Review

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Active Homework: an under-researched element of the active schools concept

Regular physical activity (PA) is near-universally acknowledged to be an important part of children's and young people's healthy functioning and well-being (Bailey, Hillman, Arent, & Petipas, 2013). Among school-aged children and youth, benefits have been reported in terms of physical, developmental, psychological, cognitive, and social health (Eime, Young, Harvey, Charity, & Payne, 2013; Lubans, Richards, & Hillman, 2016). However, there is evidence that large numbers of children and young people are inactive to the extent they compromise their well-being, both now and in later life (Aubert, Barnes, & Aguilar-Farias, 2018). It is widely accepted that there is a marked decline in moderate-to-vigorous physical activity (MVPA) around the onset of adolescence, particularly among girls (Hallal et al., 2012); however, recent research suggests the origin of relatively low levels of MVPA can be traced to about 6 years of age (Farooq, Parkinson, & Adamson, 2018). Increasing MVPA has the greatest potential for supporting health benefits for students as it generates more energy expenditure (US Department of Health and Human Services, 2018). In contrast, inactivity contributes to the rising rates of overweight and obesity, as well as other non-communicable diseases, especially in children and young people from low socioeconomic backgrounds (Loring & Robertson, 2014). In Europe, the prevalence of obesity is approximately 1-in-5 children and adolescents, rising to 1-in-4 in some countries (WHO Regional Office for Europe, 2020). This is cause for concern, as the pattern of risk associated with obesity is comparable to high blood pressure, high cholesterol levels, and smoking (Pandey, Salahuddin, & Garg, 2016).

Schools have frequently been suggested as valuable settings for interventions to address this situation, and public health entities have advocated increasing PA opportunities for children and young people through comprehensive or whole-school approaches (Beets, Okely, & Weaver, 2016; European Union, 2015). One expression of this call is the 'Active Schools' concept (Scheuer & Bailey, 2021), in which PA is embedded in multiple settings through a whole-of-school approach (Dinkel, Schaffer, Snyder, & Lee, 2017). So, Active Schools act as hubs of children's activity promotion (Daly-Smith, Quarmby, & Archbold, 2020). A driving motivation for this initiative have been doubts about the capacity of traditional settings for PA, primarily curricular physical education (PE) lessons, to provide enough PA to fulfill recommended targets (Hollis, Sutherland, & Williams, 2017; Hollis, Williams, & Sutherland, 2016), knowing well that in most European countries it is not the primordial objective of PE to focus solely on the promotion of PA in a reductionist approach. Active homework (AH) has been proposed as a practical and straightforward way of increasing PA among students at the population level by extending the time available for schools to influence the health behaviors of students (Hill, 2018; Kääpä, Palomäki, Vähä-Ypyä, Vasankari, & Hirvensalo, 2019).

The purpose of this article is to review evidence from the last ten years of the contribution of AH on the promotion of PA and related outcomes. Using a rapid review methodology, it reports in a survey of data from multiple sources on the effects of AH and considers conditions for its effective implementation. One earlier review was identified (Hill, 2018), although it took a wider remit than the present study, including non-active forms of homework, and it did not use a quasi-systematic methodology. So, to the best of our knowledge, this is the first review of its kind on AH.

Background

Homework is a common feature in most countries, with many children required to supplement their time in school with the equivalent of more than half of that time again doing homework (OECD, 2019). Tasks included within this homework are almost entirely academic and sedentary; especially physically active tasks are very rare (Vatterott, 2018). Homework has not traditionally been used as a learning tool related to PA (Hill, 2018), and the foci and efficacy of AH have received little attention from researchers. Predictably, the great majority of educational interventions for children have focused on promoting healthy behaviors while children are at school. Recent years, however, have witnessed some growth of interest

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Table 1 Study characteristics, key findings, and quality rating

