The effectiveness of interventions to increase physical activity among adolescent girls: A meta-analysis

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What this systematic review adds

- This is the first meta-analysis to be conducted on physical activity interventions on adolescent girls.

- The overall effect size was small but significant and shows that physical activity behaviour change is possible but likely to be challenging

- Stronger intervention effects were found for multi-component interventions, interventions based on theory, and those with moderate study quality.

Abstract

Objective. Research has shown that a clear decline in physical activity among girls starting in early adolescence. Therefore, adolescent girls have been identified as a key target population for physical activity behaviour change. The quantification of intervention effectiveness for this group has not been previously reported in a meta-analysis, and therefore this is the objective of the current meta-analysis.

Study Selection. Included were interventions in which the main component, or one of the components, was aimed at promoting physical activity through behaviour change in any setting. Interventions had to include a non-physical activity control group or comparison group, and include a quantitative outcome assessment of physical activity behaviour in girls aged 12-18 years.

Data Sources. Science Direct, PubMed, PsychINFO, Web of Science, Cochrane Libraries, and EPPI Centre databases were searched up to and including May 2013.

Data Extraction and Synthesis. Forty-five studies (k=34 independent samples) were eligible from an initial 13,747 references. A random-effects meta-analysis was conducted.

Results. The average treatment effect for adolescent girls involved in physical activity interventions was significant but small ($g = 0.350$, 95% C.I. = 0.12, 0.58, $p < .001$). Moderator analyses showed larger effects for interventions that were theory based, performed in schools, were girls-only, with younger girls, used multicomponent strategies, and involved targeting both physical activity and sedentary behaviour.

Conclusions and Relevance. Interventions to increase physical activity in adolescent girls show small but significant effects, suggesting that behaviour change may be challenging. Results suggest some approaches that appear to be successful.

Given the well documented health benefits of physical activity and concerns about low levels of physical activity in all age groups, there is a clear need for effective interventions that increase population levels of physical activity[1]. Recent studies have shown that the decline in physical activity during adolescence is significant for both girls and boys, and that the decline among girls begins in early adolescence[2]. Given this evidence, and that physical activity tracks in a small to moderate way from adolescence into adulthood[3], it is important that we better understand how to increase physical activity in adolescent girls.

One of the first reviews of the effects of physical activity interventions in young people was reported by Stone et al.[4] They recommended that future research involve studies that investigate the success of interventions that attempt to prevent the decline in physical activity in females and adolescents. Ringuet and Trost[5] have suggested that community-based interventions for older adolescents should be a priority, and this can include girls. The most comprehensive review to date is that by van Sluijs and colleagues[6]. Interventions conducted with adolescents generally showed no or inconclusive effectiveness; only two categories ('school plus community plus family' and 'multicomponent') showed 'strong' evidence for effectiveness. However, only eight of the included studies were exclusively on girls. Moreover, in studies that included both boys and girls, results for girls were not reported separately.

Camacho-Miano et al.[7] reported effects for young and adolescent girls, but only included those studies that focused on girls alone, thus making no distinction between those interventions focusing on girls alone and those that mixed boys and girls. While we know that physical activity levels of boys and girls differ, we do not yet know whether targeting girls

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alone is more effective than mixed interventions. The purpose of this meta-analysis, therefore, is to quantify the effect of physical activity interventions on adolescent girls by including all intervention studies that provided results for girls separately and compared an intervention with a control or non-physical activity comparison. This was from girls-only studies as well as boys and girls in the same study but where data on girls were reported separately. This is the first such meta-analysis.

Methods

Methods were adopted as reported in a parallel paper where further details can be found[8].

Eligibility criteria and study selection

For inclusion, research papers were required to (i) be an intervention study in which the main component was aimed at promoting physical activity; (ii) include adolescent girls aged 12–18 years (or a mean within these ranges) as participants of a study at baseline; (iii) include a non-physical activity control group or comparison group (randomised or nonrandomised); (iv) include a quantitative assessment of physical activity; (v) be published in English up to and including May 2013. The majority of published papers are likely to be in English and we did not have the necessary range of language skills to go beyond English. A comprehensive and representative coverage of the grey literature cannot be guaranteed and so we made the decision to review only peer-reviewed published work. Study samples, not papers, were the unit of analysis.

Potentially relevant research papers were selected by screening titles, then abstracts and, if required, the entire article. One author conducted this element with one other independently reviewing 20%.

Data extraction and coding

Information extracted (e.g., sample characteristics) can be seen in Tables 1 and 2. Information about outcomes, including means and associated SDs and mean change from baseline to post-test, were extracted for use in calculating effect sizes.

Data sources and search strategy

Search strategies were built around four groups of keywords: population, study design, behaviour, and intervention type. Key words used to guide the searching process included 'girls', 'youth', 'children', 'adolescents', 'teens', 'teenagers', 'young people', 'controlled trial', 'random', 'intervention', 'prospective', 'trial', 'cluster', 'physical activity', 'activities', 'exercise', 'physical education', 'play', 'leisure', 'sport', 'school', 'community', 'family', 'primary health care', 'counselling', 'education'. Science Direct, PubMed, PsychINFO, Web of Science, Cochrane Libraries, and EPPI Centre databases were searched. Manual searches of personal files were conducted along with screening of reference lists of previous reviews[6 7 9-21]. An example search strategy is shown in Figure 1.

Risk of Bias

The Cochrane Collaboration tool for Assessing Risk of Bias was used to assess studies [22]. Seven domains were scored with high, low or unclear risk for bias: sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective outcome reporting and 'other' issues (similarity in baseline characteristics and timing of outcome assessment). The assessment was performed independently by the first and third authors and the findings were discussed until consensus was achieved. Each domain was scored as -1 for high risk, 0 for unclear risk and 1

for low risk. Scores were summed with a possible range of scores from -6 to 6 ('other' was not scored), with positive values meaning lower risk of bias.

Data Integration

Data were screened for outliers and publication bias. Potential outliers were assessed as having relative residual scores (z-scores) that were less or greater two SDs above or below the mean effect size. If studies exceeded the criterion standard a sensitivity analysis was conducted to determine how overall results would change should an outlier be retained or removed[23]. Studies were retained when overall results remained within the 95% confidence interval and the effect size was significant. Publication bias or "file drawer problem" refers to inclusion or exclusion of published or unpublished studies that could produce a biased review[24 25]. Three standard techniques were used to marginalize the effects of publication bias including review of the funnel plot[26], Fail-Safe *N* calculation[25], and a "Trim and Fill" procedure[27 28].

Effect Size Calculations

Comprehensive Meta-Analysis software (version-2) was used to perform calculations[29]. Baseline and post-intervention means (SD) were used to calculate the study effect size. When unavailable, post-intervention means (SD), mean change in each group, or adjusted differences after the intervention were used. When key information was missing from an article, as was the case in 6 out of 48 eligible studies, three attempts were made to reach the corresponding author via e-mail before using the available data or eliminating the study from the analysis.

