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Obesity Prevention

Integrating movement in academic classrooms: understanding, applying and advancing the knowledge base

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Summary

In the context of comprehensive and coordinated approaches to school health, academic classrooms have gained attention as a promising setting for increasing physical activity and reducing sedentary time among children. The aims of this paper are to review the rationale and knowledge base related to movement integration in academic classrooms, consider the practical applications of current knowledge to interventions and teacher education, and suggest directions for future research. Specifically, this paper (i) situates movement integration amid policy and research related to children's health and the school as a health-promoting environment; (ii) highlights the benefits of movement integration; (iii) summarizes movement integration programs and interventions; (iv) examines factors associated with classroom teachers' movement integration; (v) offers strategies for translating research to practice and (vi) forwards recommendations for future inquiry related to the effectiveness and sustainability of efforts to integrate movement into classroom routines. This paper provides a comprehensive resource for developing state-of-the-art initiatives to maximize children's movement in academic classrooms as a key strategy for important goals in both education and public health.

Keywords: Classroom teachers, comprehensive school physical activity, movement integration, sedentary behaviour.

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Introduction

Movement integration (MI) involves infusing physical activity (PA), at any level of intensity, within general education classrooms during normal classroom time (1). The goal of MI is to increase PA and/or reduce sedentary time among school-aged youth, although most of the focus has centred on providing MI opportunities for children in elementary schools. Classroom MI is not intended to replace school physical education, as the former is considered a behavioural program (i.e. primarily targeting children's daily behaviours) while the latter is considered an instructional program (i.e. primarily targeting children's knowledge and skill development) (1). Yet, opportunities to be active in the classroom may be a useful way to apply and enhance instructional content taught in physical education. Approaches to integrating movement generally include incorporating PA during academic lessons (e.g. having students jump the answers to addition problems in a math lesson), scheduling short (5–15 min) PA breaks between lessons (e.g. having students follow a short dance video), or injecting PA into other transition periods (e.g. having students hop around the classroom before getting in line to go to lunch) (1).

In the United States, MI in academic classrooms has gained national attention as a promising strategy for schools to consider with respect to reaching both educational and health-related goals. Classroom MI is recommended by a number of national organizations (1–4). The National Physical Activity Plan identifies classroom MI as a key tactic in the education sector to increase children's PA (5). In tandem with these recommendations, classroom MI has been included as a component of multiple school-based interventions (6,7).

Amid increased efforts to capitalize on MI, it is important to examine the existing knowledge base and its implications for practice and future research. Therefore, in this paper, we review the rationale and research related to classroom-based MI, consider possible applications of the knowledge base to interventions and teacher education, and suggest directions for future research on MI. The paper is organized into the following sections: (i) importance of increasing PA and reducing sedentary time; (ii) schools as a key setting for intervention; (iii) benefits of classroom-based MI; (iv) MI programs and interventions; (v) factors associated with classroom teachers' MI; (vi) translating research to practice; and (vi) advancing the knowledge base. The goal of this paper is to provide researchers, interventionists and teacher educators with a comprehensive resource for developing cutting edge initiatives, based on a thorough understanding of related policy, theory and research, to maximize the effectiveness and sustainability of efforts to integrate movement in academic classrooms.

Importance of increasing PA and reducing sedentary time

PA is well documented as important and beneficial for youth in many ways (1,2,8). Increases in PA are associated with improved health through reducing risk factors for chronic diseases, such as obesity, type 2 diabetes and cardiovascular disease (2,9). Being active is also associated with improvements to muscular strength, bone strength, self-esteem, and lower levels of anxiety and/or depression (2), thereby demonstrating the importance of PA to the physical, social-emotional and mental health of children and adolescents (1). Current national guidelines for youth recommend accruing, each day, at least 60 min of PA that is mostly of moderate or vigorous intensity (10). The available evidence demonstrates, however, that many school-aged youth are not meeting this benchmark. A study using accelerometer data from a national sample of 6,329 participants found that only 42% of children ages 6–11 and 8% of adolescents ages 12–15 achieved the guideline on one or more days (11). Thus, interventions to increase the proportion of youth who spend at least 60 min each day in moderate- or vigorous-intensity PA are needed.