Source/ Country	Focus	Students' ages (mean)/ number (% girls)	Objective(s) and methods	Findings	Quality assessment
Duncan et al. (2011)/New Zealand	PA	Students aged 9 to 11 years (–)/*N* = 97 (54% girls)	To examine the efficacy of a compulsory homework program for increasing PA & healthy eating in children. Intervention: 6-week program, with control. Daily step counts monitored before/after intervention using multi-day memory pedometers. Other factors recorded concurrently in a 4-day diary	Homework resulted in a statistically significant increase in step counts, consistent between sexes, schools, and day types (weekdays and weekend days). Boys averaged 2500 more steps than girls throughout the study. 2530 fewer steps on weekend days compared with weekdays	5
Duncan et al. (2019)/New Zealand	PA	Students aged 7 to 10 years (8.7 SD 1.0)/*N* = 675 (52% girls)	To investigate the effects of a compulsory, health-related homework program on PA, dietary patterns, and body size in primary school-aged children. Cluster randomized controlled trial. Intervention: 8-week curriculum-based homework schedule, with in-class support, and professional training for teachers	Significant intervention effects were observed for weekday PA at home and weekend PA. Greatest improvements in PA occurred in children from most socioeconomically deprived schools. No consistent effects on sedentary time, or waist-to-height ratio	5
Fairclough, Hackett, & Davies, (2013)/UK	PA	Students aged 10 to 11 years (0.7 SD 0.3)/*N* = 318 (–% girls)	To investigate the effectiveness of a cluster-randomized intervention to promote healthy weight using an educational focus on PA and healthy eating. Intervention: 20-week program, with control. Teacher-led curriculum, learning resources, and homework tasks. Measures were waist circumference, BMI, accelerometers	At follow-up there was a significant intervention effect for light intensity physical activity. The intervention was most effective for overweight/obese participants, and participants with higher family socioeconomic status	5
Kääpä et al. (2019)/Finland	PA	Students aged 12 to 15 years (–)/*N* = 88 (100% girls)	To examine girls' objectively measured PA, and to provide insights into homework as part of PA. Intervention: as part of the Physical Education Homework Study, accelerometry was used to measure PA intensities, sedentary time, number of total steps, and running steps for 1 week. Self-reported, structured diaries recorded after-school activities, including AH	Significant intervention effects were observed for waist circumference, light-intensity PA. Intervention most effective for overweight/obese participants, participants with higher family socioeconomic status, and girls	3
Kriemler, Zahner, & Schindler, (2010)/ Switzerland	PA	540 6 to 11 years (1st-grade 6.9 SD 0.3; /5th-grade 11.1 SD 0.5)/*N* = 498	To assess the effectiveness of a school-based PA program during one school year on physical and psychological health in young children. Experimental study: randomized controlled trial. Multicomponent PE program, including extra PE lessons, activity breaks, and AH	MVPA and total PA at school for intervention group increased by 18%. Change in overall PA from baseline to follow-up showed only non-significant improvement in favor of intervention group. Adiposity decreased more favorably; aerobic fitness increased more favorably, and physical and psychological quality of life did not change significantly	4
Pantanowitz, Lidor, Nemet, & Eliakim, (2011)/Israel	Perceptions/ Attitudes	95 Students aged 17 to 19 years (–)/*N* = 95 (38% girls)	To explore the attitude and compliance towards homework assignments in PE among students in grades 11 and 12 and their parents Experimental study:12-week period, with AH assignments, including active and non-active content, given at the end of 2 PE classes per week. PA assignments focused on long-distance running, short distance interval sessions, strength exercises, rope skipping, and ball games	Most students and parents viewed PE homework as valuable. Very few students completed AH tasks. Students justified AH in terms of increasing knowledge of relevant topics in PE and PA; achieving healthy lifestyles; developing fitness levels; fun. About 1/3 of students did not support AH because of: lack of time; homework load in other classes; losing unique status of PE classes as a fun activity	2
Smith & Madden (2014)/US	Perceptions/ Attitudes	83 Students aged 11-13 years (–)/*N* = 83	To examine the design and delivery of an AH assignment using students' opinions and reactions to assess the extent to which the curricular innovation succeeded. Interview, journals, activity logs, and observations	There were disconnects between teachers' objectives and intentions and students' understanding and actions	1

AH active homework, *BMI* body mass index, *MVPA* moderate to vigorous physical activity, *PA* physical activity, *PE* physical education, *SD* standard deviation, (–) indicates no information was provided

in the idea of AH, mainly as a vehicle for increasing students' PA by assigning homework students can do on their own or with family members at home or in the local area (Duncan, Stewart, & McPhee, 2019).

