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Evidence for the Efficacy of the Youth-Physical Activity towards Health (Y-PATH) Intervention

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The physical education environment is a key opportunity to intervene because of access to children and adolescents for the purpose of increasing physical activity participation and improving fundamental movement skill proficiency. A non-randomised controlled trial involving two schools in a rural Irish town was carried out in September 2011 to evaluate the Youth-Physical Activity Towards Health (Y-PATH) intervention. Data were collected on 12 to 14 year olds (n = 174) at 3 time points (pre, post and retention). Data collected included measured height and weight, physical activity measured by accelerometry and by self-report and fundamental movement skill performance. Both the control and intervention school showed significant increases in daily physical activity and gross motor skill proficiency over time. Two-way repeated measures ANOVA showed a significant interaction effect between school attended and time for physical activity ($F(2, 38) = 6.177$, $p = .005$) and fundamental movement skills ($F(2, 100) = 4.132$, $p = .019$), with a significantly greater increase in physical activity and fundamental movement skills observed in the intervention school. Preliminary findings from this study suggest a positive effect for the Y-PATH intervention and provide support for its potential in increasing physical activity and fundamental movement skill levels of adolescent youth. Further research involving a definitive randomised controlled trial with a larger sample size is warranted.

Keywords: Physical Education; Adolescent; Physical Activity; Fundamental Movement Skills; Intervention

Introduction

Physical activity (PA) is a complex, multifaceted behavior which can be performed in a variety of physical and social settings, and for many reasons (Ward, Saunders, & Pate, 2007). The meaning of PA has remained consistent among public health professionals in recent years and a standardized PA definition has become accepted as any bodily movement produced by the skeletal muscles expending energy beyond resting levels (Bouchard, Blair, & Haskell, 2007; Caspersen, Powell, & Christenson, 1985). Regular PA decreases numerous health risks for all age groups and is associated with a reduced risk of developing chronic disease such as coronary heart disease, type II diabetes, cancers and hypertension (Bouchard et al., 2007; Physical Activity Guidelines Advisory Committee, 2008). In the past, the development of these chronic diseases has been rare in children (Physical Activity Guidelines Advisory Committee, 2012) but a growing body of literature is now showing that the prevalence of these risk factors is increasing among adolescents (May, Kuklina, & Yoon, 2012; Woods, Tannehill, Quinlan, Moyna, & Walsh, 2010).

Whilst the knowledge about the tracking of PA is limited (Telama, 2009), some studies have shown that the engagement of children and adolescents in regular PA significantly predicts PA participation during adulthood (Telama et al., 2005; Wichstrøm, von Soest, & Kvalem, 2012). Despite the known importance of regular PA participation in the promotion of lifelong health and well-being (Physical Activity Guidelines Advisory Committee, 2012), current evidence suggests that the levels of PA participation among children remain low, particularly noting that the age related decline occurs dramatically during adolescence (Aibar, Bois, Generelo, Zaragoza Casterad, & Paillard, 2012; Grasten, Watt, Jaakkola, & Liukkonen, 2012; Kimm et al., 2000; O' Donovan et al., 2010). Irish research from the "Children's Sport Participation and Physical Activity Study" (CSPPA) found that only 12% of adolescents aged between 12 to 18 years old met the recommended 60 minutes per day PA guideline (Woods et al., 2010). Compared to Irish adolescents, recent research in the US (Eaton et al., 2012) found that a higher percentage of adolescents (29%) achieved this recommended guideline. The prevalence of PA among Irish adolescents is also very low when compared in a European context with 35.9% of adolescents in France and Spain reported to meet the 60 minute guideline (Aibar et al., 2012). Many interventions have been evaluated for their effectiveness in increasing the PA levels of adolescents (Haerens, De Bourdeaudhuij, Maes, Cardon, & Deforche, 2007; Kalaja, Jaakkola, Liukkonen, & Digelidis, 2012; McKenzie et al., 2004; Pate et al., 2005).

Recent research, underpinning the necessity of an active lifestyle, suggests that fundamental movement skills (FMS) are the building blocks for movement as they provide the foundation for the acquisition of more complex skills in the specialized sport specific movement stage (Gallahue & Ozmun, 2006; Hardy, King, Espinel, Cosgrove, & Bauman, 2010). Furthermore, the rationale for promoting the development of FMS in childhood relies on the recent findings from a systematic review (Lubans, Morgan, Cliff, Barnett, & Okely, 2010) of the current and future benefits associated with the acquisition of FMS in children and adolescents. This systematic review (Lubans et al., 2010) found a relationship between FMS competency and eight potential benefits, namely global self-concept, perceived physical competence, cardio-respiratory fitness (CRF), muscular fitness, weight status, flexibility, PA and reduced sedentary behavior. While in recent years, adolescent PA levels have shown some correlation with FMS proficiency (Barnett, Morgan, Van Beurden, Ball, & Lubans, 2011; Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009; Okely, Booth, & Patterson, 2001), further longitudinal research examining their relationship is recommended (Lubans et al., 2010).