While increasing opportunities for PA is important, reducing sedentary time also warrants attention. The Institute of Medicine uses the term 'sedentarism' to describe engagement in sedentary behaviours or activities, which include time spent other than in sleep or in light, moderate or vigorous physical activities (1). Importantly, reducing sedentarism may have health benefits independent of those tied to meeting PA guidelines. Although much of the focus on health benefits of PA has centred on moderate-to-vigorous PA, engagement in light PA (i.e. not being sedentary) uniquely contributes to health outcomes. A qualitative review of research on children and adolescents found a dose–response relationship between higher levels of sedentarism and undesirable health outcomes, such as unfavourable body composition and lower fitness, self-esteem and academic achievement (12). It is estimated that youth spend 80–93% of their waking hours being sedentary (1). Interventions are therefore needed, which specifically target reducing sedentarism/increasing light PA in youth.

Schools as a key setting for intervention

A number of interventions targeting increases in PA or decreases in sendentarism of children have taken place in schools (7,13). Schools are a unique and promising setting to help children meet PA guidelines (1–3,5) and have historically played a role in children's health. Schools have access to most children regardless of race, ethnicity or socioeconomic status for most waking hours on weekdays (1,2,5). Further, increased amounts of PA during school have been associated with improved academic performance of children. An extensive review of literature conducted by the Centers for Disease Control and Prevention (8) found the majority of studies on PA provided evidence supporting a positive association between PA and academic achievement, skills and behaviours. Moreover, the report confirmed that increasing opportunities for students to be physically active in schools does not result in declining academic performance. These days, children tend to spend more time in school-based programming than they used to, given the increase over the last few decades in the number of women who participate in the paid labour force. As children spend greater amounts of time away from home in schools, it becomes increasingly important to maximize the potential for PA in the school environment (14).

Traditionally, physical education and recess have been thought of as obvious school-based settings for providing children with opportunities to be physically active. Yet, increased pressure for performance on high stakes testing has caused many schools to reduce the amount of time allocated for physical education and recess. Results from

the 2006 School Health Policies and Programs Study (SHPPS) indicated that only 8% of elementary schools provided daily physical education for the full school year (15), while the 2012 SHPPS found that 46.9% of school districts adopted a policy describing reasons that elementary students may be exempted from physical education (16). Further, elementary schools that reported meeting national recommendations for physical education (at least 150 min per week) were less likely to report meeting national recommendations for recess (at least 20 min per day), and vice versa (17). Despite evidence that physical education and recess interventions can increase student PA levels (18), limited offerings in recess and/or physical education suggest that the school environment is increasingly embodying the characteristics of sedentarism. This trend makes it imperative to explore alternative approaches to maximize children's daily PA engagement.

In tandem with this perspective, recent recommendations for helping children meet PA guidelines emphasize utilizing a multicomponent, 'whole-of-school' approach (1,2,4). This approach is defined as 'all of a school's components and resources operat[ing] in a coordinated and dynamic manner to provide access, encouragement, and programs that enable all students to engage in vigorous- or moderate-intensity PA 60 minutes or more each day' (p. 367) (1). Importantly, this approach does not redirect or undermine the critical roles of quality physical education or recess in children's PA. Rather, it expands the possibilities for increasing the number of opportunities children receive to be physically active at school on a daily basis.

Nationally, the most prominent conceptualization of a whole-of-school approach to PA promotion is the Comprehensive School Physical Activity Program model, which includes five components: (i) Quality Physical Education; (ii) PA During the School Day; (iii) PA Before or After School; (iv) Staff Involvement and (v) Family and Community Engagement (2). The purpose of Quality Physical Education is to prepare youth for a lifetime of PA through a structured instructional program, as well as to provide opportunities for PA during instructional time (1). PA During the School Day encompasses other recommended opportunities for PA during regular school hours, such as recess, classroom activity breaks and lunch 'drop-in' PA events. Before and after school programs might provide additional PA opportunities through walk/bike to school initiatives, activity clubs, intramurals and interscholastic sports. Theoretically, all school staff can play important roles in providing such opportunities and helping to build a comprehensive program, which can extend to both home and community contexts to maximize PA engagement. With access to children, facilities, equipment and staff, schools have the foundation already in place to facilitate a school-wide approach to PA promotion (1).