On the face of it, the characteristics of AH seem well-suited to contributing to the promotion of children's PA. PA is positively associated with parental involvement, activity choice, and the acquisition and practice of motor skills (Messing et al., 2019), all of which are common in AH assignments (Smith & Claxton, 2003). These activities can be designed for students to apply and practice skills learned in PE lessons, and some advocates have framed AH as a means by which students can become better acquainted with their local environments and available facilities to help make PA part of their lifestyles (Williams & Hannon, 2013). AH also presents a constructive response to concerns that many children are inactive when at home (Cope, & Bailey, 2017). Out-of-school time is of particular interest to those working in PA promotion because, compared with school hours, this phase is generally considered discretionary or 'free time', which might be used for physically active or sedentary activities (Wickel, Issartel, & Belton, 2013). These findings highlight out-of-school time as a key context for interventions aimed at promoting children's PA, and homework seems well-placed to be an efficacious setting.

Methods

Evidence was gathered using a 'rapid reviewing' methodology, a form of knowledge synthesis in which components of the systematic review process are simplified to produce information in an accessible or timely manner (Tricco, Antony, & Zarin, 2015). Rapid reviews can take different formats. In this case, evidence was sought from several electronic databases (PsycARTICLES, PsycINFO, SPORTdiscus, CINAHL Complete, Google Scholar, ResearchGate, and Academia.edu). The research team also sought relevant information from non-English language sources via purposive searches using the partner organizations' expertise and networks within the 'HEPAS (Healthy and Physically Active Schools in Europe) Project' (see Acknowledgements for further details). This search included contacting Czech, Danish, French, German, Hungarian, Luxembourgish, Portuguese, Spanish, and Swiss experts. Despite this, all eligible studies were written in English.

The following criteria were used to keep searches focused:

- Published from 1 January 2010 to 31 May 2020
- Study conducted in either primary/elementary or secondary/high schools
- Study investigated PA outcomes or attitudes to PA in AH either as the sole or substantial focus, and
- Empirical study

Data were extracted, and the findings validated with reference to other gathered data and published reviews. Unlike the previous studies (Hill, 2018), this review did not include consideration of non-active forms of homework, such as 'conceptual' or 'cognitive' physical education (Williams, McGladrey, Silva, & Hannon, 2013). The initial intention was to focus solely on PA outcomes, but a scoping search suggested this would result in a small number of empirical studies. Consequently, it was decided to include studies reporting on attitudes and/or perceptions of AH. This was judged to be justifiable as attitude and perceptions are associated with PA during childhood and adolescence (Kelso, Linder, & Reimers, 2020).

Studies identified as eligible were assessed independently for quality by two authors (Sandra Heck & Richard P. Bailey), who with a third author (Claude Scheuer) resolved any disagreements by discussion. The tool developed by Tooth, Ware, and Bain, (2005), and adapted by Martin, Kelly, Boyle, Corlett, and Reily (2016) was used as the basis for assessing the quality of eligible studies. A 12-item checklist (based on sample, description, attrition, data collection, and results) provided a 5-point rating score, with higher scores reflecting higher study quality. The results of this exercise are included in **Table 1**, alongside details of sample size and age, objective(s) and methods, and key findings.

Results

The research literature on the effects of AH is limited. Indeed, there has been

Abstract

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Abstract

Background. Most physical activity (PA) interventions targeting children focus on the school setting. However, children and young people are often less active at home. The purpose of this article is to review evidence from the last ten years of the contribution of physically Active Homework (AH) to the promotion of PA.

