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Findings from the EASY Minds cluster randomized controlled trial: evaluation of a physical activity integration program for mathematics in primary schools

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Abstract

Background: To evaluate the impact of a primary school-based physical activity integration program delivered by teachers on objectively measured physical activity and key educational outcomes. **Methods:** Ten classes from eight Australian public schools were randomly allocated to treatment conditions. Teachers from the intervention group were taught to embed movement-based learning in their students' (n=142) daily mathematics program in three lessons per week for 6-weeks. The control group (n=98) continued their regular mathematics program. Primary outcome was accelerometer-determined physical activity (PA) across the school day. Linear mixed models were used to analyze treatment effects. **Results:** Significant intervention effects were found for PA across the school day (adjusted mean difference 103 CPM, 95% CI 36.5 to 169.7, $p = 0.008$). Intervention effects were also found for PA (168 CPM, 95% CI 90.1 to 247.4, $p=0.008$) and MVPA (2.6%, 95% CI 0.9 to 4.4, $p=.009$) in mathematics lessons, sedentary time across the school day (-3.5%, 95% CI -7.0 to -0.13, $p=0.044$) and during mathematics (-8.2%, CI -13.0 to -2.0, $p=0.010$) and on-task behavior (13.8%, 95% CI 4.0 to 23.6, $p = 0.011$) - but not for mathematics performance or attitude. **Conclusion:** Integrating movement across the primary mathematics syllabus is feasible and efficacious

Key Words: on task behavior; accelerometry; teachers

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Trial Registration No: Australian and New Zealand Clinical Trials Register
ACTRN12613000637741

Introduction

Participation in physical activity by children is associated with a range of physiological and psychological benefits¹ and it is recommended that children participate in at least 60 minutes of moderate-to-vigorous physical activity (MVPA) each day². In addition, there is an increasing body of literature demonstrating a positive association between physical activity and academic performance^{3,4}. Physical activity is important for cognitive and brain health, particularly in childhood⁵. Participation in physical activity leads to a number of physiological effects on the brain including enhanced levels of neural connections and heightened arousal, which is key to cognitive development⁶. Worldwide many children are not sufficiently active to accrue the associated health benefits⁷.

While schools represent an ideal opportunity to provide young people with physical activity opportunities, the crowded curriculum, lack of teacher confidence and expertise, and restrictive school policies have impacted on both the quality and quantity of physical activity opportunities within elementary schools^{8,9}. The Centres for Disease Control and Prevention (CDC) have identified a number of key strategies to promote physical activity in their Comprehensive School Physical Activity Program¹⁰. Opportunities include recommendation's to increase avenues to promote physical activity in schools through Physical Education lessons, active transportation initiatives, maximising opportunities at recess and lunch, after school clubs, taking physically active breaks in the classroom and integrating physical activity in classroom-based lessons.

Integrating physical activity within the existing curriculum is a potentially time and cost effective strategy that is currently under researched¹¹. Most of the existing physical activity integration studies have promoted active breaks during class^{12,13}, while others have provided movement-based activities for teachers to deliver across the school curriculum to reinforce previously taught academic concepts¹⁴⁻¹⁶. Whilst promoting physical activity

breaks can be successful in increasing school time physical activity levels, this approach may in fact intensify the already crowded curriculum by placing further pressure on academic instruction time. The curriculum-based studies, whilst successful in increasing physical activity levels, have provided teachers with pre-prepared resources to deliver and teachers have not necessarily been directly involved in the planning and ownership of the activities or received appropriate professional development.

Previous school-based physical activity interventions have highlighted the importance of the participating teachers on intervention outcomes¹⁷ and professional development has been identified as a critical factor in improving the effects of such studies^{18,19}. Without direct teacher involvement and deeper engagement with intervention components, the sustainability of such programs becomes questionable beyond the study period. Indeed, a recent systematic review highlighted the need for teachers to act as ‘agents of change’ and to be involved in the design and delivery of subsequent programs¹¹. More research on the effect of classroom-based physical activity interventions on both physical activity and learning and health outcomes is warranted as physical activity integration can potentially be an inexpensive and effective intervention for improving both learning and health outcomes for all learners^{11,20}.

