Child report                | Activity monitor (5 d)          | OR 1.12, 95% CI 1.00-1.26; r = .004 | .15        |                     |         |       |
| Sabiston & Crocker (2008) | USA     | CS           | Child report                | GLTEQ                            | OR 1.12, 95% CI 1.00-1.26; r = .004 | .15        |                     |         |       |
| Studies and effect sizes for individual parental support behaviours (k = 64) (Continued) |
|---|---|---|---|
| Schary et al. (2012) [84] USA | N = 195 | CS | Parent report |
| Parental support – aggregated & individual measures (encouragement, transportation, co-activity, watch, inform) | | | Parent report |
| a = .76 (86% respondents mothers) | PAEC-Q | Children's PA & encouragement: r = .28, p < .001 | .38 |
| 90 m, 105 f | 4.0 yrs | | Children's PA & watching: r = .22 | .30 |
| Vella et al. (2014) [65] Australia | N = 4042 | CS | Parent report |
| Co-activity | Parent report | Organized sports participation | Children's PA & co-activity: OR = 1.40, 95% CI 1.24-1.57 p < .05; r = .13 |
| 2069 m, 1973 f | 8.3 yrs | .70* (96% respondents mothers) | .70* |
| Verloigne et al. (2014) [85] Australia | N = 134 | CS | Parent report |
| Co-activity | Accelerometer (4 d) | Adolescent MVPA & co-activity: r = .01 | .01 |
| 66 m, 68 f | 14.1 yrs | Praise | Adolescent MVPA & praise: r = .01 | .01 |
| Zhao & Settles (2014) [69] USA | N = 1514 | CS | Parent self-report |
| Encouragement | Parent report | Children's MPA & encouragement: β = .30, p < .05 | .24 |
| Co-activity | .70* | Children's VPA & encouragement: β = .14 | .33 |
| 763 m, 751 f | 11.8 yrs | | Mean β = .17 |
| | | | Children's MPA & co-activity: β = .21, p < .01 |
| | | | Children's VPA & co-activity: β = .25, p < .01 |
| | | | Mean β = .23 |

Note: *reliability not reported; 7DPAR = 7-Day Physical Activity Recall; BEACHES = Behaviors of Eating and Activity for Children’s Health Evaluation System; CS = cross-sectional; d = days; f = females; FATS = Fargo Activity Timesampling Survey; GLTEQ = Godin Leisure-Time Exercise Questionnaire; m = males; MPA = moderate physical activity; MVPA = moderate to vigorous physical activity; PA = physical activity; PAEC-Q = Physical Activity and Exercise Questionnaire for Children; PAQ-C = Physical Activity Questionnaire for Older Children; PRO = prospective; CATS = Children’s Activity Timesampling Survey; VPA = vigorous physical activity.
## Table 7: Studies and effect sizes for parental support and girls’ physical activity moderated by parental gender (k = 13)

| Study, country | Sample (number, gender, mean age) | Design | Parental support measure | Child physical activity measure | Results & Corrected effect size |
|----------------|-----------------------------------|--------|--------------------------|-------------------------------|--------------------------------|
| Beets et al. (2007) | N = 259 | CS | Child report | Child self-report | Girls’ MVPA & paternal support: $\beta = -0.09$ | -11 |
| | USA | All female | Parental support – aggregated measure (encouragement, co-activity, transportation, watch, praise) | | Girls’ MVPA & paternal support: $\beta = 0.25$ | 32 |
| | | 15.5 yrs | Mother $\alpha = .85$ | | | |
| | | | Father $\alpha = .91$ | | | |
| Brunet et al. (2014) | N = 558 | CS | Child report | Accelerometer (7 d) | Girls’ MVPA & paternal support: $r = 0.24$, $p < .001$ (normal weight) | 28 |
| | Canada | 306 m, 252 f | Parental support – aggregated measure (co-activity, watch, transportation, encouragement, inform) | $r = 0.20$ | Girls’ MVPA & paternal support: $r = 0.20$ | 19 |
| | | 9.6 yrs | $\alpha = .77$ | | Mean $r = .22$ | |
| | | | ICC = .81 | | Girls’ MVPA & maternal support: $r = 0.10$ | |
| | | | | | Girls’ MVPA & maternal support: $r = 0.20$ (normal weight) | |
| | | | | | Mean $r = .15$ | |
| Butcher et al. (1983) | N = 696 | CS | Self-report | Child self-report | Girls’ PA & maternal support: $r = 0.21$ | 30 |
| | Canada | All female | Parental support | $r = 0.70$ | | |
| | | 11.0-16.0 yrs | | | | |
| Butcher (1985) | N = 140 | PRO | Child report | Child self-report | Girls’ PA (structured PA outside of school) & paternal support: $r = 0.36$, $p < .01$ | 51 |
| | Canada | All female | Parental support | $r = 0.70$ | Girls’ PA (structured PA outside of school) & maternal support: $r = 0.27$, $p < .01$ | 39 |
| | | Followed from age 11.0 to 15.0 yrs | | | | |
| Davison et al. (2003) | N = 180 | CS | Parent report | Child self-report | Girls’ PA & paternal logistic support: $r = 0.14$ | 28 |
| | USA | All females | Logistic support | | | |
| | | 9.0 yrs | Mother $\alpha = .61$ | | | |
| | | | Father $\alpha = .74$ | | | |
| Hinkley et al. (2012) | N = 705 | CS | Parent report | Accelerometer (8 d) | Girls’ PA & paternal logistic support: $OR = 1.01$, 95% CI .99-1.03 | 0.01 |
| | Australia | 366 m, 262 f | Logistic support | $r = 0.70$ | | |
| | | 4.5 yrs | | | | |
Table 7 Studies and effect sizes for parental support and girls’ physical activity moderated by parental gender (k = 13) (Continued)