Benefits of classroom-based MI

The academic classroom has potential to be an integral component of a whole-of-school approach to PA (19,20). Pragmatically, the classroom environment is uniquely situated to facilitate multiple school-based opportunities for PA on a daily basis, as elementary students spend most of their time in school within academic classrooms (1,21). The recommendation for classroom MI also has empirical support for facilitating adaptive outcomes tied to targeted goals in both health and education Although not all MI interventions have demonstrated positive outcomes in terms of academics (22–24), attitude towards PA (22) and PA levels (25), there are a number of benefits to MI. Specifically, MI has been shown to increase moderate-to-vigorous PA (26–32), decrease sedentary time (33–36), positively influence body mass index (37,38), reduce weight in girls (38), increase health-related fitness (39), improve on-task behaviour (31,40–43), enhance cognitive function (37,44,45), increase academic standardized test scores (46), increase enjoyment and positive affect (45,47–49), and increase perceived competence and effort in the classroom (48). MI may also positively influence children's recreational PA outside of school (50). The use of stability balls and standing desks in lieu of chairs has been found to positively impact student behaviour (51–53), PA (54,55), sedentary behaviour (56,57) and sitting posture (54), as well. While more research is warranted to determine the precise mechanisms responsible for these improvements, it appears that utilizing these strategies can benefit students in multiple ways.

The relationship between classroom MI and aspects of academic performance is of particular interest for school professionals. Extant, albeit preliminary, data on the effect of MI on learning outcomes and behaviours in the classroom are positive. Small effects in favour of MI interventions were found in recent meta-analyses (6,58), suggesting that MI is not antagonistic to student's academic performance but may even work synergistically to promote academic achievement. However, the small number of studies identified in the meta-analyses (four and eight, respectively) highlights the need for more interventions in this area. Experimental studies showed that on-task behaviour in the classroom either improved (31,42,45,59) or remained stable (i.e. was not impaired) (41) for the MI lessons, compared with the non-active lessons, whereas, on-task behaviour declined after traditional lessons.

MI programs and interventions

Integrating movement in the academic classroom can be accomplished in a variety of ways, ranging from teachers utilizing existing resource guides and/or pre-packaged programs to creating and implementing their own unique

strategies. Several resource guides and pre-packaged programs currently exist to help teachers integrate movement into the academic classroom. These materials can generally be categorized into two groups reflecting the recommended approaches to MI: (i) guides and programs with activities integrated into academic lessons and (b) guides and programs with stand-alone activities designed as PA breaks (~1–10 min) between academic lessons or during transitions. Guides and programs with activities integrated into academic lessons use PA to reinforce academic content by directly linking core content to the activities. Some examples of incorporating this approach to MI are guidebooks by Reed (60) and Pangrazzi (61), and programs such as Energizers (31), Move for Thought (62), Move-To-Improve (63), SPARKabc's (http://www.sparkpe.org/abc/sparkabc/), and Take10 (20)! Guides and programs designed as PA breaks use PA as a vehicle to insert short bursts of movement throughout the day, breaking up sedentary time by integrating movement between or within lessons. Some examples primarily reflecting this approach to MI are Activity Bursts in the Classroom for Fitness (22), Instant Recess (64), Just-a-Minute (http://www.healthetips.com/jam-program.php) and Bizzy Break (65)! Used to rest and refresh the brain, these exercise breaks are often aptly referred to as 'brain breaks'; they serve as a mental break that can be employed in the middle of, or between, core lessons. All of these guides and programs espouse activities that are designed as 'ready to use' for teachers.