Methods. Using a rapid review methodology, the article reports on evidence contribution of AH and considers conditions for its effective implementation.

Results. Although research literature on the effects of AH is limited and missing a theoretical base, studies reporting small positive associations between AH and PA levels were identified. Increases in PA were, however, of low intensity; moderate and vigorous intensities remained relatively unchanged.

Conclusions. Strategies to increase PA extending beyond the school gym are needed. Further and better research is needed to understand the conditions of effective implementation of AH. Nevertheless, there is a plausibility in providing students regular opportunities to further promote PA in students' lives by practicing movement and sports skills, and offering a flexible way of finding and pursuing meaningful activities. The fact that AH may encourage the engagement of families and communities, multiplies its potential benefits.

Keywords

Child and adolescent health · Physical activity · Family engagement · Rapid review

only one short review of the literature (Hill, 2018). Seven empirical studies were found for this review, of which five considered homework as a source of PA as the sole or primary focus (Duncan et al., 2011; Duncan et al., 2019; Fairclough et al., 2013; Kääpä et al., 2019, Kriemler et al., 2010), and two examined perceptions and attitudes (Pantanowitz et al., 2011; Smith & Madden, 2014; **Table 1**).

Even though most commentators identified physical activity promotion as the primary goal of AH (e.g., Burt, 2017; Hill, 2018), a surprisingly small number of empirical studies have examined its efficacy in this regard. There was considerable variation in quality among this sample, indicating caution should be maintained in interpreting findings. Four studies focused on the promotion of PA reported small positive associations between AH and PA levels (Duncan et al., 2011; Fairclough et al., 2013; Kääpä et al., 2019; Kriemler et al., 2010). However, the impact of interventions varied considerably.

Fairclough et al. (2013) used a cross-curricular intervention with English 10- and 11-year-olds including AH and found girls benefitted more than boys, and obese students benefitted more than those of normal body weight. However, due to their study's multi-faceted nature, they did not separate the effects of AH, so it is not possible to assess the direct impact of AH. Overall, the researchers found increases in PA to be of low intensity. Moderate and vigorous intensities remained relatively unchanged. A similar school-based intervention from New Zealand with the same age range found students experiencing the intervention logged significantly more pedometer steps (Duncan et al., 2011). That research team carried out a follow-up study (Duncan et al., 2019) also using pedometers to measure the effects of a curriculum-based health-related PA program among a group of primary school-aged children. They reported significant and sustained increases in physical activity 6-months after the completion of the intervention. Large effects on out-of-school PA were particularly noteworthy, approximate to hypothetical increases of 15.6 and 29.7% each weekday and weekend day, respectively. The intervention effect was consistent across day type (weekend vs weekday), sex, and school, although the use of pedometers, rather than accelerometers, means it is impossible to distinguish PA intensity levels.

Only two studies examined the effects of AH on MVPA. The first was a Swiss curriculum-based intervention (Kriemler et al., 2010) that used accelerometers to measure PA objectively and found changes in MVPA from baseline to follow-up were significantly higher in primary school students who participated in a multicomponent intervention (including AH) compared to the control group. The difference corresponded to 13 additional minutes. Likewise, the change in total PA while at school was 18% higher in the intervention group. However, due to the study's multi-faceted nature, the effects of AH were not separated and it was not possible to assess the direct impact of AH. The second study focused on girls in lower secondary school in Finland (Kääpä et al., 2019). The researchers reported a small but significant effect of AH, and, on the whole, those who did AH at least twice per week were more physically active than those who did none or less. In all, 38% of intervention girls reached the 60 min of PA recommendation, and AH contributed an average of 34 min of PA per week. There was also a statistically significant difference in vigorous PA (VPA) between the two groups. The differences between different age groups' MVPA were a few minutes, but the 11- and 12-year-olds were the most active when light PA (LPA), moderate PA (MPA), and VPA were combined.