| Study | Country | Sample Size | Gender | Design | Age | Method | Variable | OR (95% CI) | p-value |
|-------|---------|-------------|--------|--------|------|--------|----------|-------------|---------|
| Kirby et al. (2011) | UK | N = 641 | 313 m, 328 f | PRO | 5 yrs | Child report | Parental support – aggregated measure (encouragement, transportation, watch, co-activity, praise) | .70* | 2.02 (1.13-3.60) | <.05 |
| | | Followed from age 11-15 yrs | | | | | | | |
| | | | | | | Child report | PAQ-C | | |
| Raudsepp (2006) | Estonia | N = 329 | 168 m, 161 f | CS | | Parent report | Parental logistic support – aggregated measure (enrollment, financial support, transportation) | .70* | .32 | <.010 |
| | | Followed from age 13.8 yrs | | | | Father α = .78 | | | |
| | | | | | | Mother α = .68 | | | |
| Stucky-Ropp & DiLorenzo (1993) | USA | N = 242 | 121 m, 121 f | CS | | Parent report | Parental support – aggregated measure (encouragement, offers to exercise with child) | .70* | .32 | <.01 |
| | | Followed from age 11.2 yrs | | | | | | | |
| | | | | | | Child self-reported | | | |

Note. *reliability not reported; 7DPAR = 7-day physical activity recall; CS = cross-sectional; d = days; f = females; m = males; MVPA = moderate to vigorous physical activity; PA = physical activity; PAQ-C = Physical Activity Questionnaire for Older Children; PRO = prospective.
Parental modeling as a correlate

**Overall effect size**

A total of 36 effect sizes were used in the analysis to determine the overall relationship between parent and child PA (Table 9). Based on the fixed effects model and correcting for measurement error, parent and child PA associations approached a medium effect size ($r = .29$, 95% CI .28-.30). However, the results showed that the effect sizes in the sample were significantly heterogeneous ($Q (36) = 1597.52, p < .001$). Due to the high degree of heterogeneity, using the point estimate from random effects model was appropriate, which resulted in a small effect size ($r = .16$, 95% CI .09-.24). Moreover, 98% of the observed variance was explained by true systematic effect size differences between studies.

**Moderators of child physical activity**

Table 8 indicates that subsequent analyses did not find any of the proposed moderators of parent and child physical activity to be significant ($p > .05$).

Based on 49 effect sizes, our analyses found that parental gender moderated the relationship between boys' PA and parents' PA (Table 9). The results showed that father-son PA ($r = .29$, 95% CI .21-.36) was significantly higher than mother-son PA ($r = .19$, 95% CI .14-.23; $p < .05$). For parental modeling and girls' PA, results from the 62 effect sizes showed that parental gender did not moderate the relationship. The correlation for father-daughter PA ($r = .22$, 95% CI .16-.27) and mother-daughter PA ($r = .23$, 95% CI .18-.27) were both similar in magnitude.