Overall, different approaches to MI appear to be effective in promoting both health-based and education-based outcomes. Several school-based interventions have tested the effectiveness of available MI programs on students' PA and academic-related outcomes. One of the most commonly reported MI programs implemented in interventions is the Take10! program. A review of 19 journal articles, published abstracts, final reports and unpublished studies that included the Take10! program or variations of the program found that teachers were reported as willing and able to implement the lessons, while students experienced greater levels of PA, improved academic performance and decreases in off-task behaviour (66). Some of the other programs that have been tested in interventions include Energizers and Move to Improve. Marhar *et al.* (31) assessed over 240 students in grades K-4 at one school on their PA and on-task behaviour using pedometers and systematic observation, respectively. Classes at each grade were randomly assigned to intervention or control groups. Results indicated a significant difference between control and intervention groups with students in the intervention group taking more steps in school and demonstrating improvements in on-task behaviour. The Move to Improve program was used in a study with 144 elementary classrooms (72 trained in MTI, 72 untrained) in New York City (63). The primary goal of the Move to Improve program was to use PA in the classroom to help students progress towards meeting PA and physical education guidelines. The activity breaks aligned with national physical education standards, as well as with Common Core curriculum standards. Based on a full-day observation in each classroom, results were promising with students in Move to Improve classrooms experiencing an average of 7 min more classroom PA than students in the control classrooms.

Other interventions have been conducted using MI as an exercise break from academics. For example, the Brain BITES (Better Ideas Through Exercise) intervention (45) strictly focused on aerobic exercises, intentionally leaving out academic content. Observations of third and fourth grade students ($n = 96$) indicated the children enjoyed the exercise breaks more than doing sedentary activities. The Instant Recess program was tested in a randomized controlled trial using direct observation with third to fifth grade classrooms across eight elementary schools in North Carolina (59). Significant increases were found for light PA (51%), moderate PA (16%), and on-task behaviour (11%) of children in the intervention classrooms significantly increased from baseline to follow-up. The Activity Bursts in the Classroom for Fitness program, designed to incorporate short bursts of activity throughout the day during teachers' 'down time' (22), was also tested in a randomized controlled study from September to April of one school year. Students ($n = 1,214$) in five schools (three interventions and two controls) participated, with students at the intervention schools demonstrating significant increases in physical fitness (e.g. upper body strength, abdominal strength) and significant decreases in medication use for asthma and Attention Deficit Hyperactivity Disorder (ADHA).

Several interventions have tested alternative MI approaches, which incorporate strategies that extend beyond, or do not include pre-packaged programs. In the Physical Activity Across the Curriculum intervention (47), Take10! activities were combined with existing teacher lessons in a three-year randomized controlled trial in Northeast Kansas. Students exposed to a minimum of 75 min of the program each week had a significantly smaller increase in body mass index than those without the intervention. Some studies investigated the effects of novel equipment or environmental changes for MI (67,68). For example, an intervention conducted as part of a Master thesis employed a unique MI approach, which focused on manipulating the physical environment instead of the teacher's instruction (P. Janulewicz, unpublished data). In the 12-week intervention, students in two fourth grade elementary classrooms in Nebraska had their chairs gradually replaced with FitBall exercise balls. Accelerometers were used to assess PA at baseline, 4 weeks, 8 weeks and 12 weeks. At the end of the study, results showed a significant increase in PA across 3 months. In other studies, teachers either modified existing lesson plans and/or created new

lesson plans with the help of researchers and in-service training days (26,69,70). For example, in the study by Erwin *et al*. (70), four teachers participated in an all-day training session with researchers to enhance students' PA during instruction in math. The teachers developed over 20 MI activities to be incorporated across 13 math lessons. Students participating in these lessons were more physically active than at baseline, suggesting teachers can enhance student PA during the school day through modifying/creating their own lessons instead of utilizing pre-packaged programs. This strategy offers a cost-effective approach to increasing PA through schools that may hold promise in times of budget constraints.