An inverse variance weighting procedure for independent effect sizes was used to improve overall precision[30][31]. Cooper's shifting unit of analysis approach was also applied to provide flexibility in reporting outcomes and minimize a violation of the independence statistical assumption[32]. Hedges' g was the effect size metric selected[33] and is recommended when there are fewer than 20 studies to prevent underestimation of effect size[34]. The overall sample size (k = 34) exceeded the recommended guidelines, however, moderator analyses compared smaller subgroups (k < 4) and, to ensure consistency in reporting methods, Hedges' g was selected.

Random Effects Model

A random effects model was selected to represent the data due to the variability between interventions being employed to measure physical activity in adolescent girls[35-37].

Subgroup Analyses

Subgroup (moderator) analyses were conducted[38] to test for differences between a number of levels of independent variables (i.e., Intervention type, Intervention quality). Assessment of data homogeneity was performed using the three test statistics of Q-value, tau-squared (τ^2)-value, and I-squared (I^2)-value to provide an overall interpretation. The rationale for including three separate statistics is that significant Q-values only indicate between study variance and not the magnitude of dispersion[39]. Initial evaluation of the data distribution is based on a significant ($p < .05$) total Q-value (Q_T) and indicates a heterogeneous distribution. The τ^2-value quantifies between study variance and larger values reflect true differences between studies. To complete the interpretation of heterogeneity an I^2-value provides information about the amount of variance (confidence interval overlap) that can be explained by analyzing covariates[40]. When I^2-values exceed 50 percent, or moderate levels of relative

variance[40], additional statistical techniques resembling t-test or ANOVA are required to determine differences between covariates[33].

Results

Figure 2 shows the flow chart of sample extraction with 48 studies meeting inclusion criteria, resulting in 37 independent samples. Three studies were excluded because data were unavailable[41-43]. Forty five studies were included in the analysis (34 independent samples; k).

Table 1 describes the interventions included in the meta-analysis and Table 2 provides the coding according to the three categories of intervention, sample and study characteristics. A total of 5680 adolescent girls were exposed to physical activity treatment conditions compared to 5126 in control conditions. Cohen's[44] criteria for small (> .20), moderate (> .50), and large (> .80) effect sizes were used for interpretation. Positive effect sizes were indicative of treatment or experimental groups having higher physical activity scores.

Screening for outliers found two studies reported in four separate papers [45-48] with relative residual (z-score) values greater than two, therefore a sensitivity analysis was conducted. Both studies were retained as the overall effect size from removing either study would have been marginal (-0.045), remaining significant (p <.001) and within the 95% confidence interval. Publication bias was unlikely as there was a balanced distribution of studies in the funnel plot, no studies were added in the "Trim and Fill" procedure, and a Fail Safe N calculation that determined 3476 studies were needed to nullify significant results.

Treatment Effects for Physical Activity

The average treatment effect was significant but small ($g = 0.350$, 95% C.I. = 0.12, 0.58, p < .001). Results suggest that adolescent girls exposed to physical activity intervention treatments participated in more physical activity (self-reported or measured minutes/hours) than girls in control conditions equivalent to about one-third of a standard deviation in magnitude. Another interpretation of the difference between experimental and control groups using z as standard score would be that adolescent girls exposed to experimental physical activity treatments engaged in approximately 13.68% more physical activity than adolescent girls in control conditions. A large Q_T –value (1436.90) suggested that the effect size distribution was heterogeneous. Review of the two additional homogeneity statistics found a sizeable between study variance ($\tau^2 = .421$) and a large portion of variance ($I^2 = 98$) could be explained by performing a subgroup (moderator) analysis of covariates. Figure 3 provides the summary and individual study data in a forest plot.

Subgroup Analyses

Homogeneity statistics provided evidence for the diversity of interventions. Based on the significant heterogeneous distribution, moderator (subgroup) differences were analysed. Table 3 provides the subgroup analyses for intervention, sample and study characteristics. Results between subgroups were not significant for any of the subgrouping variables; however, there were several trends. Conservative interpretations should be applied to subgroup analyses that contain fewer than five studies [39].

Intervention characteristics that provided small to moderate trends were multicomponent interventions ($k = 9$, $g = .618$, $p < .01$), interventions focusing on both physical activity and sedentary behaviours ($k = 4$, $g = .73$, $p < .01$), theory based interventions ($k = 21$, $g = .42$, $p < .01$), and intervention designs of high quality ($k = 4$, $g = .524$, $p < .05$). Sample

characteristics with significant trends included interventions that were applied to girls only (k = 19, g = .439, p <.01), interventions designed for younger adolescent girls (k = 22, g = .360, p <.05), and interventions that were conducted within the United States (k = 22, g = .394, p <.05). Study characteristics that produced significant trends included interventions conducted in school-based settings (k = 19, g = .427, p <.05) and where physical activity was assessed by self-report (k = 26, g = .380, p <.05). Each of the significant trends for all three categories had large τ^2 and I^2 values which is indicative of a large variance between studies within a subgroup.

Discussion

We conducted a meta-analysis of physical activity interventions that included data for adolescent girls. This follows our previous similar review focussing on pre-adolescent girls[8]. The overall effect size was small but significant and can be interpreted in several ways. First, it shows that physical activity behaviour change is possible for adolescent girls and is broadly comparable to other physical activity intervention effects across other age groups and settings[49]. For example, an early meta-analysis of physical activity interventions in boys and girls reported an effect size of 0.47 across 10 studies[5], and a more recent review of after-school interventions showed an effect size of 0.44[50]. Our recent meta-analysis of interventions for pre-adolescent girls reported an ES of 0.31[8]. It therefore appears that our meta-analytic findings are broadly comparable to other analyses in respect of the strength of effect of behaviour change.

Second, our data suggest that the effect is modest and therefore indicative that behaviour change may be challenging. Contemporary environments often inhibit physical activity and,

at the same time, sedentary behaviours have become habitual, socially normative and often highly reinforcing. However potent some interventions might try to be, they are taking place against the tide of an unhelpful environment. Small effects, therefore, could be seen as encouraging.

The meta-analysis shows that the overall effect is highly heterogeneous. This is not surprising given the diversity of approaches adopted. Consequently, it is necessary to document the effects of potential moderators. Regarding intervention characteristics, stronger effects were found for multi-component interventions (moderate effect), interventions based on theory (small-to-moderate), and those with moderate study quality (moderate). A large effect was found for interventions that targeted both physical activity and sedentary behaviour but this should be treated with some caution as only three studies were included. Multi-component interventions were also found to have strong effects in the systematic review by van Sluijs et al[6] and our review of pre-adolescent girls[8]. The make-up of multicomponent interventions included strategies that targeted dietary, physical activity, and sedentary behaviours using a number of methods to target and change unhealthy patterns. Methods used to decrease undesirable behaviours contained combinations of support components (i.e., family, friends, etc.), individual components (i.e., specifically tailored programs for individuals/groups), choice components (different options to facilitate behaviour change), and educational and environmental components targeting during and after school behaviours. Multicomponent interventions were designed to provide comprehensive programs that facilitate changes in behaviour in a multitude of ways and as a result were almost twice as effective when compared with programs designed to focus on singular components. This suggests that

different agencies might need to work together more, such as schools, community and parent groups, and not just rely on one setting, such as the school or family.

