

# School-Based Intervention to Children exercise

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Three key health behaviors, physical activity (PA), sedentary behavior (SB) and sleep (SLP), have been identified by the 24-h framework as movement behaviors. School-based interventions targeting these multiple health behaviors among children have the potential to increase health outcomes. Despite this, the efficacy and sustainability of school-based movement behavior interventions among children has not been evaluated yet. To fill this gap in literature, this systematic review will aim to: 1) Summarize and classify movement behavior strategies used in literature to improve PA, SB and SLP in/from school in children; and 2) measure the effect of movement behavior strategies used in literature to improve PA, SB and SLP in children. The review protocol was registered in PROSPERO (CRD42020199154). A systematic search will be conducted between 2010 to 2020 in five databases: Pubmed, Scopus, SPORTDiscuss, The Cochrane Library and Web of Science. Risk of bias and quality assessment will be evaluated and measured according to the recommended tools. This systematic review will provide information about which kind of school-based movement behavior interventions are effective, sustainable and the best to implement in children.

Keywords: 24-h guidelines ; movement behaviors ; physical activity ; sedentary behavior ; sleep ; school ; children ; intervention program

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## 1. Introduction

Public health concern has increased over the past decade due to the rise of non-communicable diseases as the first cause of death worldwide [1]. It is known that insufficient physical activity (PA) is one of the most important health behavioral risks for non-communicable diseases in children, youths, and especially in adults [1][2][3]. Sedentary behaviors (SB) such as sedentary screen-time behaviors (i.e., TV viewing, computer use, playing video-games, or smartphone use), and sitting time (i.e., leisure and occupational sedentary time) are behaviors closely related to physical inactivity in children, but must be considered separately [4][5]. Related to sleep (SLP) behavior, some studies have shown that unhealthy SLP (i.e., irregular sleep patterns, poor sleep quality and short sleep duration) is associated with a higher risk of obesity and a lack of health outcomes (e.g., good physical shape, physical and psychological well-being, healthy dietary patterns, and cognitive performance) among children and adolescents worldwide [6][7][8]. For convenience only the acronyms PA, SB and SLP instead of their full expressions will be used throughout the manuscript.

Some research studies indicated that the adoption of a healthy lifestyle during childhood can have protective effects against the onset of chronic disease [9], and health-related behaviors acquired at this age usually tend to persist into adulthood [10], so it can influence sustainable long term health behaviors. PA, SB and SLP, separately and combined, can influence and increase health benefits in children [11][12]. These three health behaviors are correlated [13][14][15][16] and can interact among them to increase healthy outcomes (e.g., high PA/low SB/improve SLP) in children and youths [17]. Traditionally, school health research has been mainly focused on promoting PA and reducing SB in children [11], but SLP research has usually been treated independently and separately [18]. Although this approach has been very important to the field so far, emerging evidence indicates that today another integrated approach is necessary to understand and promote school health behaviors in children [19]. PA is an important health behavior, but only accounts for a small part of daily time, however SB and SLP make up the majority of a 24-hour period [20]. As a consequence, a new paradigm was developed in 2016, called the 24-hour Movement Guidelines [21]. This framework recognizes and integrates the importance of correctly combining PA, SB and SLP to reach and improve health outcomes in children [12]. According to the recommendations provided by the 24-h Movement Guidelines [17] and the WHO [22], children aged 5–12 years should accumulate >60 minutes of daily moderate-to-vigorous physical activity (MVPA), spend several hours in a day doing Light Physical Activity (LPA), sleep more than 9 hours per night and dedicate less than 2 hours each day to sedentary screen-time behaviors.

Previous studies suggested that combinations of behaviors (e.g., increase PA, reduce SB and improve SLP quality) can impact health in a different way that would not be explained by the effect of individual behaviors studied separately [23][24]. Interventions targeting a combination of multiple health behaviors are a promising method to improve several health

outcomes [25]. This approach evidences that changing one health behavior could affect or improve others [25][26]. However, interventions that simultaneously address several health behaviors are usually difficult to implement at schools [26], especially due to various barriers and limitations (e.g., lack of teacher's formation in health promotion, a limited school timetable, the school curricula organization, etc.). On the other hand, interventions that combine PA (e.g. MVPA, LPA), SB (e.g., short sitting time, low screen-time) and SLP (e.g., high sleep quality, high sleep duration) have shown more beneficial outcomes compared with interventions that do not combine these behaviors. School is an ideal setting for health promotion behaviors in children, because the majority of the population stay there for a long period of their lifetime, and children spend approximately 50% of their daily waking time at school [27]. Today, school children spend approximately 6–8 hours per day at school, being sedentary [28][29], so it is even more important to target school interventions that can increase PA (i.e. MVPA and LPA) and reduce SB (i.e., sitting time and screen time). Considering the 24-h movement guidelines framework, SLP should also be considered.