Factors associated with classroom teachers' movement integration

Given that children spend the majority of their time in school within academic classrooms, classroom teachers have more access to children during the school day than other school professionals (e.g. physical education teachers). It is therefore important to understand the factors associated with classroom teachers' MI so that interventions and teacher education programs can provide these teachers with optimal support for maximizing children's PA. During interventions, teachers may not implement MI activities as the interventionists intended. Teachers might use an MI program less frequently than originally asked by the interventionists, for shorter durations than they said they would, or with modifications that reduce the intensity of the activities. Lack of implementation fidelity could lead to a limited ability of interventions to demonstrate positive outcomes. Alternatively, teachers may make changes to the original program design or implementation schedule that leads to better results than anticipated. Either way, researchers must give attention to factors that might mediate or moderate MI. A review of 25 PA intervention studies and 45 PA correlational studies suggested that a clear understanding of how these factors function in program implementation will allow interventionists to tailor program design and teacher training for maximum effectiveness and sustainability (71,72). Similarly, this information will allow teacher educators to target key variables that can be manipulated to increase the chances of pre-service or inservice teachers' integrating movement in their classrooms.

Studies highlight a range of factors associated with classroom teachers' MI. Teachers from 10 elementary schools who were randomly assigned to one of three conditions of school-based intervention (i.e. Usual Practice, Liaison or Champion) in Canada felt the extent that they integrated movement was based on preparation time for MI, access to resources, the design/flexibility of MI activities, whether there was an obligation to implement movement, whether they had permission to implement movement, the support of the school environment, and the response of their students (73). Vazou and Skrade (74) found through interviews and focus group discussions with 15 teachers who implemented Move for Thought reported that with more years of teaching experience, they had higher perceived competence and willingness to use Move for Thought activities, whereas teachers who were new to the profession felt that they had to focus exclusively on the requirements related to the academic content. In an intervention in the UK, eight elementary teachers were asked to implement Take 10! Activities 3–4 times a week reported through qualitative interviews that they only used the activities an average of 1.5 times per week due to time constraints within the school day to accomplish other responsibilities, such as covering curriculum content, administering assessments, performing assigned extracurricular duties and accommodating special events/functions (e.g. school trips) (75). The teachers also felt that some academic content is better learned sitting down rather than through PA and that the classroom environment generally did not provide enough space to integrate PA. Cothran, Kulinna and Garn (76) also found that teachers ($n = 23$) who were involved in a curricular project where they integrated PA into the school day reported through qualitative interviews that they perceived barriers to MI, which were mainly related to time constraints (e.g. scheduling, academic testing). Nonetheless, the teachers felt more inclined to implement MI when they were committed to positively influencing all aspects of their students' development and had personal histories that included positive experiences in PA. With respect to PA breaks, a recent study found that 12 elementary and high school teachers reported through qualitative interviews and reflective journals that they preferred breaks that connected with academic content and were of short duration, easy to manage and enjoyable for students (77). External support from facilitators may enhance teachers' MI, as shown in a three-year experimental study with 30 middle schools in Texas (78).

Other studies have investigated classroom teachers' MI using several theoretical perspectives, which help to organize influential factors into frameworks for further investigation and explanation of the processes that support or hinder MI. Social learning perspectives were drawn upon in several investigations (26,79–83). Social learning perspectives emphasize the role of the social environment and life experiences (e.g. pre-professional and professional biography), in socializing teachers and shaping their classroom behaviours (84–88). At the pre-service level, a descriptive study with elementary and early childhood education majors ($n = 247$) found that perceived competence for classroom/recess-based PA promotion was significantly higher for majors who reported having experience teaching/coaching in PA settings than for

majors who reported not having such experience (81). In the same study, perceived competence for, and attitude towards, school-based PA promotion were both significantly and positively correlated with how satisfied the participants were with their personal K-12 physical education experiences.

At the inservice level, a correlational study using structural equation modelling found that classroom teachers' ($n = 213$) satisfaction with personal K-12 physical education directly supported the development of these teachers' self-schemas related to PA, which in turn promoted, in sequence, self-reported PA engagement, perceived MI competence and self-reported MI (83). In another correlational study, classroom teachers ($n = 314$) reported that their willingness to integrate movement was positively and significantly correlated with their individual and collective efficacy beliefs (80). Individual efficacy (i.e. beliefs about one's own ability to have a positive influence on students through MI) was primarily rooted in the teachers' mastery experiences related to MI (e.g. past success with MI). Collective efficacy (i.e. beliefs about the ability of a whole group of classroom teachers' to have a positive influence on students through MI) was based on the teachers' perceptions of a supportive school environment (e.g. enthusiasm and encouragement from colleagues and administrators). A review study by Bartholomew and Jowers (26)and an experimental study with 24 schools (14 interventions and 10 controls) by Gibson *et al*. (79) also highlight the role of teacher efficacy in MI.