Basing an intervention on theory produced slightly stronger effects than the overall mean. This was not the case for our review on pre-adolescent girls, suggesting that theory may be less relevant for younger ages. Theory-based interventions may allow for the identification of 'active ingredients' in an intervention and for better explanations of intervention effects through mediators and moderators[51]. The predominant theory used as a basis for interventions was Social Cognitive Theory[52]. Others identified included the Trans-Theoretical Model, Intervention Mapping, Behavioural Determinants, Behavioural Choice, Health Promotion Model, and Social Learning Theory.

High quality studies produced the largest effects, however, there were insufficient studies (k = 4) to drawn any firm conclusions. What is challenging is that the confidence interval and subsequent homogeneity statistics have large variability. Physical activity interventions that were designed and representative of both low and moderate quality provide evidence that improvements in physical activity behaviours in adolescent girls produce small to moderate effects, however, the most promising results may be connected to rigorous and controlled interventions that are able to explain larger portions of variance.

A higher effect was also seen for school-based interventions. This was the only study characteristic showing a signficant moderating effect. School-based interventions have the advantage of a supportive physical environment, easy access to recruitment and

availability of professional staffing. Future school-based studies might need to take further account of the needs of adolescent girls and ensure that extra-curricula physical activity is appealing and not simply a repetition of existing activities from physical education, some of which may be more appealing to boys. Involvement of the adolescent girls in the planning of such programmes is essential. Moreover, health professionals from outside education could play a valuable role, including physical therapists and dieticians.

Finally, higher sample characteristic effects were noted for interventions that targetted girls only, young adolescent girls, and were conducted in the US. The latter cannot be explained easily and may be accounted for through specific cultural factors or the lack of compulsory school physical education which has the potential to produce greater intervention effects. However, the additional benefit afforded by having girls take part separately from boys is an interesting issue. It appears that girls may prefer being in classes with their same-sex peers. This could be because some may be inhibited in classes where boys also take part, coupled with some boys possibly dominating certain activities. Moreover, research has shown that girls may be sensitive to issues of body image and self-presentation while being active in mixed-sex environments[53]. For example, feelings of social physique anxiety may be heightened and is much more likely for girls of this age. By having separate classes, these issues are eliminated or diminished. The stronger effects for younger girls may be the result of this age group still being maleable for behaviour change.

It should also be noted that self-reported physical activity showed a higher effect size than objective measures or self-report and objective combined, although the latter two had very few studies. Self-reported physical activity for adolescents often shows weak validity due to recall bias and error. Whether this has inflated the effect remains to be seen, but it is a slight concern that the six interventions using objective assessment showed a smaller effect size.

The limitations of this review include the over-reliance on studies that are of low-moderate quality, the use of self-report measures for physical activity and the under-representation of studies set in the community or home and from the rest of the World compared to those from the US. Insufficient data can also influence the estimate of effect size and there were several studies that failed to report baseline information or only reported data that were significant. Even though a thorough analysis for publication bias was conducted, the authors acknowledge that bias is always possible when determining and setting inclusion criteria.

Overall, the meta-analysis shows that physical activity interventions for adolescent girls are effective but the effect is small. Subgroup analyses suggest that greater effectiveness appears to result from interventions that are multi-component, theory based, school based, with girls only or with younger adolescent girls, and target both physical activity and sedentary behaviour. Future research should focus on filling the gaps identified in this review, such as the lack of high quality studies and studies in the home setting. Future studies should aim to strengthen the evidence base for interventions among adolescent girls with rigorous designs, longer follow-ups, use of objective measures, and assessment of potential mediators of behaviour change. Moreover, studies would

benefit from learning from those adolescent girls who are active and who enjoy being active. Qualitative work with such girls, as well as with those less motivated, could identify potential strategies to engage the adolescent girls who need interventions. Meanwhile, our results suggest that interventions might usefully target younger adolescent girls in girls-only school settings, using multi-component strategies and based on strong theory.