Previous curriculum based physical activity integration interventions have generally had a positive effect on educational and health outcomes³. However, these have been characterised by a number of methodological limitations. For example, the majority of previous studies have used self-report measures or pedometers, that do not provide an accurate assessment of time spent in sedentary, light, moderate and vigorous physical activity^{21,22}. This is a notable omission because activity of different intensities may have unique health and academic benefits. Only one previous study has attempted to embed physical activity solely across mathematics in the primary school²³. However, this trial did not have a

control group. To our knowledge, no previous RCT has examined the effect of physically active integrated lessons solely in mathematics or reported on physical activity levels in mathematics or other key academic outcomes. The integration of PA into other subjects may also enhance connectedness by providing real life application of academic concepts to enable students to view learning as significant and meaningful ²⁴. For example, in mathematics, using real stimuli such as stopwatches, tape measures, and trundle wheels to gather data provides a real life context and interactive teaching methods that promote movement, which are associated with greater learning ²⁴.

Whilst integration of physical activity across the curriculum is acknowledged as a key avenue for increasing school-based physical activity levels, this approach relies upon teachers being successfully recruited to deliver such programs. The single biggest barrier to physical activity promotion are teachers’ attitudes, beliefs and perceptions of physical activity ⁹. It is therefore necessary that to promote physical activity, researchers must develop programs that compliment teachers’ values and beliefs about teaching and therefore physical activity is not seen as “something else to squeeze in” ^{17,25}.

The EASY Minds (Encouraging Activity to Stimulate Young Minds) cluster RCT was informed by a pilot study, in which significant intervention effects were found for MVPA and reduced sedentary time during mathematics lessons and across the whole school day ²⁶. Furthermore, children displayed significantly greater ‘on-task’ behavior across the mathematics instruction period. However, this pilot study was carried out in a single school and all sessions were planned and delivered by a member of the research team. Therefore the primary aim of this study was to evaluate the effects of the EASY Minds programs in a cluster randomized controlled trial when planned and delivered by trained classroom teachers.

Methods

Study design

The design, implementation and reporting of the EASY Minds study conforms to the Consolidated Standards of Reporting Trials (CONSORT) guidelines for clustered randomized controlled trials²⁷ and the study methods are reported in detail elsewhere²⁸. Ethics approval was sought and obtained from the University of Newcastle, New South Wales (NSW), Australia and the NSW Department for Education and Communities (SERAP: 2013011). The EASY Minds trial is registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12613000637741). Twenty schools were randomly selected from a list of government schools located within a 20 km radius of the University of Newcastle. The first eight schools to provide written informed consent from the school Principal participated in the study. Schools were then matched on size and demographics using the participating schools' Index of Community Socio-Educational Advantage (ISCEA)²⁹ and then randomized using a simple computer algorithm by an independent researcher, into the treatment or control groups following baseline assessments. Baseline assessments were conducted in March/April 2013. Post intervention assessments were carried out in July 2013. All assessments were conducted by trained research assistants who were blinded to treatment conditions at baseline only.

Power calculation

Power calculations were conducted to determine the sample size required to detect changes in the in the primary outcome of accelerometer-determined physical activity counts per minute (CPM)³⁰. Accelerometer-determined activity counts per minute were selected as the primary outcome because the intervention was focused on increasing children's total physical activity throughout the school day, regardless of intensity. Calculations assumed

baseline-posttest correlation scores of $r = 0.30$ and were based on 80% power, with alpha levels set at $p < 0.05$. Using the standard deviation (SD) of change observed in the EASY Minds pilot study ($SD = 200$ CPM)²⁶ and an intra-class correlation coefficient ($ICC = 0.15$), it was calculated that a study sample of $N = 200$, with eight clusters (i.e., schools) of 25 students would provide adequate power to detect a between group difference of 200 CPM across the school day.

Intervention

Briefly, the program involved classroom teachers adapting mathematics lessons over a 6-week (3 x 60 min sessions per week) period to ensure students were involved in movement-based learning. All lesson content was generated from the NSW Mathematics syllabus³¹. The EASY Minds program involved a one day teacher professional learning day, the provision of equipment and resources (stopwatches, tape measures, balls, markers etc.) and example activities²⁸ to encourage teacher-initiated adaptation of mathematics lessons to incorporate movement and email support for teachers during program implementation. The workshop included a rationale for PA integration, presentation of results from the feasibility trial, practical examples of PA integration and a peer supported planning session.