Another theoretical perspective that has been used to examine MI with both pre-service and inservice classroom teachers is social ecology theory. Social ecological models situate human behaviour amid multiple levels of influence (89,90). With such models, the most proximal and direct level of influence on a person's behaviour is the intrapersonal level, which includes factors such as the person's own beliefs and attitudes. Each subsequent level then becomes increasingly distal and is theorized to indirectly affect the behaviour. In the school-based health behaviour literature (91,92), levels above the intrapersonal level typically include the interpersonal, organizational, community and policy levels. A qualitative study using interviews with 10 pre-service classroom teachers indicated that they were mostly concerned with possible organizational-level barriers to MI, including lack of time, pressure from academic testing, limited space, issues with classroom management, and attitudes of other classroom teachers and administrators (93).

Social ecology framed research with inservice classroom teachers reinforces the importance of organizational factors related to MI, but also demonstrates key factors at other levels of influence (91,94). Studies showed that the school environment mediates the influence of higher level policies related to MI. Langille and Rodgers (91), through qualitative interviews with 14 participants (government, public school board, principal and teachers), found that school culture, defined in part by the level of academic pressure and perceived time constraints, filtered classroom teachers' receptiveness to policy-determined priorities and changes related to MI. Webster *et al*. (94) examined classroom teachers' ($n = 201$) adoption of MI from both a social ecological and an innovation diffusion perspective through questionnaires (95). Based on structural equation modelling, teachers' awareness of state policy worked through their perceived school support to influence perceived attributes of MI, domain-specific innovativeness and self-reported use of MI strategies. The teachers viewed the school environment (e.g. classroom space, materials/resources, administrators) as supportive of MI, the more they perceived MI as an innovation with favourable attributes and were willing to explore and adopt new educational ideas/practices. Ultimately, the more teachers perceived MI to be compatible with their current educational philosophy/skills, to produce observable benefits, and to be easy to implement, and the more innovative they felt as innovators, the more they reported using MI strategies in their classrooms.

An emerging line of research explores factors that might facilitate or undermine MI from a self-determination theory perspective (96). According to self-determination theory (97), autonomously motivated behaviour (i.e. doing something because it is inherently interesting, enjoyable or highly valued) is more enduring than behaviour that is controlled by external pressures and rewards. Investigating classroom teachers' motivation from this perspective can make a significant contribution to the developing knowledge outlining the factors that lead to successful implementation and sustainability of MI. If teachers are not autonomously motivated to integrate movement, then the chances that they will integrate movement may decrease. Vazou and Vlachopoulos (96) found in a preliminary study using the Situational Motivation Scale that classroom teachers ($n = 230$) reported being highly autonomously motivated to promote 1-min activity breaks.

Translating research to practice

The existing research on MI carries implications for professional practice at the pre-service and inservice levels. Carefully designed pre-service preparation experiences may lead to adaptive changes in pre-service classroom teachers' beliefs and perceptions related to MI. Specifically, college coursework infusing opportunities to practise MI and addressing negative personal experiences and perceptions related to PA appeared to have a positive influence on pre-service classroom teachers' self-awareness concerning

personal PA behaviours (93), perceived competence (98), efficacy beliefs, perceived barriers and willingness to integrate MI (82). In line with these findings, Hall, Little and Heidorn (99) suggest that pre-service preparation should include experiences that assist aspiring classroom teachers in identifying personal benefits of a physically active lifestyle and encouraging them to pursue activities they enjoy. Increasing pre-service classroom teachers' self-awareness of personal health behaviours and empowering them to make changes towards healthy lifestyles may consequently increase their beliefs as agents of change in the health and well-being of their students as they enter the education profession (93).