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Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Bayne-Smith et al., 2004[54] US	PATH programme	Randomised controlled trial (individual and class)	N=442 girls. Mean age 16.0 (SD 1.3) years	Intervention group: 12 week, physical education curriculum based programme. Daily 30 minute classes (five days per week); classes consisted of 5-10minute lecture and 20-25minutes of vigorous physical activity, with additional homework assignments. Control group: normal curriculum (no lecture, so about 5 minutes more physical activity per class).
Bronikowski, 2010[55] Poland	No name	Quasi-experimental (individual)	N=170 girls. Mean age 13.22 (SD 0.29) years.	Intervention protocol included lesson plans of regular PE activities facilitated by PE teachers in addition to the specially self-designed, personalised planner 'planning form of leisure time PA'. Pupils planned the amount of time and forms of weekly hours of PA in out-of-school leisure time each week for 15 months. Small meetings were held every two weeks to evaluate the leisure time activities (teacher and pupil led). Control participants received usual PE curriculum.
Bronikowski and Bronikowski, 2011[56] Poland	No name	Quasi-experimental (individual)	N=65 girls. Mean age 13.22 (SD 0.29) years.	Intervention protocol included lesson plans of regular PE activities facilitated by PE teachers in addition to the specially self-designed, personalised planner 'planning form of leisure time PA'. Pupils planned the amount of time and forms of weekly hours of PA in out-of-school leisure time each week for 15 months. Small meetings were held every two weeks to evaluate the leisure time activities (teacher and pupil led). Control participants received usual PE curriculum.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Bush et al., 2010[57] Canada	FunAction programme	Quasi-experimental (year group)	N=131 girls aged 11-15 years.	Intervention group: 16 week intervention led by university students. Up to 3 different activities per day were offered 3-5 days a week during lunch time for 45 minutes (non-curricular intervention). Control group usual lunch time.
Chin A Paw et al., 2008[58 59] The Netherlands	DoiT	Cluster Randomised Controlled Trial (school)	N=436 girls. Mean age 12.6 (SD 0.4) years	Intervention included an individual and an environmental component. Individual component consisted of an educational programme covering 11 lessons for the subjects biology and PE. Environmental component involved encouraging additional changes to PE classes and school cafeteria. Control schools were requested to maintain usual practice.
DeBar et al. 2012[60] US	No name	Randomised Controlled Trial (individual)	N=208 girls. Mean age 14.1 (SD 1.4) years.	Multicomponent intervention comprised sixteen 90 minute group meetings over 5 months. The multicomponent intervention included the following: (1) change in dietary intake and eating patterns; (2) increasing physical activity by using developmentally tailored forms of exercise (eg, exergaming); (3) addressing issues associated with obesity in adolescent girls (e.g. depression, disordered eating patterns, poor body image); and (4) training participants' primary care providers to support behavioural weight management goals collaboratively. Group sessions were also held for parents so that they could support their daughters. Control group: usual practice.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Dewar et al. 2013[61] Australia	NEAT Girls	Randomised Controlled Trial (School)		The 12 month intervention included enhanced school sport, lunchtime physical activity sessions, interactive seminars, student handbooks, nutrition workshops, pedometers, parent newsletters and text messages to encourage physical activity and healthy eating, and a decrease in sedentary behavior. Control group: usual practice.
Dishman et al., 2004-05[45-47] US	LEAP	Randomised Controlled Trial (School)	N=2744 girls at baseline. Mean age 13.6 (SD 0.6) years.	Intervention group: one year multicomponent intervention with emphasis on enhancing physical activity self-efficacy through successful experiences of physical activities and skill development. Focus on six components: changing physical education, providing health education, creating supportive school environment, school health services, staff health promotion, and family based and community based activities. Control group: no intervention: regular physical education classes
Dudley et al., 2010[62] Australia	No name	Randomised Controlled Trial (individual)	N=38 girls. Mean age 16.5 (SD 0.28) years.	Intervention was implemented in school sport over the course of an 11-week school term. There were six 90 minute fortnightly sessions over the term. The programme included sports/activities that girls had stated enjoying in pre-randomisation focus groups. The intervention consisted of enjoyable, challenging, and new activities such as yoga/Pilates/dance etc. Girls in the control group received no intervention and had usual school sport.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Dunton et al., 2007[63] US	No name	Controlled trial (School)	N=146 girls. Mean 15.10 (SD 0.81) years.	The intervention class met five days a week for 60 minutes each day (approx. 40 minutes of activity), with one day a week devoted to an educational component. Class activities included yoga, aerobics, swimming, weight-training, dance etc. Weekly lectures addressed topics such as time management, body image, motivation, nutrition, and strength training. Control schools received no intervention.
Everhart et al., 2003[64] US	No name	Controlled trial (individual)	N=78 girls (high school aged)	Students in intervention group interacted with a multimedia software programme designed to provide nutritional information and record workout and nutritional patterns. Students entered their physical activity participation and eating behaviours into the programme. Control students took part in usual PE and had no access to the multimedia programme.
Faircloth & Stratton, 2005-06[65][66] UK	No name	Randomised controlled trial (class)	N=33 girls. Mean age 12.4 (SD 0.4) years	Intervention group: 5 weeks' duration, curriculum based intervention delivered during a 6-lesson unit of gymnastics. Weekly two hour physical education classes taught by usual physical education teacher. Teacher given objectives to work by to increase physical activity during class. Control group: usual curriculum.
Gortmaker et al., 1999[67] US	Planet Health	Randomised controlled trial (school)	N=627 girls. Mean age 11.6 (SD 0.6) years.	Intervention group: 2 year programme, 32 classroom based sessions taught by regular teachers (who received training from planet health staff). Interdisciplinary intervention for prevention of obesity aimed at decreasing TV viewing, making space for activity, healthy eating, with a focus on 'lifestyle' changes in behaviour. Control group: usual curriculum.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Haerens et al., 2006[68] Belgium	No name	Randomised controlled trial (school)	N=1039 girls. Mean age 13.1 (SD 0.8) years.	Intervention group 1: 2 year intervention implemented by school staff. Focus on creating opportunities for physical activity during breaks, lunch, and after school. Provision of extra sports material and setting up of variety of (non-competitive) activities. Computer tailored intervention (once in year 2) providing feedback on physical activity levels and determinants. Intervention group 2: intervention group 1 plus parents invited to interactive meeting on physical activity, diet, and health. Parents received CD with similar computer tailored intervention and regular newsletters. Control group: usual curriculum
Jago et al. 2010[69] UK	Bristol Girls Dance Project (BGDP)	Cluster Randomised Controlled Trial (school)	N=203 girls aged 11-12 years.	Intervention schools received two, 90-minute after-school dance classes per week for 9 weeks. The dance class content included opportunities for participant input and time to practice short dance pieces. All sessions were based on the hip-hop/street dance genre. At the end of the intervention all participants were provided with information about local dance opportunities. Instructors were provided with the outline dance program and attended a half-day content familiarization session. "Control incentives only" group received small thank you gifts of £3, £5 and £10 for data collections 1, 2 and 3 respectively. "Control incentives + workshop" were provided with the same small thank you gifts as well as a half-day dance workshop at the end of the study.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Jamner et al., 2004 [70-74] US	Project FAB	Controlled trial (school)	N=122 girls. Mean age 15.04 (SD 0.79) years	The intervention goal was to increase students levels of PA through supervised in-class activity, health education, and internet-based self-monitoring. Participants in the intervention school attended supervised exercise sessions 4 days a week over 4 months of a school year (40 minutes of PA per session). Health education was provided during class on the fifth day. The supervised PA sessions were in part determined by participant preferences. Control school were given no instruction regarding PA, usual PE curriculum.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Jones et al., 2008[48] US	IMPACT	Randomised controlled trial (school)	N=718 girls. Mean age 11.6 (SD 0.4) years.	