All sessions of the professional learning day were delivered by the research team and the session was accredited with the NSW Institute of Teachers. A diffusion of innovations model was used for the professional learning. This model acknowledges that teachers are more likely to adopt a new innovation if they view it as relative to current practice, simple to understand, introduced gradually, and likely to produce observable results.

A key principle of the EASY Minds program is the alignment of the program with the NSW Quality Teaching Framework. The NSW quality teaching framework encourages teachers to develop innovative skills that promote high levels of intellectual quality, establish

a quality learning environment and generates significance by making learning meaningful and purposeful²⁴. Classroom teachers were responsible for the planning and the delivery of all movement-based lessons during the intervention. The control schools participated in their usual mathematics program delivered by their regular classroom teacher. Both groups continued to teach mathematics in their usual timetable slot for 60 minutes per day. The control group received the study resources after all assessments were completed in July 2013.

Primary outcome

The primary outcome of the EASY Minds program was CPM across the school day, assessed using GT3X Actigraph accelerometers (LLC, Fort Walton Beach, FL). Actigraph accelerometers were used as to provide a reliable and valid measure³² of physical activity and Evenson cut points were used to classify activity intensity^{33,34}. In a validation study comparing five common accelerometer cut-points, the Evenson cut-points were found to be the most accurate at all intensities of physical activity in a sample of 206 children and adolescents³⁴. Participants' physical activity was only included for analysis if they wore the accelerometer for at least five school hours on any given day. Similarly, students were only included in the analysis if they wore the accelerometer for 50 minutes of the 60 minute mathematics lessons. All participating schools were asked to teach mathematics lessons as per their programmed timetable and notify the research team of any changes in delivery. Classroom teachers were responsible for distributing and collecting accelerometers on a daily basis.

Secondary outcomes

Secondary outcomes included CPM across the mathematics lessons, time spent in MVPA (minutes and percentage) and sedentary time across both mathematics lesson and school day, and a range of academic measures. Time spent 'on-task' during the mathematics

lesson was observed via momentary time sampling³⁵ reported as a percentage of time. Six students per class group of either sex were selected and observed in 15 second intervals on a rotational basis over a 30 minute period in the allocated mathematics time slot. A cross-section of students with varying mathematical ability were selected by the classroom teacher from those working above, those working at, and those working below the class average, as determined by existing teacher assessments. On-task behavior included behavior that could be categorised as being ‘actively engaged’ or ‘passively engaged’. Actively engaged refers to a child being actively engaged in academic responding, e.g. reading, writing, performing a set task. Passively engaged was categorised as behavior where the child is listening to the teacher or a fellow student but is not actively participating in a set task. Off-task behavior included behavior that can be described as being either: ‘off-task motor’ where a child moves in a manner not associated with the task, for example walking around the class; ‘off-task verbal’ includes non-work related talking or ‘off-task passive’ where a child is disengaged but passive, including staring into space. Additionally students’ attitudes to mathematics, measured via two separate subscales of confidence (n=12) and perceived usefulness (n=12)^{36,37} and mathematics performance were measured using a standardised mathematics progressive achievement test³⁸. All demographic information (i.e., age, sex, language spoken at home, country of birth) was collected via a student questionnaire at baseline.

Process evaluation

Following the professional learning day teachers were asked to complete a nine item workshop evaluation questionnaire which assessed teachers’ perceptions of the skills and ideas gained from the training, their satisfaction with the quality of the teacher training and their confidence to plan and deliver movement-based mathematics lessons across the study

period. A 5-point Likert scale was used with responses ranging from ‘*strongly disagree*’ = 1 to ‘*strongly agree*’ = 5.

Throughout the intervention period, teachers were asked to complete an activity evaluation log after each session and reflect on their lesson and rate their lesson using a 5-point Likert scale. The teachers all received a weekly email presenting tips and strategies from the research team and a fortnightly fidelity check via observation during weeks one, three and five of the intervention. During this observation, a five minute informal discussion took place where teacher and researcher discussed a 3 scale self-evaluation/ activity log. These were 1) mathematical concepts (n=3), e.g.; the key mathematical concepts reinforced throughout the movement based activity, 2) activity levels (n =3) e.g. transitions were manage smoothly and 3) engagement (n=3) e.g. students were engaged by the activities taught²⁸. Following the program, evaluation questionnaires were administered to determine students’ satisfaction with the program, for example, “*I liked being physically active in Maths outside the classroom*” and mathematical outcomes, “*My involvement in the program has increased my knowledge in maths*” using a five point Likert scale with responses ranging from ‘*strongly disagree*’ = 1 to ‘*strongly agree*’ = 5.