Parental support as a correlate

**Overall effect size**

A total of 34 effect sizes were used to estimate the relationship between overall parental support and child PA (Table 10). Both the fixed and random effects model found that the relationship between parental support and child PA was moderate in size ($r = .38$). Analyses from the fixed model also indicated that a significant degree of heterogeneity within the sample was present ($Q (34) = 1204.70, p < .001$) and that 97% of the observed variance was explained by true systematic effect size differences between studies.

According to the corrected random effects models, many of the effect sizes for the various individual support behaviours were small. Parent–child co-activity, praising the child for being active, watching the child participate in PA, providing transportation to a place where the child could be active, monitoring the child's PA levels, and supplying the child with PA equipment ranged between $r = .15-.28$ (Table 10). The only support behaviour to have a moderate effect size was the relationship between parental encouragement and child PA ($r = .34$, 95% CI .25-.41). Overall, the dispersal of the effect sizes calculated was variable, ranging from 66 to 100%.

**Moderators of child physical activity**

Table 10 presented the potential moderators that were investigated in our analysis. In the analysis, child and adolescent PA was moderated by the type of measurement used to quantify the child’s PA ($p < .001$). When objective PA measures were used, the results showed a small effect of $r = .20$ (95% CI .13-.26) between a composite measure of parental support and child PA; whereas reported PA had a moderate effect size of $r = .46$ (95% CI .37-.55). Developmental age, study design, and geographical location were not significant moderators of overall parental support and child PA. Due to the limited number of prospective studies, moderator analyses were not conducted to examine the effects of study design.

Among individual supportive behaviours, only parental encouragement had an adequate amount of studies to examine potential moderating variables (Table 10). Modulating variables such as developmental age and geographical location were not significant moderators of the parental encouragement and child PA relationship ($p > .05$).

When examining the relationship between girls' PA and parental support, the summary analysis of 10 effect sizes found that the parental gender did not significantly moderate this relationship ($p > .05$) (Table 9). Analyses exploring the moderating effects of parental gender in boys’ PA were limited by the number of studies and were not conducted.

**Publication bias**

Funnel plots were constructed to investigate the possibility of publication bias for parent and child PA, parental support and child PA, and individual support behaviours and child PA associations. When visually inspected, the resulting funnel plots suggested a potential publication bias for parent and child PA, and providing transportation for the child to be active and child PA associations.

A subsequent classic fail-safe N analysis for child–parent PA associations showed that 7590 studies with a mean effect of zero were necessary for the overall effect found to become statistically insignificant. Based on this relatively large computation, it indicated that the results were not skewed. However, for providing the child with transportation to opportunities to be active, only 198 studies needed to create a mean effect of zero for the effect to be insignificant, alluding to a skewed effect size. Subsequent trim and fill analyses specified that it was necessary to trim two studies from the computation. With the correction, the effect size for transporting the child to physical activities and child PA decreased from...
the original point estimate of $r = .22$ (95% CI .12-.31) to a corrected point estimate of $r = .14$ (95% CI .03-.24).

Discussion
The main objectives of this meta-analysis were to thoroughly investigate and quantify the strength of parental correlates and identify whether parent–child gender interactions are notable in child and adolescent PA. Previous systematic reviews have been narrative in nature and meta-analyses attempting to quantify the overall effects between parental support and modeling behaviours and child PA have been restricted to 20–30 studies [8,16] – resulting in a partial depiction of the parental correlates in child and adolescent PA. This meta-analysis encompasses 112 studies published to date and thus sheds a more definitive light on the relationship between parental behaviours and children’s PA.

One of the contentious topics has been whether parental modeling is an important correlate in child and adolescent PA. Recent narrative reviews have suggested that parent’s PA behaviours were unassociated with child and adolescent PA [14,20]. The meta-analysis conducted by Pugliese and Tinsley [8] found a small effect ($r = .10$) for parent and child PA. Our results, after correcting for measurement error, concurred with the previous meta-analysis showing a small overall association between parental and child PA.

During preadolescent years, parental modeling of PA plays an integral role in establishing a social norm regarding activity [7], but as the child matures, modeling behaviours in the PA domain may be drawn from the emergent influence of the child’s peers while the influence of parental modeling wanes. It is also possible that in early years of childhood parent–child coactivity is more prevalent; and as the child ages, the association between parent and child PA bifurcates and becomes more independent from each other. In any case, the results suggest the importance of family-based coactivity interventions in the early years of child development.