IMPACT intervention sought to affect behaviour change through promoting active learning in classrooms as well as through environmental reinforcement. To this end, the intervention consisted of three major components: a health curriculum for grades 6 and 7 which included classroom lessons and behavioural journalism, a physical education program, and a school food service component that emphasized calcium rich food choices. The use of peer-based behavioural journalism involved the use of media such as a school-based newsletter with role model stories to increase adoption of desired behaviours. The over-arching goal of the physical activity component of the IMPACT trial was to improve bone health in the study sample by increasing overall levels of physical activity, specifically focusing on increasing weight bearing physical activity. To this end, the intervention employed a 6th grade health curriculum which included 16 sessions that were implemented during physical education classes (3 times/week). The lessons in this curriculum were designed to promote increased consumption of calcium-rich foods and increased activity, specifically weight-bearing physical activities, while participating in behaviourally-based and active lessons adapted to the physical education environment. During 7th grade, a series of science-based lessons were administered during science classes. The physical education component of the program known as IMPACTivities, was implemented in the 6th and 7th grades during physical education (PE) and athletics classes. The PE classes focused on an initial 10 minute warm-up (range: 5–15 minutes), which consisted of high impact activities such as rope-jumping, circuit training and box-step activities.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Kelder et al., 1993[75] [76] US	Class of 1989 study	Controlled trial (class)	N=1196 girls aged 13-14 years.	Intervention group: received the MHHP intervention plus the class of 1989 intervention: classroom based intervention using peer leaders; self-monitoring intervention FM250 in 8th grade (hypothetically cycle 250 miles between two towns in 4 weeks, based on daily energy expenditure). In 10th grade the 'slice of life programme' was implemented. A 7 session programme focused on skills to improve eating and exercise patterns. Control group: no intervention
Killen et al., 1988-89[77] [78] US	Stanford Adolescent Heart Health Programme	Randomised controlled trial (school)	N=518 girls aged 14-16 years.	Intervention group: 7 week classroom based educational programme (three 50 minute sessions per week) taught by special teachers in five modules (physical education, diet, smoking, stress, problem solving). Each module contained health benefits, skills acquisition, resisting social influence, and skills practice. Control group: usual curriculum
Lubans & Sylva, 2009[79] UK	LAP	Randomised controlled trial (individual)	N=48 girls aged 16-18 years.	Intervention: group met twice a week for 10-weeks. One session involved a researcher-led work-out, for the other session, students completed their own training. The LAP was a conceptual PE program developed with reference to SCT and SET. Control group: required to attend the same health centre and complete their own activity for two 90 minute sessions per week.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Sallis et al., 2003[80] [81] US	M-SPAN	Randomised controlled trial (school)	N=24 classes of girls aged 11-13 years.	Intervention group: 2 year programme based on ecological model focused on physical activity and nutrition. Physical activity intervention included changing content and structure of physical education, increasing choice for physical activity during leisure periods and environmental changes (increased supervision, equipment, and activities). No health promotion. Control group: usual curriculum. (schools received $1000 (£500; €700) for physical education equipment)
Nader et al., 1992[82] US	No name	Randomised controlled trial (school)	N=158 girls. Mean ages ranged from 11.8 – 12.1 years.	Intervention group: 12-week intensive intervention consisting of 12 after school sessions (90 minutes), with family attendance. Each session included aerobic exercise, education (separate for children and adults), behaviour management, and heart healthy snacks. This was followed by six maintenance sessions over the following 9 months. Control group: no intervention. Four groups in total, Intervention Anglo-American and Mexican-American, and control Anglo-American and Mexican-American.
Neumark-Sztainer et al., 2003[83] US	New Moves	Randomised controlled trial (school)	N=201 girls. Mean age 15.4 (SD 1.1) years.	Intervention group: 16 week programme with five classes per week. Female only PE classes four times a week and one educational session per week (either discussion social support or nutrition). Aimed to create environment in which larger girls could feel comfortable being physically active. Control group: girl's only PE usual curriculum.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Neumark-Sztainer et al., 2010[84] US	New Moves	Randomised controlled trial (school)	N=356 girls. Mean age 15.8 (SD 1.17) years.	Intervention group: 16 week programme with five classes per week. Female only PE classes four times a week and one educational session per week (either discussion social support or nutrition). Aimed to create environment in which larger girls could feel comfortable being physically active. Control group: girl's only PE usual curriculum.
Patrick et al, 2006[85] US	PACE+ for adolescents	Randomised controlled trial (individual)	N=438 girls. Mean age 12.7 (SD 1.3) years.	Intervention group: 12 month programme, one stage based computer tailored intervention with endorsement of primary care provider. Focus on diet and physical activity (MVPA and sedentary behaviour). After initial consultation, participants received manual and 11 telephone-based follow-up sessions. Parents were targeted to help them encourage attempts at behaviour change. Control group: sun protection intervention.
Perry et al., 1987[86] US	Slice of Life	Randomised controlled trial (class)	N=159 girls aged 14-15 years.	Intervention group: 10 sessions of peer led classroom based educational intervention with focus on changing environmental, personality, and behavioural attributes to behaviour change (including videotaped instructions and goal setting, self-monitoring, social support, and how to change environment). Control group: usual curriculum.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Robbins et al., 2006[87] US	Girls on the move	Randomised controlled trial (grade)	N=77 girls aged 11-13 years	Intervention group: 9 week programme set in school wellness centre. Included three individually tailored computer sessions with face to face feedback from school paediatric nurse, and two telephone calls with research assistant, focusing on agreed goals. Parents were posted tip sheets to support girls to achieve goals. Control group: one page leaflet with age specific recommendations for physical activity.
Robbins et al. 2012[88] US	No name	Quasi-experimental (school)	N=69 girls in sixth and seventh grade.	The intervention involved two components: (1) a 90-min after-school physical activity club offered at the middle school 5 days a week for 6 months (total of 98 sessions) and (2) a face-to-face motivational, individually tailored counselling session with a registered (school) nurse during the school day every other month over the 6 months (total of three 20-min sessions were planned). The attention control condition involved two components: (1) a 90-min after-school workshop once a month for 6 months (total of six workshops) and (2) a face-to-face session with a registered (school) nurse during the school day every other month over the 6 months (total of three 20-min sessions were planned). Each workshop focused on one of the following health-promoting topics: (1) caring for my body; (2) fashion, hair, and nail tips; (3) sun and food safety; (4) healthy relationships and friendship; (5) building self-esteem; and (6) career exploration. The same workshop was offered on 2 consecutive days each month to enhance the opportunity for participation. Each session with the nurse included a discussion of two of the six topics.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Schofield et al., 2005[89] Australia	No name	Randomised controlled trial (school)	N=85 girls. Mean age 15.8 (SD 0.8) years	Intervention group 1: twelve weekly sessions, with pedometer based self-monitoring and educative meetings encouraging daily increases in steps until 10,000/day. Intervention group 2: twelve weekly sessions, with self-monitoring by recording daily minutes of MVPA and educative meetings encouraging daily activity by 10-15 minutes per week until 30-60 minutes per day. Control group: no intervention.
Simon et al., 2004[90] France	ICAPS	Randomised controlled trial (school)	N=486 girls. Mean age 11.7 (SD 0.6) years.	Intervention group: 4 years' duration, in partnership with families and community groups. Focus on three areas: increasing knowledge, attitudes, beliefs, and motivation for physical activity through debates and providing information; social support from parents, peers, teachers, and physical activity instructors; and changing environmental conditions for physical activity. Educational component and new opportunities for physical activity. Control group: usual health curriculum and physical education.
Spruijt-Metz et al., 2008[91] US	Get Moving	Randomised controlled trial (school)	N=459 girls. Mean age 12.47 (SD 0.63) years	Media-based intervention delivered during 5-7 in-class sessions for 5-7 consecutive school days (one session per day). Intervention group received fact sheets, reinforcing fact sheets, videos and in-class presentations, make your own headline hand-outs, 'four ways' hand-outs and a reiteration session. Control schools received no intervention.