Statistical methods

Statistical analysis of the primary and secondary outcomes was conducted using linear mixed models in SPSS statistics version 20 (2011 SPSS Inc., IBM Corp Armonk, NY) and alpha levels were set at $p < 0.05$. The models were used to assess the impact of treatment (EASY Minds or control), time (baseline and post-test) and the group-by-time interaction. The models were specified to adjust for the clustered nature of the data (i.e., class was included as a random intercept in the models) and included all randomized participants in the analysis. Mixed models are robust to the biases of missing data and provide appropriate

balance of Type 1 and Type 2 errors³⁹. Mixed model analyses are consistent with the intention-to-treat principle, assuming the data are missing at random⁴⁰. Sex and weight status were included as covariates in the models. The data was screened for skewness and normality and six CPM outliers were retracted prior to analyses.

Results

The flow of participants through the trial is reported in Figure 1. From the 20 schools that were targeted, eight were recruited via an initial letter to the Principal and a follow-up email to the school. EASY Minds successfully recruited 240 participants from Stage 3 (Grade 5 and 6) (mean age $11.13 \pm .73$, 59.1% male). Participants were assessed at baseline in April 2013 and post-test in July 2013. Table 1 displays baseline demographic information.

Following all baseline assessments schools and their students were randomized into control (n=98, 4 schools, 6 classes, 6 teachers) and intervention (n=142, 4 schools, 4 classes, 4 teachers) groups. Two of the intervention schools had double classes of Grade 5/6 students that worked together. Therefore both classes were included in the program.

Changes in primary outcome

All baseline and post-test outcomes are presented in Table 2. Significant intervention effects were found for CPM across the school day (adjusted mean difference = 103 CPM to 95% CI 36.5 to 169.7, $p=0.008$)

Changes in secondary outcomes

Significant intervention effects were found for CPM during mathematics lessons (168 CPM, 95% CI 90.1 to 247.4, $p=0.008$), MVPA during mathematics (2.6 %, 95% CI 0.9 to 4.4, $p=0.009$) and sedentary time was also significantly reduced in the intervention group across the whole school day (-3.5%, 95% CI -7.0 to -0.1, $p=0.044$) and during mathematics (-8.2%, 95% CI -13.0 to -2.0, $p=0.010$). Significant intervention effects were also found for

‘on-task’ behavior (13.8%, 95% CI 4.07 to 23.6, $p=0.011$). There were no significant group-by time effects for mathematical attitude or performance across the study period.

Process evaluation

All teachers reported that they delivered the recommended three sessions per week of movement-based learning. A total of 18 fidelity checks were carried out over the evaluation period and teachers responded well to researcher feedback with mean scores for promoting mathematical concepts rising from 3.3 to 4.4, activity levels 3.4 to 4.1 and engagement 3.7 to 4.3. Teachers also reported that they were also now integrating physical activity in other curriculum areas. For example, in mathematics students would recall multiplication tables whilst skipping, throwing and catching a ball or running through drill ladders. This was easily adapted to learning weekly spelling words in English. Teacher evaluation of the professional learning day was very positive with mean scores of 5.0 for all nine items on the survey. Teachers added additional written feedback commenting on the high level of engagement, real life practical participation and realistic expectations of the study. Mean scores from the student evaluation survey ranged from 3.4 to 4.7 out of 5 (1= strongly disagree to 5 strongly agree), indicating high to very high overall satisfaction rates for the EASY Minds program (See Table 4). For example students clearly enjoyed the program (4.46, SD .61), believed that being active made mathematics more enjoyable (4.60, SD .72) and really enjoyed working outside of the classroom (4.66, SD.62).

Discussion

The primary aim of this study was to evaluate the impact of a novel movement-based intervention within the primary school mathematics curriculum. Intervention effects were found for overall physical activity across the whole school day and mathematics lessons.

Intervention effects were also found for sedentary time (school day and mathematics lessons) and on-task behavior.