Building pre-service classroom teachers' competency in implementing MI may be particularly important to future successful implementation of MI. Pre-service preparation should include hands-on experiences for education majors to practise implementing MI in a peer-teaching setting in the university context (93) and possibly in a real classroom setting with actual students in the school context. Allaying pre-service classroom teachers' concerns about possible organizational barriers to MI (e.g. time constraints tied to academic testing) should also be a key focus of course discussions and assignments (82,93). Given that concerns of pre-service classroom teachers in implementing MI are echoed in research with inservice teachers (79,80,100), external support structures (e.g. peer-based social learning networks, online communities of practice, school–university partnerships) may be helpful when implementing school-based initiatives (78). Furthermore, with continued emphasis on standardized testing and increased demands for classroom teachers to improve students' academic standards, it may be challenging for teachers to implement PA interventions that do not directly support academic instruction (26,91). MI that integrates with academic subjects provides an opportunity for teachers to maintain an academic focus and allow students to be physically active concurrently. If time is a concern, teachers may be more inclined to implement short bouts of MI that is about 1 min in length (96,101). Building on these short bouts of MI may motivate teachers to implement more and/or longer duration of MI in the future.

Considering the potential educational benefits of MI, such as improving students' on-task behaviours, academic learning capability and academic performance (26,37,66), it may be necessary to garner support for MI from broader spheres of influence, such as at the administrative level. Garnering support from a higher level in a school structure may consequently alleviate some of the organizational barriers in implementing MI (93). Informing and advocating for MI at the organizational, community and policy levels may provide support for curriculum alignment for inservice teachers to reduce time constraints (26,73,79) in implementing MI.

Advancing the knowledge base

As we move forward in this line of research, it is important to make accurate recommendations for classroom teachers to provide children with adequate amounts of PA during classroom time. Once recommendations can be established based upon sound research, position statements and/or technical reports need to be written to inform not only the public, but also professionals in education. These reports should serve to guide teacher education programs in effectively training educators to employ MI within their daily lessons and educating administrators that MI should be utilized as a teaching strategy (as opposed to something extra for teachers to do) during each school day.

A number of questions remain to continue the momentum for MI in schools:

1. How often, how long and in what ways do classroom teachers currently integrate movement and what can we learn from their strategies? Currently, there is a dearth of descriptive research on classroom teachers' MI, particularly in non-intervention contexts, in early childhood settings (e.g. preschools), at the secondary (middle and high) school level, and with children who have special educational needs. The assumption has been that MI rarely occurs in academic classrooms, but little is actually known about the extent or nature of classroom teachers' PA promotion. Identifying and cataloguing examples of how teachers integrate movement in various classroom environments and school settings could provide new perspective on MI strategies that are ideally suited for different classroom situations and contexts. Observational research will play a particularly valuable role in this enterprise, given that studies providing accounts of MI have tended to rely on teachers' self-reports.

2. What characterizes classroom contexts where MI occurs the most frequently? The available evidence identifies numerous teacher characteristics (e.g. satisfaction with personal K-12 physical education experiences, education/training related to MI, domain-specific innovativeness) and classroom-/school-level characteristics (e.g. classroom space, availability/accessibility of resources, a supportive school administration) that facilitate MI. Further research is needed to test the generalizability of these initial findings and to determine which characteristics must be present for MI to occur in most classrooms, and which characteristics are uniquely important to only certain types of classrooms.

3. Are there ways to increase MI among teachers who do not integrate movement or do so minimally? Research from multiple theoretical perspectives (i.e. social learning theory, social ecology theory, diffusion of innovation theory, self-determination theory) has begun to identify potentially influential variables in classroom teachers' MI. School-based interventions need to incorporate the findings from

theoretical studies into the design of MI approaches and teacher training to implement these approaches (71,72). Based on existing evidence, it does not appear that policies beyond the level of the school have had a strong influence on teachers' MI. Variables within the school (e.g. administrative support, teachers' self-efficacy) and the MI approach itself (e.g. how flexible it is in regard to the teachers' classroom routines, teaching skills and existing lessons) may need to receive the most attention in efforts to maximize all teachers' MI when there is a lack of accountability for meeting policy benchmarks. Training specific to MI seems to promote MI for both pre-service and inservice classroom teachers. However, the long-term effects of such training are relatively unknown. Future research needs to address the sustainability of training outcomes as they pertain to teachers' continued implementation of MI.