There are multiple reviews targeting PA [30][31][32][33][34], SB [35][36][37][38] and SLP [39][40][41] interventions separately, but there is a lack of reviews about multiple health behavior (i.e., 3 or more health behaviors) interventions. We have only found some reviews that target combined health behavior interventions (e.g., PA and SB, PA and SLP) in children that address issues such as obesity prevention [42][43][44][45], weight gain prevention [46], energy-balance [47], and preschoolers aged 0–4 years [48]. Other reviews related to multiple health behavior interventions (e.g., PA and SB, PA and SLP) have mainly focused on adolescents [49][50][51][52][53] and suggested that although they were effective in terms of PA outcomes, more evidence and high quality studies are required to determine their effectiveness related to other health behaviors such as SB or SLP.

## **2. Discussion**

The proposed systematic review will be the first to evaluate the school-based movement behavior interventions designed to promote healthy outcomes among children and their efficacy: Increase PA (i.e., MVPA, LPA), reduce SB (e.g., sitting and screen-time) and improve SLP (i.e., sleep patterns, duration and quality). This systematic review of recent and older studies will also allow us to obtain information about the degree of development and sustainability of interventions addressing movement behaviors among primary school students. Although there are some recent systematic reviews, which have examined health behavior interventions in children and adolescents, these were focused on preventing diseases or unhealthy behaviors (e.g., overweight, obesity, physical inactivity, alcohol and smoke consumption, etc.), instead of promoting health behaviors [54][55][56][57][58][59][60]. Consequently, there is a lack of reviews focused on targeting movement behavior interventions in children. Thus, this protocol provides a description of the future systematic review to be carried out, exploring this literature gap. According to our task to find multiple health behavior intervention studies, previous reviews found that studies usually do not detail their strategies or methods of intervention, and further high quality research is needed. In order to do that, an important number of methodological unclear studies is expected to be found in our future search. In addition, a review and meta-analysis carried by Champion et al., found that school-based multiple health behavior interventions were beneficial in increasing PA, and reducing screen time (i.e., SB), but concluded that effects were small and the overall quality of evidence was low (measured by GRADE [Grading of Recommendations Assessment, Development and Evaluation] framework). As mentioned in the introduction, combinations of health behaviors can impact health in a different way, which would be not explained by the effect of individual behaviors separately. However, recent reviews have found that benefits of single health behavior interventions versus multiple health behavior interventions remained unclear. Nevertheless, although there is no consensus in this regard, the present review will only include school interventions targeting at least two movement behaviors simultaneously to further study this topic.

Strengths of this review protocol come firstly from the detailed research guide (i.e., eligibility criteria and search strategy exposed) that will help future researchers to conduct other valid and reliable systematic reviews related to movement behavior interventions. Another methodological strength that should be highlighted in the current review is the detailed quality assessment and risk of bias procedure, according to recent recommendations to conduct systematic reviews [61]. Related to the limitations of this review, language restriction of published English written studies could limit the generalization of future results. Another limitation is that authors could be ignoring other databases [62] and do not identify more studies in the present systematic review.

## **3. Conclusions**

The systematic review to be carried out will provide information about existing studies that have implemented school-based intervention programs targeting movement behaviors to increase health outcomes in children. It is expected that data extracted will be able to identify the most effective strategies and measure the intervention program effect according

to our aim. Moreover, results of the present study will show a deeper understanding of which are the most effective and sustainable intervention programs to improve movement behaviors (i.e., PA, SB and SLP) in school-aged children. Finally, reviewing a broad range of adequate intervention programs to improve movement behaviors in/from school will provide information to researchers and practitioners of our field about which kind of interventions and strategies are the best to implement, related to each study design and program objectives.

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