The increase in CPM across the whole school day is also consistent with other physical activity interventions that have reported increases in CPM in the primary school⁴¹ and those that have embedded physical activity across the curriculum^{15,16}. Of note, previous studies have used a sub-sample of participants, due to limitations in the number of available accelerometers and not the full study cohort. Our study provides a unique contribution to the literature. It provides objective measures of PA across both the whole school day and also during primary school mathematics lessons. Previous studies have highlighted that teachers are critical to the success of school-based interventions^{16,19,42}. In our study, teachers were given autonomy to embed movement-based learning activities in their mathematics lessons using the professional learning development workshop as a stimulus, as opposed to other interventions where pre-prepared materials have been provided. This teacher ownership, high level of engagement and subsequent teacher reflection on their involvement has the potential to contribute to program sustainability and may explain our positive findings. Professional learning was therefore fundamental in classroom teachers adopting the initiative. As in other successful studies^{43,44}, a diffusion of innovations model was used⁴⁵. The EASY Minds intervention significantly reduced sedentary behavior. Primary school students spend a large portion of their school day in the classroom with their teacher, and it is generally believed this time should be tapped as a resource for promoting and increasing physical activity⁴⁶. Notably, a recent study found that children spend the majority of their time in school in an academic classroom setting yet this contributes less than 5% of a student's daily physical activity⁴⁷. At baseline, students in the eight study schools spent 66.4% of their time in sedentary behavior across the whole school day including recess and lunch. During mathematics lessons 76.5% of the time was spent being sedentary. Therefore, children's

mathematics lessons represent a particularly sedentary period of the day. The evidence on the health and developmental effects of reducing sedentary behavior in children is currently inconsistent, but changes in sedentary behavior and a corresponding increase in light physical activity might contribute to increased energy expenditure ⁴⁸, metabolic health ⁴⁹, and cognitive functioning ⁵⁰. Our process evaluation revealed that teachers had already started to embed physical activity across other curriculum areas whilst continuing this approach in mathematics.

The potential advantages of the curriculum approach to physical activity promotion may well lie in the additional academic benefits that may ensue. Similar to other physical activity classroom-based interventions ^{12,21}, there was a significant increase in on-task behavior observed. In previous studies, this on-task behavior was recorded following the physical activity as opposed to during the activity in this study. In our study, the observation was carried out during mathematics lessons only. EASY Minds demonstrated a significant improvement in ‘on task’ behavior and thus movement-based learning may potentially result in increased time on task. Furthermore, these reductions in sitting time may partly explain why students were more on task during class time as previous studies have demonstrated the importance of activity breaks in increasing students on task behavior ¹². Whilst little is known about students’ perceptions of sitting for prolonged periods throughout the school day, a recent primary school physical activity intervention on sedentary time has observed a significant intervention effect on child-reported enjoyment of standing in the classroom during the school day ⁵¹.

It is important to highlight that this time on task is time spent engaged in academic learning not simply time spent “behaving”. On task behavior has been shown to be a key predictor of academic success ¹⁶. We are unable to determine if improvements in students’ on task behavior was a result of increased physical activity or the innovative approach to

learning⁵². For example, the integration of physical activity into other subjects may actually enhance connectedness for students by providing real life applications of academic concepts to enable students to view learning as significant and meaningful²⁴. Whilst our results are promising, and in the hypothesized direction for measures of mathematical attitude (6.1, CI - 4.2 to 16.5, $p=.212$), our analysis did not show a statistically significant effect for mathematic performance (-.91, CI -3.9 to 2.1, $p=.509$). It is worth noting here that the increase in physical activity and lesson time spent outside in mathematics and the change in delivery did not have a detrimental effect on academic performance. It is widely accepted that students are developing lifelong attitudes towards mathematics in Grade 6 (ages 12-13)⁵³. Fortunately, students’ attitudes towards mathematics are not fixed⁵⁴ and therefore innovative interventions, such as the EASY Minds program have the potential to positively influence students’ attitudes and subsequently lead to increased enjoyment of mathematics, which may be a key strategy for addressing student disengagement⁵⁵. Of note, a standardized instrument was used to assess the impact of the intervention on mathematics and as such, its content was not specifically matched to the content that was addressed over the 6-week study period. Student and teacher evaluations indicated enjoyment of the lessons and suggested that being physically active led to greater enjoyment in mathematics lessons. This could be crucial in a subject area such as mathematics as the development of negative attitudes has long been a concern in mathematics education⁵⁶.