Completion of voluntary tasks is a reasonable marker for attitude to AH. Pantanowitz et al. (2011) recorded only 4% of high school students completing all assignments, while 53% completed none of them. A third of students did not support AH, mainly citing reasons due to pressure from other school commitments and the perception AH contradicted the notion of PE as a 'fun' subject. Similar findings were reported by Smith and Madden (2014). Data from student interviews, teacher journal entries, student activity logs, and observations included comments such as "homework in gym is stupid", and admissions of falsifying activity logs. In contrast, Kääpä et al. (2019) found the adolescent girls generally responded positively to AH, especially when it included practicing with family members, and opportunities to plan their own activities.

Discussion

The evidence base related to AH is currently weak. There are a relatively small number of studies, with many using either descriptive or qualitative approaches. The heterogeneity in the effectiveness of school-based PA interventions may be explained by differences in intervention length, mode of delivery, provider, or content of the intervention. Therefore, it is difficult to draw confident conclusions from the findings. Unfortunately, no information was available to make an informed judgment on the impact of these factors.

Information was also lacking concerning the contribution of AH to PA. It seems clear there is a potential contribution if students complete their allocated tasks, but further research is needed to understand the extent of that contribution, and particularly its intensity. Three otherwise impressive studies failed to provide this information. The design of the multi-faceted interventions by Fairclough et al. (2013) and Kriemler et al. (2010) mean the impact of specific elements could not be isolated, and the use of pedometers in the New Zealand studies (Duncan et al., 2011, 2019), rather than accelerometers meant the researchers could not accurately measure intensity. Nevertheless, the positive association between AH and PA reported by these studies should not be underplayed. Nor should the relatively large effects recorded with children from the most socioeconomically deprived areas, as this suggests AH interventions might prove useful in engaging at-risk populations in PA (Duncan et al., 2019).

In light of its under-developed empirical base and generally low quality, it is not surprising theoretically or empirically robust guidance of AH's effective implementation has been limited (Hill, 2018). Previous research has suggested the explicit use of formal theories in the de-

sign of intervention was associated with enhanced intervention outcomes (Pang, Kubacki, & Rundle-Thiele, 2017), so it is somewhat surprising most studies in this review identified no theory. The exceptions to this pattern were the studies by Fairclough et al. (2013), which explicitly identified social–cognitive theory as the basis for its intervention, and the two studies from New Zealand (Duncan et al., 2011, 2019), which drew on a mix of behavior change theories, including information–motivation–behavioral skills model, the theory of reasoned action, the theory of planned behavior, social–cognitive theory, control theory, and operant conditioning. The absence of a theoretical base in the other studies in this review is a possible explanation for why they tended to have limited impact and highlights the need for intervention planners to incorporate more theoretically rigorous approaches.

Findings that some students reject the concept of AH (Pantanowitz et al., 2011; Smith & Madden, 2014) is consistent with an earlier study by Mitchell, Stanne, and Barton (2000), who reported students believed "homework should not be required, and that they knew of no homework that had been assigned by physical education teachers" (p. 415). The positive response from the girls in Kääpä et al. (2019) study might be explained in terms of gender, as girls tend to be more compliant with homework tasks (Xu, 2011), culture, as Finland is routinely cited as a leader in PA promotion (Kämppi, Aira, & Halme, 2018), or pedagogy. However, no details were provided about this by any of the studies.

Despite being a school-based intervention, AH's potential strength is the scope to develop approaches maximizing family participation and community engagement, thereby targeting out-of-school behaviors (Duncan et al., 2019). Parents' support in the promotion of physical activity seems to be particularly important for the realization of sustainable goals (Rivard, Deslandes, & Collet, 2010). However, the realization of this potential assumes a robust theoretical basis that is currently lacking.