Table 1. Intervention characteristics of included studies aiming to increase physical activity among adolescent girls (k=34) (Cont'd/..)

Author (year), country	Intervention name	Design	Participants	Description of intervention and control conditions
Taymoori et al., 2008[92] Iran	No name	Randomised controlled trial (school)	N=161 girls. Mean age 14.79 (SD 0.44) years	Intervention (THP and HP): baseline, week 4, week 10 and week 18 each participant received 45-60 minutes group educational sessions, plus individual counselling session at week 10 and week 18. The THP group also received education on the two processes of change: counter conditioning and stimulus control. Week 22 girls received an individual phone call and during week 24 the intervention groups went mountaineering. Control group received no intervention.
Young et al., 2006[93] US	No name	Randomised controlled trial (individual)	N=221 girls. Mean age 13.8 (SD 0.5) years	Intervention group: one school year programme focusing on social independence, environmental factors, and problem solving skills. Delivery during class lectures, small group discussions, and homework activities. Included physical activity monitoring and strategies to maximise physical activity during physical education classes. Families were invited for workshop and received newsletters and parent-child homework. Control group: usual curriculum.

Table 2. Coding Information for Studies meeting Inclusion Criteria

Study	Intervention Characteristics							Sample Characteristics			Study Characteristics	
Study	**Type**	**Focus**	**Level**	**Time**	**Follow-up**	**Theory**	**Quality**	**Population**	**Age**	**Country**	**Setting**	**Measure**
Bayne-Smith et al., 2004[54]	ED	HH	C	1	N	A	L	GO	O	US	S	SR
Bronikowski, 2010[55]	ED	PA	I	2	Y	T	L	BG	Y	W	S+	SR
Bronikowski and Bronikowski, 2011[56]	ED	PA	I	2	Y	T	L	BG	Y	W	S+	SR
Bush et al., 2010[57]	EV	OB	Y	2	N	A	L	BG	Y	W	S	SR
Chin A Paw et al., 2008[58 59]	M	OB	S	2	Y	T	M	BG	Y	W	S+	SR
De Bar et al., 2012[60]	ED	PAD	I	2	Y	A	H	GO	Y	US	C+	SR
Dewar et al., 2013[61]	ED	PAS	S	2	Y	T	M	GO	Y	W	S+	O
Dishman et al., 2004-05 [45-47]	M	PA	S	2	N	T	M	GO	Y	US	S+	SR

Table 2. Coding Information for Studies meeting Inclusion Criteria (Cont'd/…)

Study	Intervention Characteristics							Sample Characteristics			Study Characteristics	
	Type	Focus	Level	Time	Follow-up	Theory	Quality	Population	Age	Country	Setting	Measure
Dudley et al., 2010[62]	EN	PA	I	1	N	T	L	GO	O	US	S	O
Dunton et al., 2007[63]	EN	PA	I	2	N	T	L	GO	O	US	S	SR
Everhart et al., 2002[64]	ED	PA	I	2	N	A	L	BG	Y	US	S	SR
Faircloth & Stratton, 2005-06 [65 66]	ED	PA	C	2	N	A	L	GO	Y	W	S	O
Gortmaker et al., 1999[67]	ED	OB	S	2	N	T	H	BG	Y	US	S+	SR
Haerens et al., 2006[68]	M	PAD	S	2	N	T	M	BG	Y	W	S+	SRO
Jago et al., 2012[69]	ED	PA	S	1	Y	N	M	GO	Y	W	S	O
Jamner et al., 2004 [70-74]	M	PA	S	2	N	A	L	GO	O	US	S	SR

Table 2. Coding Information for Studies meeting Inclusion Criteria (Cont'd/…)

Study	Intervention Characteristics							Sample Characteristics			Study Characteristics	
	Type	**Focus**	**Level**	**Time**	**Follow-up**	**Theory**	**Quality**	**Population**	**Age**	**Country**	**Setting**	**Measure**
Jones et al., 2008[48]	M	PAS	S	2	N	T	H	GO	Y	US	S	SR
Kelder et al., 1993 ł75 76	ED	HH	C	2	N	T	M	BG	Y	US	S+	SR
Kilen et al., 1988-89 ł77 78	ED	HH	S	1	Y	T	M	BG	O	US	S	SR
Lubans & Sylva, 2009[79]	ED	PA	I	1	N	T	L	BG	O	W	S	SR
Sallis et al., 2003 ł80 81	EN	PAD	S	2	N	T	M	BG	Y	US	S	O
Nader et al., 1992[82]	ED	HH	S	2	Y	T	M	BG	Y	US	S+	SR
Neumark-Sztainer et al., 2003[83]	M	OB	S	2	Y	T	L	GO	O	US	S	SR
Neumark-Sztainer et al., 2010[84]	M	OB	S	2	Y	T	L	GO	O	US	S	SR

Table 2. Coding Information for Studies meeting Inclusion Criteria (Cont'd/…)

Study	Intervention Characteristics							Sample Characteristics			Study Characteristics	
	Type	Focus	Level	Time	Follow-up	Theory	Quality	Population	Age	Country	Setting	Measure
Patrick et al, 2006[85]	ED	PAD	I	2	N	T	L	BG	O	US	C	SRO
Perry et al., 1987[86]	ED	PAD	C	2	N	T	L	BG	Y	US	S	SR
Robbins et al., 2006[87]	ED	PA	Y	1	N	A	H	GO	O	US	S+	SR
Robbins et al., 2012[88]	ED	PA	S	2	N	T	M	GO	Y	US	S+	O
Schofield et al., 2005[89]	ED	PA	S	1	N	A	L	GO	O	W	S	SRO
Simon et al., 2004[90]	M	PAS	S	2	N	A	M	BG	Y	W	S+	SR
Spruijt-Metz et al., 2008[91]	ED	PAS	S	1	Y	T	M	GO	Y	US	S	SR
Taymoori et al., 2008[92]	M	PA	S	2	Y	T	L	GO	O	W	S	SR

Table 2. Coding Information for Studies meeting Inclusion Criteria (Cont'd/…)

Study	Intervention Characteristics							Sample Characteristics			Study Characteristics	
Study	**Type**	**Focus**	**Level**	**Time**	**Follow-up**	**Theory**	**Quality**	**Population**	**Age**	**Country**	**Setting**	**Measure**
Winette et al., 1999[94]	ED	PAD	C	1	N	T	L	GO	O	US	S+	SR
Young et al., 2006[93]	ED	PA	I	2	N	T	L	GO	Y	US	S+	SR

Note. [1] indicates data was used by multiple studies. Type (Intervention Type): Ed = Educational, En = Environmental, M = Multicomponent. Focus (Intervention Focus): HH = Heart Health, O = Obesity-Related Behaviors, PA = Physical Activity Only, PAD = Physical Activity AND Diet, PAS = Physical Activity & Sedentary Behaviors. Level (Level of Randomization). C = Class, I = Individual, S = School, Y = Year Group. Time (Intervention Length): 1 = less than or equal to 12 weeks, 2 = greater than 12 weeks. Follow-up (Intervention Follow-Up AFTER Post Test): N = No, Y = Yes. Theory (Theoretical Foundation): T = Theoretical, A = Atheoretical. Quality (Study Quality): L = Low Delphi score < 3, M = Moderate Delphi score between 4 and 6, H = High Quality Delphi Score > 6. Population (sample composition) BG = Boys and Girls, GO = Girls Only. Age (Mean age of sample): O = Older Adolescent mean age $\geq$ 16 years, Y = Younger Adolescent mean age < 16 years. Country (Participants Country of Origin): US = United States, W = Rest of World. Setting (Study Setting): C = Community, C+ = Community and Parent, S = School-Based, S+ = School and Outside of School. Measure (Study Outcome Measures) O = Objective, OS = Objective & Self-Report, S = Self Report.