Based on students’ responses on the process evaluation questionnaire, it appears that they preferred working outside of the classroom (4.66, SD 0.62) as opposed to inside the classroom (3.43, SD 1.18). Teachers generally used the school playgrounds and adjoining school ovals to work mathematically. For example students estimated and measured the outdoor school netball court markings when learning about perimeter, area, circumference and diameter. This may have implications for program adoption, scalability, and

sustainability as evidence has already been gathered on teachers perceptions and barriers when working outside of the confines of the classroom⁵⁷. Therefore it is likely that a key part of future professional learning may well need to focus on up-skilling teachers in working outside the classroom. Furthermore, teachers are more likely to be persuaded to embed movement across the curriculum if evidence can be shared on how physical activity can enhance student engagement and/or at least not detract from academic performance¹⁷.

Study strengths and limitations

Strengths of the current study include the cluster RCT design and the use of accelerometers to provide an objective measure of physical activity. As accelerometers were distributed each morning and collected in the afternoon, compliance with accelerometer protocol was high and no accelerometers were lost at any of the time-points. Evaluative data collected from students involved in the program is novel as to the authors' knowledge; no other curriculum-based physical activity intervention has sought to gather data on students' perceptions of integrating physical activity across the curriculum.

Despite these strengths; there are some limitations that should be noted. Firstly, our intervention was only delivered over a six week period and we did not collect follow-up data to determine if outcomes were maintained beyond the study period. Secondly, the teachers recruited for the study were committed to the program and were given support via email and fortnightly fidelity checks. We do not know what may have occurred without this support from the research team. Thirdly, whilst it is recommended that schools provide as many of the recommended 60 minutes of MVPA during school hours as possible, only a small increase in MVPA was noted in the actual mathematics lessons. It may well be that the promotion of MVPA in a subject such as mathematics is an unrealistic expectation as they are not PE lessons. Therefore, teachers in this study may or may not have planned activities that

promoted MVPA but rather they may have focussed on embedding movement-based learning across the curriculum without focussing on the intensity of the movement. At no point in the professional learning workshop was physical activity intensity discussed or highlighted.

Conclusion

The EASY Minds intervention has highlighted that integrating physical activity across the curriculum in a subject area like mathematics is a viable option for classroom teachers to increase the amount of physical activity undertaken at school while not sacrificing academic performance and increasing students’ on-task behavior. Teachers of primary school children should be encouraged to embed movement-based learning across the curriculum. EASY Minds offers a practical solution to the constraints to children’s school-based physical activity levels brought on by a crowded school curriculum. It may well be that future attempts to change school policy and practice in regard to physical activity intervention need to focus on the academic benefits of such an approach to change teachers attitudes and beliefs. Unfortunately, worldwide studies have identified a decline in mathematics achievement among middle school-aged children⁵⁵ and disengagement in mathematics is considered a factor in this decline⁵⁸. Therefore it is important to arrest this disengagement and look at innovative methods that challenge, but compliment traditional teacher approaches.

Conflicting Interest Statement

The authors declare that they have no conflicts of interest

Authors’ contributions

NR, DRL, KH and PM obtained funding for the research. All authors contributed to developing the protocols and reviewing, editing and approving the final version of the paper. NR is the guarantor and accepts full responsibility for the conduct of the study. All authors have read and approved the final manuscript.

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Figure 1: Flow of Participants through the Study

Table 1: Baseline characteristics of students randomized to the intervention and control groups

Demographic Characteristics	Control (<i>n</i> = 98)		Intervention (<i>n</i> = 142)			
	Mean	SD	Mean	SD	Mean	SD
Age (years)	11.1	.70	11.1	.76	11.1	.7
Height	150.8	6.9	149.9	7.9	150.3	7.5
Weight	44.3	10.1	44.4	11.6	44.4	11.0
	%		%			
English language spoken at home, n (%)	95.9		81.6		89.1	
Sex (male)%	60.2		58.4			