Conclusions

Despite the notes of caution mentioned in this article, there is a strong intuitive appeal for AH. It is near-universally accepted that serious and sustainable measures are needed to raise the PA levels of children and young people (see, for example, WHO, 2020), and schools are uniquely well-placed to contribute to this agenda. Physical education lessons play a role, but they generally lack the frequency, intensity, and time to make substantial contributions to achieving recommended targets. Therefore, strategies extending beyond the school gym are needed, especially those strategies that encourage the development and rooting of healthy habits during the critical period of childhood development. In principle, at least, AH provides an opportunity to embed active assignments into students' daily lives, practicing movement and sports skills, and offer more flexible ways of finding and pursuing meaningful activities. Also, AH often encourages the engagement of families and communities, which can multiply its benefits.

At the moment, AH is not a common phenomenon in schools, and its introduction is likely to face resistance. Many teachers already struggle to meet competing curricula demands, so they might view AH as another source of pressure (Redín & Erro-Garcés, 2020). Students and their parents in many countries might worry AH adds to the already substantial time commitment for school homework (OECD, 2019). Communication, strategy, and sensitivity will all be needed to ensure AH is seen as a constructive addition to school life and not a burden. Despite its face validity, much more research is needed on the characteristics of effective implementation, and, initially at least, that may mean adapting and extrapolating principles from the literature on general academic homework, which is itself an under-developed field (Roschelle & Hodkowski, 2020). Nevertheless, there are clues (Vatterott, 2018) suggesting some critical questions for advocates of AH:

- Purposeful: How can AH be made meaningful for learning? How should AH relate to school-based learning? How will AH provide teachers feedback about student learning? What are the best ways to ensure students (and parents) understand the purpose of AH tasks?
- Efficient: How can AH be made time-efficient? How can AH be planned to add value to school learning? How can teachers evaluate the quality of AH?
- Personalized: How can AH be differentiated to meet the interests and abilities of all students? How can students take ownership of AH? Who should decide the details of AH: teachers or students?
- Doable: How can curricula requirements be balanced with a variety of learning experiences? Which approaches to AH support all students' inclusive participation and learning, including those with additional or special needs? How can AH be supported and 'scaffolded' to maximize success?
- Inviting: How can AH capitalize on students' interests? How can tasks enhance motivation by balancing challenge and student ability?

These practical questions reinforce the need for more and better-quality empirical studies of the efficacy of the different manifestations of AH. There is also a need to develop and test theories underpinning practices associated with enhanced outcomes. At present, the theoretical basis of AH is weak.

The effects of the coronavirus disease 2019 (COVID-19) pandemic and other environmental challenges have highlighted the precariousness of traditional, face-to-face schooling. On the one hand, disruptions have had and will continue to have detrimental effects on the well-being of children and their families (United Nations, 2020), and have resulted in changes to the form of children and young people's exercise behaviors away from the organized sport to incidental and informal activities (Schmidt, Anedda, & Burchartz, 2020). On the other hand, these challenges have inspired a resurgence of innovation within the education sector, especially related to alternative teaching methods

and learning away from school premises (Ganimian, Hess, & Vegas, 2020). The rise in homeschooling and calls for closer collaboration between parents and teachers in the delivery of remote programs creates a need to re-evaluate the character and role of homework and the increasingly permeable boundaries between home and school. AH would seem to have a role to play here. Many parents feel under-prepared to provide home learning, in general (Walsh et al., 2020), and extrapolation from cognate research suggests they feel even less confident when expected to support their children's physical education (Bailey, 2006). Digital solutions supporting both parents and teachers in these tasks, such as applications for smart-phones or tablets presenting resources for AH, could facilitate these processes of innovation, and provide much-needed support to parents. Discussions of educational futures are always somewhat conjectural, and only time will tell how schooling adapts following the recent shock to the system. However, even if nothing fundamentally changes, the case for AH warrants further research and development. Though sparse, the existing literature indicates a potential for contributing to students' PA and achieving a variety of other physical education goals.

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Declarations

Conflict of interest. R.P. Bailey, S. Heck, C. Scheuer and declare that they have no competing interests.

For this article no studies with human participants or animals were performed by any of the authors. All studies performed were in accordance with the ethical standards indicated in each case.

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