Table 3. Adolescent Girl Physical Activity Moderator Analyses

Moderator Variable	$\underline{k}$	$\underline{G}$	$\underline{SE}$	$\underline{s^2}$	$\underline{95\%\ C.I.}$	$\underline{Z}$	$\underline{Q}$	$\underline{\tau^2}$	$\underline{I^2}$	Fail Safe $\underline{N}$
	Effect Size Statistics					**Null Test**	**Heterogeneity Statistics**			**Publication Bias**
Random Effects Model [A]	34	0.350	0.115	0.013	(0.124, 0.577)	3.034*	1436.90*	0.421	97.70	3476
Intervention Characteristics [B]										
Intervention Type							2.310 [B]			
Educational	21	0.225	0.145	0.021	(-0.060, 0.509)	1.547		0.105	89.21	
Environmental	4	0.372	0.344	0.118	(-0.301, 1.046)	1083		0.130	71.60	
Multicomponent	9	0.618	0.215	0.046	(0.197, 1.039)	2.877*		0.827	99.18	
Intervention Focus							2.715 [B]			
Heart Health	4	0.214	0.315	0.099	(-0.404, 0.832)	0.679		0.219	97.58	
Obesity Related	4	0.076	0.315	0.099	(-0.541, 0.693)	0.241		0.000	0.000	
PA and Diet	6	0.220	0.272	0.074	(-0.313, 0.753)	0.809		0.029	48.46	
PA and Sedentary	4	0.729	0.320	0.102	(0.102, 1.356)	2.280*		0.786	98.32	
PA Only	16	0.410	0.164	0.027	(0.089, 0.732)	2.502*		0.778	97.35	

Table 3. Adolescent Girl Physical Activity Moderator Analyses (Cont'd/…)

Moderator Variable	Effect Size Statistics					Null Test	Heterogeneity Statistics			Publication Bias
	_k_	_G_	_SE_	_s²_	_95% C.I._	_Z_	_Q_	_τ²_	_I²_	Fail Safe _N_
Randomisation Level							1.521 [B]			
Class	5	0.185	0.321	0.103	(-0.443, 0.814)	0.578		0.045	80.37	
Individual	9	0.281	0.249	0.062	(-0.207, 0.769)	1.130		0.010	22.60	
School	18	0.472	0.170	0.029	(0.140, 0.805)	2.783*		0.660	98.57	
Year Group	2	-0.072	0.518	0.269	(-1.088, 0.944)	-0.139		0.000	0.000	
Intervention Time							0.034 [B]			
≤12 weeks	10	0.384	0.218	0.048	(-0.044, 0.812)	1.758		0.201	89.95	
> 12 weeks	24	0.336	0.140	0.020	(0.063, 0.610)	2.408*		0.472	98.28	
Intervention Follow-up							0.128 [B]			
No	22	0.383	0.152	0.023	(0.084, 0.681)	2.509*		0.639	98.27	
Yes	12	0.292	0.202	0.041	(-0.104, 0.688)	1.444		0.179	94.51	
Theoretical Approach							0.888 [B]			

Table 3. Adolescent Girl Physical Activity Moderator Analyses (Cont'd/…)

Moderator Variable	k	G	SE	s²	95% C.I.	Z	Q	τ²	I²	Fail Safe N
		Effect Size Statistics				Null Test	Heterogeneity Statistics			Publication Bias
Atheoretical	10	0.180	0.215	0.046	(-0.241, 0.601)	0.840		0.032	59.64	
Theoretical	24	0.422	0.140	0.020	(0.148, 0.696)	3.021*		0.494	98.35	
Intervention Quality							0.637 [B]			
High	4	0.524	0.352	0.124	(-0.166, 1.214)	1.489		1.104	98.74	
Low	18	0.261	0.169	0.029	(-0.070, 0.592)	1.547		0.081	79.76	
Moderate	12	0.420	0.204	0.042	(0.020, 0.820)	2.058*		0.577	98.98	
Sample Characteristics [B]										
Population							0.879 [B]			
Boys and Girls	15	0.239	0.161	0.026	(-0.076, 0.553)	1.486		0.074	90.08	
Girls Only	19	0.439	0.142	0.020	(0.162, 0.717)	3.103*		0.751	98.04	
Age							0.013 [B]			
Older Adolescence	12	0.332	0.201	0.040	(-0.062, 0.725)	1.653		0.180	91.70	

Table 3. Adolescent Girl Physical Activity Moderator Analyses (Cont'd/…)

Moderator Variable	$\underline{k}$	$\underline{G}$	$\underline{SE}$	$\underline{s^2}$	$\underline{95\%\ C.I.}$	$\underline{Z}$	$\underline{Q}$	$\underline{\tau^2}$	$\underline{I^2}$	Fail Safe $\underline{N}$
	Effect Size Statistics					Null Test	Heterogeneity Statistics			Publication Bias
Younger Adolescence	22	0.360	0.149	0.022	(0.068, 0.651)	2.420*		0.529	98.39	
Country							0.214 [B]			
World	13	0.278	0.196	0.038	(-0.105, 0.662)	1.423		0.075	82.56	
US	21	0.394	0.153	0.023	(0.093, 0.694)	2.568*		0.593	98.52	
Study Characteristics [B]										
Setting							0.713 [B]			
Community	1	0.110	0.820	0.672	(-1.497, 1.717)	0.134		0.000	00.00	
Community + Parent	1	0.122	0.702	0.493	(-1.255, 1.499)	0.173		0.000	00.00	
School	19	0.437	0.163	0.027	(0.117, 0.757)	2.680*		0.354	95.56	
School + Outside	13	0.255	0.196	0.038	(-0.130, 0.639)	1.298		0.546	98.81	
Measure							0.223 [B]			

Table 3. Adolescent Girl Physical Activity Moderator Analyses (Cont'd/…)

Moderator Variable	Effect Size Statistics					Null Test	Heterogeneity Statistics			Publication Bias
Moderator Variable	_k_	_G_	_SE_	_s²_	_95% C.I._	_Z_	_Q_	_τ²_	_I²_	Fail Safe _N_
Objective	6	0.287	0.292	0.084	(-0.282, 0.856)	0.988		0.124	69.11	
Objective & Self-Report	3	0.204	0.409	0.167	(-0.598, 1.006)	0.498		0.000	00.00	
Self-Report	26	0.380	0.135	0.018	(0.115, 0.645)	2.808*		0.456	98.31	

Note. k = number of effect sizes. g = effect size (Hedges g). *SE* = standard error. S2 = variance. 95% *C. I.* = confidence intervals (lower limit, upper limit). Z = test of null hypothesis. τ^2 = between study variance in random effects model. I^2 = total variance explained by moderator. * indicates p < .01. A = Total Q-value used to determine heterogeneity. B = Between Q-value used to determine significance ($\alpha < 0.01$).

Figure 1. Example search strategy run through Science Direct on May 14th 2013.