Table 2: Intervention effects of the EASY Minds program

Measure	Baseline Mean (95% CI)		6 week Mean (95% CI)		Adjusted difference in change (95%CI)	Time	Group*Time P value
	Control Group	Intervention Group	Control Group	Intervention Group			
CPM school day	505.2 (432.2,587.1)	529.19 (461.4,596.9)	499.84 (417.5,587.1)	627.0 (559.3,694.6)	103.1 (36.5,169.7)	.013	.008
CPM Math	258.7 (187.1,330.3)	284.4(225.0,343.8)	246.2 (174.2,318.2)	440.7 (381.4,500.0)	168.7 (90.1,247.4)	.004	.002
Percent MVPA day	7.6 (5.9,9.3)	8.1 (6.7,9.5)	7.1 (5.4-8.9)	9.3 (7.9-10.7)	1.7 (0.01,3.3)	.308	.052
Percent MVPA Math	2.9 (1.6,4.3)	3.4 (2.3,4.5)	2.9 (1.5-4.2)	6.0 (4.9-7.2)	2.6 (0.9,4.4)	.010	.009
Percent Sed day	67.3 (63.4,71.2)	65.7 (62.4,68.9)	67.8 (63.9-71.7)	62.6 (59.4-65.8)	-3.5 (-7.0,-0.13)	.134	.044
Percent Sed Math	78.1 (73.8,79.5)	75.4 (71.9,79.0)	78.3 (74.0- 82.6)	67.4 (63.8-71.0)	-.8.2 (-13, -2.0)	.013	.010
Percent light day	25.1 (22.0,28.3)	26.3 (23.7,28.9)	25.0 (21.9 , 28.2)	28.1(25.5,30.6)	1.8 (0.1,3.9)	.095	.065
Percent light Math	19.0 (15.2,22.8)	21.2 (18.0,24.3)	18.8 (15.0,22.7)	26.6 (23.4, 29.7)	5.5 (1.5,9.5)	.017	.013
Av min MVPA day	27.88 (20.8,34.9)	30.94 (25.1,36.7)	29.5 (22.5,36.6)	33.31(27.5,39.1)	0.6 (-11.5,12.9)	.467	.901
Av min MVPA Math	1.79 (0.9,2.6)	2.23 (1.5,2.9)	1.6 (0.8,2.5)	3.59 (2.8,4.2)	1.4(0.1,2.8)	.064	.034
On task behavior	79.9 (71.9,87.8)	78.0 (71.5984.4)	80.0 (72.5,88.3)	92.4 (86.6 ,98.8)	13.8 (4.0,23.6)	.008	.011
Math Performance	22.18 (15.4,28.9)	22.9(16.9,29.0)	24.5 (17.7, 31.2)	24.3 (18.3,30.4)	-.91 (-3.9,2.1)	.021	.509
Math Usefulness	47.61 (40.5)	48.9 (42.3,55.4)	48.85 (41.78,55.9)	52.6 (46.1,59.1)	2.51 (-3.5,8.5)	.094	.366
Math confidence	42.7 (35.2,50.2)	44.1 (36.9,51.3)	43.30 (35.8,50.8)	48.3 (41.1-55.5)	3.6(-0.8,8.0)	.040	.102

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Measure	Baseline Mean (95% CI)		6 week Mean (95% CI)		Adjusted difference in change (95%CI)	Time	Group*Time P value
	Control Group	Intervention Group	Control Group	Intervention Group			
Overall Attitude	90.4(76.9,103.9)	93.0 (80.3,105.8)	92.24 (78.7,105.7)	101.0 (88.3-113.7)	6.1 (-4.2,16.5)	.062	.212

Abbreviations: CI, confidence interval; CPM, counts per minute; MVPA, Moderate-vigorous physical activity; sed, sedentary, Av min, average minutes

Table 4: Participant Process Evaluation Questionnaire

Question	Mean	SD
I enjoyed the EASY Minds program	4.46	.61
Being active made Maths more enjoyable	4.60	.72
I liked being physically active in Maths outside the classroom	4.66	.62
I liked being physically active in Maths inside the classroom	3.43	1.18
I looked forward to EASY Minds lessons	4.34	.72
My teacher enjoyed the lessons	4.44	.79
I liked EASY Minds lessons more than Maths in the classroom	4.44	.93
After participating in E.A.S.Y. Minds I have more positive feelings about Maths	4.04	.85
After participating in an E.A.S.Y. Minds lesson I found it easier to concentrate in class	3.76	.93
My involvement in the program has increased my knowledge in maths	3.93	.91

Likert scores: 1=strongly disagree; 2=disagree; 3= neutral; 4= agree; 5= strongly agree;