4. Relative to different MI approaches, should different results be expected when integrating PA into academic lessons versus providing PA breaks between academic lessons/during transitions, or when using/adapting pre-packaged programs versus creating new activities? In a recent study, the effects of academic-infused activities in the Move for Thought program, activity breaks and traditional instruction (no PA) were compared in a sample of 560 fourth and fifth grade students (102). At the end of the 8-week intervention, the group using the Move for Thought kit (PA integrated into academic lessons) showed greater improvement on math performance than students exposed to only activity breaks or the control group. Continued research is needed to expand on these results and compare the feasibility, effectiveness, scalability and sustainability of different MI approaches. In addition, the number of Internet-based videos and websites devoted to MI is rapidly increasing, and investigation into the role of these online resources in successful implementation of MI is warranted. Increased research on the effects of different MI approaches in special education, early childhood and secondary school classrooms is needed, as well. For instance, the results of a survey study indicate that activity breaks may positively influence middle school students' weight (103), while PA integrated with science lessons may benefit middle school students subject knowledge and skills (104).

5. What should be the goals of MI? While MI is tied to numerous benefits related to both health and education, its desired outcomes are not clear. No benchmarks have been set for classroom-based PA, making it difficult to differentiate successful from unsuccessful MI from a policy perspective. Realistic expectations for MI must be established, based on research investigating issues related to feasibility of implementation (e.g. teacher preferences, sustainable resources for supporting MI), dose–response relationships (i.e. different educational/health benefits resulting from different amounts or types of MI) and sustainability of implementation. In addition, current recommendations for MI do not reflect the diverse needs of different students. For example, emerging evidence (41,49) shows that the cognitive benefits of MI are stronger for overweight children, who also perform significantly worse (in time-on-task and executive function, respectively) after a period of sitting. Other research shows that MI especially benefits students who are the most off-task (105) and who are the lowest academic achievers (106). Finally, research is needed to examine the potential contribution of classroom MI to physical education curriculum outcomes, and to determine whether MI should be viewed as an extension of physical education instruction. Until now, the focus of MI research has centred on health- and academic-related outcomes to the exclusion of several important instructional goals in physical education, such as improved motor competence and positive dispositions towards PA. Research on MI should ultimately yield specific guidelines for teachers, including the proportion of classroom time that should include PA, the types of students who should receive the most PA opportunities and the optimum durations (e.g. length of activity breaks), frequencies of implementation (e.g. once per day vs. multiple times per day), times of day (e.g. whether to schedule PA immediately prior to academic testing), approaches (e.g. pre-packaged vs. teacher-designed), and types or MI activities (e.g. different levels of intensity, academic- or non-academic-related and/or aligned with the physical education curriculum) that should be used to reach established goals.

Conclusion

The compulsory nature of formal education for children and adolescents makes schools ideally positioned to extend the reach of public health-driven innovations to virtually all youth. Based on the existing research, it can be concluded that elementary classrooms hold promise as an innovative platform for early intervention to maximize children's daily PA. However, efforts to increase MI should be sensitive to the dynamic conditions that characterize classroom contexts, and the demands placed on classroom teachers. Research building on the existing knowledge base to develop and demonstrate sustainable MI approaches must be prioritized. While mounting evidence suggests numerous MI approaches can generate positive results in the short term, there is as yet little assurance that such approaches will ultimately find balanced footing in the day-to-day exigencies of classroom teaching. Sustainable strategies must be identified and pursued to secure the successful assimilation of MI into routine practices, the attainment of a new stasis in classroom life, and a guarantee that student health receives the attention it deserves throughout each and every school day.

Conflict of interest statement

No conflict of interest was declared.

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