TITLE-ABSTR-KEY((Girls OR children OR adolescents OR youth) AND (school OR family or education OR community)) and TITLE-ABSTR-KEY((intervention OR trial OR controlled trial) AND (physical activity OR activity OR exercise))

Figure 2. Flow chart describing the study-identification process

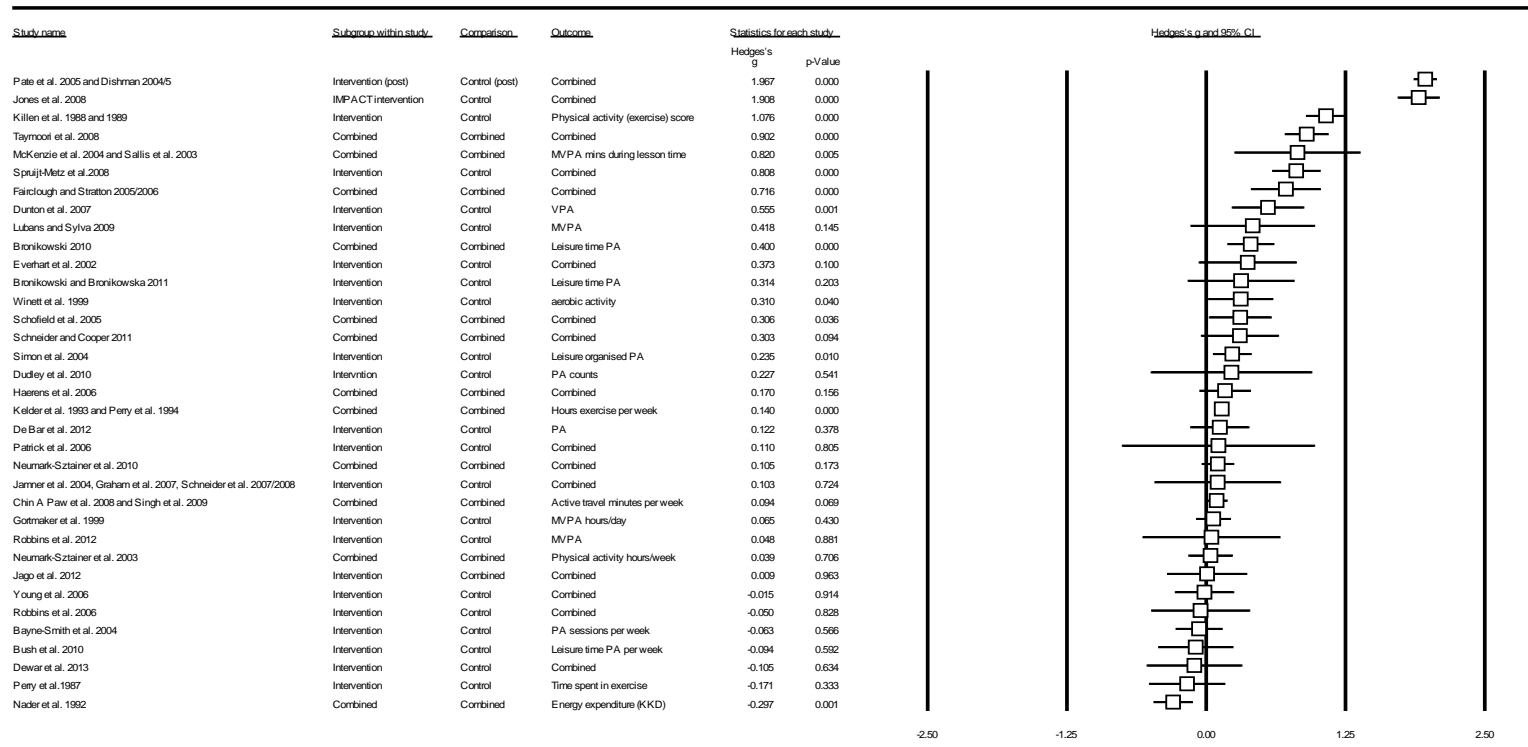| Study name	Subgroup within study	Comparison	Outcome	Statistics for each study		Hedges's g and 95% CI
				Hedges's g	p-Value	
Pate et al. 2005 and Dishman 2004/5	Intervention (post)	Control (post)	Combined	1.967	0.000	
Jones et al. 2008	IMPACT intervention	Control	Combined	1.908	0.000	
Killen et al. 1988 and 1989	Intervention	Control	Physical activity (exercise) score	1.076	0.000	
Taymoori et al. 2008	Combined	Combined	Combined	0.902	0.000	
McKenzie et al. 2004 and Sallis et al. 2003	Combined	Combined	MVPA mins during lesson time	0.820	0.005	
Spruijt-Metz et al.2008	Intervention	Control	Combined	0.808	0.000	
Fairclough and Stratton 2005/2006	Combined	Combined	Combined	0.716	0.000	
Dunton et al. 2007	Intervention	Control	VPA	0.555	0.001	
Lubans and Sylva 2009	Intervention	Control	MVPA	0.418	0.145	
Bronikowski 2010	Combined	Combined	Leisure time PA	0.400	0.000	
Everhart et al. 2002	Intervention	Control	Combined	0.373	0.100	
Bronikowski and Bronikowska 2011	Intervention	Control	Leisure time PA	0.314	0.203	
Winett et al. 1999	Intervention	Control	aerobic activity	0.310	0.040	
Schofield et al. 2005	Combined	Combined	Combined	0.306	0.036	
Schneider and Cooper 2011	Combined	Combined	Combined	0.303	0.094	
Simon et al. 2004	Intervention	Control	Leisure organised PA	0.235	0.010	
Dudley et al. 2010	Intervntion	Control	PA counts	0.227	0.541	
Haerens et al. 2006	Combined	Combined	Combined	0.170	0.156	
Kelder et al. 1993 and Perry et al. 1994	Combined	Combined	Hours exercise per week	0.140	0.000	
De Bar et al. 2012	Intervention	Control	PA	0.122	0.378	
Patrick et al. 2006	Intervention	Control	Combined	0.110	0.805	
Neumark-Sztainer et al. 2010	Combined	Combined	Combined	0.105	0.173	
Jamner et al. 2004, Graham et al. 2007, Schneider et al. 2007/2008	Intervention	Control	Combined	0.103	0.724	
Chin A Paw et al. 2008 and Singh et al. 2009	Combined	Combined	Active travel minutes per week	0.094	0.069	
Gortmaker et al. 1999	Intervention	Control	MVPA hours/day	0.065	0.430	
Robbins et al. 2012	Intervention	Control	MVPA	0.048	0.881	
Neumark-Sztainer et al. 2003	Combined	Combined	Physical activity hours/week	0.039	0.706	
Jago et al. 2012	Intervention	Combined	Combined	0.009	0.963	
Young et al. 2006	Intervention	Control	Combined	-0.015	0.914	
Robbins et al. 2006	Intervention	Control	Combined	-0.050	0.828	
Bayne-Smith et al. 2004	Intervention	Control	PA sessions per week	-0.063	0.566	
Bush et al. 2010	Intervention	Control	Leisure time PA per week	-0.094	0.592	
Dewar et al. 2013	Intervention	Control	Combined	-0.105	0.634	
Perry et al.1987	Intervention	Control	Time spent in exercise	-0.171	0.333	
Nader et al. 1992	Combined	Combined	Energy expenditure (KKD)	-0.297	0.001	

-2.50   -1.25   0.00   1.25   2.50

Figure 2: Forest Plot for Adolescent Girls Physical Activity Interventions