A number of narrative reviews have consistently identified an association between parental support and children’s PA [6-9,11,12,14,16,18-21]. This meta-analysis is the first to quantify the relationship between overall parental support and child PA as well as various individual supportive behaviours. In our analyses, overall parental support and child PA yielded a medium effect size. This effect is worthy of noting, particularly when compared to other correlates of child behaviour. For example, a recent meta-analysis examining children’s affective judgments in PA, found that affect had a small to medium an effect size ($r = .26$) between children's and random effects analyses (using corrected r values)

| Variable                                      | $Q_b$ | $p$  | $k$ | Random effects $r$ 95% CI | Fixed effects $r$ 95% CI | SE  | $Q_w$ | $I^2$ |
|-----------------------------------------------|-------|------|-----|--------------------------|--------------------------|-----|-------|-------|
| Parental modeling-summary                     | 36    | .16  | .09-24 | .29  | 28-30 | .04  | 1597.52* | 97.81 |
| Developmental age                             |       |      |       |                           |                           |     |       |       |
| 2-5.4 yrs                                     | 2.61  | .27  | 9    | .25  | .06-42 | .20  | .15-24  | .04  | 109.03* | 90.70 |
| 5.5-12.4 yrs                                  | 17    | .17  | .09-40 | .08  | .06-10  | .03  | 378.48* | 94.65 |
| 12.5-19 yrs                                   | 10    | .08  | .07-22 | .32  | .32-33  | .05  | 467.01* | 85.92 |
| Measurement of PA                             |       |      |       |                           |                           |     |       |       |
| Objective                                     | 1.42  | .23  | 11   | .24  | .09-37 | .12  | .08-16  | .04  | 115.80* | 91.36 |
| Reported                                      | 25    | .13  | .04-22 | .29  | .29-30 | .04  | 1404.20* | 98.29 |
| Quality                                       |       |      |       |                           |                           |     |       |       |
| High                                          | 4.73  | .09  | 4    | .05  | .26-15 | .07  | .14-00  | .04  | 26.49*  | 88.67 |
| Moderate                                      | 27    | .19  | .10-27 | .29  | .29-30  | .04  | 1419.74* | 98.17 |
| Low                                           | 5     | .22  | .02-40 | .25  | .19-31  | .04  | 31.58*  | 87.33 |
| Geographical locationa                        |       |      |       |                           |                           |     |       |       |
| USA                                           | 3.52  | .06  | 24   | .19  | .09-28 | .32  | .31-32  | .06  | 889.55* | 97.41 |
| AUS/NZ                                        | 6     | .02  | .13-17 | .00  | .03-03  | .03  | 36.11*  | 86.15 |
| Study design                                  |       |      |       |                           |                           |     |       |       |
| CS                                            | .56   | .45  | 32   | .15  | .07-23 | .30  | .30-31  | .04  | 1210.09* | 97.44 |
| PRO                                           | 4     | .23  | .04-41 | .02  | .01-05 | .04  | 28.79  | 89.58 |

Note: *p < .001; †some countries excluded from the analysis based on < 4 effect sizes.
affect and PA behaviour [25]. Based on these findings, it suggests that parental support for child and adolescent PA may be an important consideration for future PA intervention efforts.

In line with this thinking, it is important to examine whether any particular support behaviour is of critical value over others as a potential intervention target. Our analyses of specific behaviours such as praising the child, watching the child participate in PA, engaging in parent–child co-activity, transporting the child to places where the child could be active, and providing the child with equipment all had small effect sizes \((r = .14-.28)\). The only individual support behaviour that was moderate in size was parental encouragement. To date, much quantitative reviews have only investigated the individual support behaviour of parental encouragement on child PA, which has been identified as a small correlation of \(r = .15-.18\) \([8,16]\), which is smaller than our results. How-ever, it is important to mention that these correlations were not previously corrected for measurement error. Overall, based on these various small effect sizes, it may be important to consider the potency of parental support taken as an aggregate rather than any individual support behaviour.

To date, various studies have examined the moderating effect of parental gender in boys’ and girls’ PA, yet the finding has been unclear and speculative. In a systematic review, a positive association was found for father-son PA [7]. Similarly, among maternal relationships, mother-daughter PA was significantly related [7]. Our results brought forth a degree of transparency regarding parent–child gender interactions further supporting a stronger correlation for father-son PA. However, in our results no differences were found for mother-son and mother-daughter PA correlations. In the area of parental support, no differences were found for the maternal and paternal interaction for girls’ PA. However, the parental interaction regarding boys’ PA will require further investigation. Overall, these results suggested that the importance between the intergenerational relationship between father and son PA and may be an important consideration when targeting boys’ activity behaviour. As well, our findings indicated that the incorporation of parental support behaviours, irrespective of parental gender, were an essential component for prospective interventions that target girls’ PA.

The limitations of this review highlight the fact that additional research is needed in several areas to improve our understanding of the correlates in child and adolescent PA. First, the use of parental support instruments and reporting of the correlation between parental support and child PA in this meta-analysis have been quite diverse, which also has been documented in the previously published literature [18,22]. Moving forward, it may be important to utilize previously validated measures, such as the activity support scale [37], and report both individual support behaviours and parental support as a construct (see [22] for an overview of parental support measures). Second, an important consideration may be children’s peers and siblings and how they relate the child’s behaviour. Thus, future research will be needed to explore the role of socialization of the immediate social network outside of the family unit and whether other children provide more salient models or social support for PA. Third, much of the research has been limited to developed nations such as the United States, Australia, or Europe. More studies will be needed from other countries to explore whether cultural differences are present. Fourth, an important detail to underscore from this review was that many of the parental respondents were mothers. It may be important to investigate the roles of fathers in the area of parental support and child PA. Lastly, several individual support behaviours were unexamined due to the limited amount of research (e.g., informing the child that PA is beneficial or financial support). More research is needed to uncover the

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**Table 9 Summary statistics for parent–child intergenerational relationships for boys’ and girls’ physical activity and parental modeling: fixed and random effects analyses (using corrected \( r \) values)**

| Variable          | \( Q_w \) | \( p \) | \( k \) | Random effects | Fixed effects | SE | \( Q_w \) | \( r \)  | 95% CI     | \( r \)  | 95% CI     |
|-------------------|----------|-------|-------|--------------|---------------|----|----------|-------|------------|-------|------------|
| Parental modeling |          |       |       |              |               |    |          |       |            |       |            |
| Son-father        | 4.89     | .03   | 24    | .29          | .21-.36       | .27 | .25-.29  | .02   | 386.57*    | 94.05 |
| Son-mother        | 25       | .19   | 14-23 | .15          | .13-.16       | .01 | 160.91*  | .01   | 432.81*    | 90.64 |
| Daughter-father   | .05      | .83   | 28    | .22          | .16-.27       | .21 | .19-.22  | .01   | 288.48*    | 90.64 |
| Daughter-mother   | 34       | .23   | 18-27 | .22          | .21-.24       | .01 | .352.81* | .01   | 90.65      |        |
| Parental support  |          |       |       |              |               |    |          |       |            |       |            |
| Daughter-father   | .26      | .61   | 7     | .24          | .07-.40       | .22 | .17-.26  | .03   | 71.68*     | 91.63 |
| Daughter-mother   | 8        | .32   | 27-37 | .32          | .28-.35       | .00 | 10.64    |       | 34.23      |        |

_Note:_ \( ^* p < .001 \)
relationship these support behaviours and child PA and whether certain parental support behaviours are conducive to a specific type of PA (e.g., structured or unstructured PA).

In summary, this meta-analysis presents results that align with previous reviews but represent a larger and more robust assessment of the parental and child correlates literature and the consideration for measurement.
error and methodologic quality. The findings demonstrate that both parental modeling and support related to child and adolescent PA. However, overall parental support emerged as a sizeable correlate linked to child activity. In addition to this, our results revealed a significant degree of heterogeneity among the studies that could not be explained well by our proposed moderators. In order to advance our intervention approaches to increase PA in children and adolescents, it will be critical to consider the development of interventions based on the child's developmental age. More notably, it will be essential to integrate parents as a source of social support to change child and adolescent PA behaviour.

Abbreviation
PA: Physical activity.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
CY was responsible for the conception and drafting of the manuscript, and acquisition of data. RR was involved in revising the manuscript critically for important intellectual content. Both authors were responsible for the design of the manuscript, and analysis and interpretation of data. Both authors read and approved the final manuscript, and agree to be accountable for all aspects for the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigate and resolved.

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