Despite the associated physiological, psychological and behavioral outcomes for FMS proficiency and their positive impact on public health, it is apparent that a lot of children do not acquire these basic patterns of movement. There is now strong evidence that early adolescents have low levels of FMS proficiency (Booth et al., 1999; Hardy et al., 2010, 2013; Mitchell et al., 2013). A previously successful intervention among primary school children, "Move it Groove it" (Van Beurden et al., 2003), provided school aged youth with opportunities to incorporate PA into their daily life while simultaneously targeting FMS. Other school-based intervention studies, in more recent years have also shown positive effects for FMS provision during childhood (Lemos, Avigo, & Barela, 2012; Mitchell et al., 2013; Zask et al., 2012). Yet, there appears to be a dearth of FMS intervention research among adolescents, therefore, addressing both PA and FMS may be perceived as a practical intervention approach for the journey into sport and exercise skill development (Woods et al., 2010).

In terms of increasing active adolescent behavior, the school environment has the potential to make important differences to PA participation and presents a number of opportunities for intervention (Garn, McCaughtry, Shen, Martin, & Fahlman, 2013; Lavelle, Mackay, & Pell, 2012; Van Sluijs, McMinn, & Griffin, 2008; Vasques et al., 2013; Ward et al., 2007). A recent report by Sallis et al., (2012) highlighted that in the past two decades, evidence-based school curricula have shown significant differences in moderate to vigorous physical activity (MVPA) during and outside of school hours. The school environment presents many opportunities for targeting the adolescent directly with many studies suggesting the importance of targeting ecological domains beyond the individual (Kahn et al., 2002; Perry, Garside, Morones, & Hayman, 2012; Sallis et al., 2012). Effective school environments present opportunities to embody a culture of care, and to be fully inclusive of the individual regardless of the existing racial or socio economic background differences (Cavanagh, Macfarlane, Glynn, & Macfarlane, 2012). The development of evidence-based school programmes has seen the acceptance of Physical Education (PE) as an efficacious resource (Sallis et al., 2012).

As a viable change agent to increase PA in the school-aged population, PE is considered a very important provider of PA (McKenzie & Lounsbery, 2009; Payne & Morrow, 2009; Scheerder et al., 2008; Ward et al., 2007). PE also gives children and adolescent youth an opportunity to learn physical and behavioral movement skills (Haerens et al., 2007; Lemos et al., 2012; McKenzie & Lounsbery, 2009; Mitchell et al., 2013; Van Beurden et al., 2003). A recent meta-analysis of the effectiveness of motor skill interventions illustrates a significantly positive association between participation in school-based motor skill programmes and FMS proficiency (Logan, Robinson, Wilson, & Lucas, 2011). Recent intervention programmes such as "Move it Groove it" (MIGI) and "Project Energize" highlighted that both PA and FMS can be integrated during the provision of PE (Mitchell et al., 2013; Van Beurden et al., 2003).

The purpose of this paper was to evaluate the intervention effect after 9 months (end of academic school year) and 12 months (follow-up) of a tailored PA and FMS programme for an Irish adolescent cohort (12 - 14 years of age). The Y-PATH intervention is an innovative whole school approach to activity promotion among adolescents; there is a specific gap in the literature among adolescents as no previous study to this researcher's knowledge has examined the effect of a prescribed Health Related Activity (HRA) and FMS intervention on PA levels and its impact on public health. The study involved one intervention group who received the Youth-Physical Activity Towards Health (Y-PATH) intervention over the course of one school year, and one control group who received their usual PE programme for the same period. The main research question was to examine if the intervention group would demonstrate a significant increase in minutes of daily PA and levels of FMS proficiency over time when compared to the control group. Standard anthropometric characteristics (height and weight) were also measured over time between both groups to see if body mass index (BMI) was having any underlying effect on the intervention.

Methods

Participants and Recruitment

This quasi-experimental non-randomised controlled trial is part of the Y-PATH research programme which was initiated in September 2010 at Dublin City University (DCU). Following the Medical Research Council (MRC) guidelines (2000) for developing and evaluating a tailored intervention, this research represented Phase 2 on the continuum of increasing evidence; the exploratory trial. Non-randomised controlled trials can detect associations between the intervention and the outcome (Sibbald & Roland, 1998).

For this pilot study (2011-2012), a convenience sample of Irish adolescents enrolled in year one of post-primary education (12 - 14 years of age) from two mixed-gender schools were invited to take part in the study (N = 192). Both schools involved in this research study were from the same rural Irish town, had no school fee paying requirements (public), and were not listed as "Designated Disadvantaged" schools by the Department of Education and Skills. The school with the largest sample size (n = 132) was randomly selected to receive the intervention for one academic school (with the agreement that all intervention resources would be made available to the control school in October 2012, following the completion of data collection). Data collected included measured height and weight, PA measured by accelerometry and by self-report and FMS performance. Approval from each of the principals of the two participating schools was granted. Informed consent for participation was sought from each adolescent and their parent/

guardian. Ethical approval was obtained from the Dublin City University Research Ethics Committee.

The Y-PATH Intervention

There are four key components to the Y-PATH intervention 1) Student component: Specific focus on HRA and FMS content subsumed within the existing PE curriculum, delivered by specialist PE teachers. 2) Parent/Guardian component: PA information evening prior to the beginning of the intervention, and distribution of specifically tailored Y-PATH PA information leaflets. 3) Teacher component: All school teachers attending two workshops (Aug 2011 and Jan 2012) which highlighted the importance of "active role modeling", and voluntary participation in a one week "Teacher Pedometer Challenge". The teacher pedometer challenge was integrated mid-course during the Y-PATH intervention to further stimulate teacher involvement in youth PA promotion (teacher pedometer data, however, was not collected as part of this pilot Y-PATH exploratory trial). 4) Website component: All student, parent and teacher resources were made readily available for all intervention participants (http://www.dcu.ie/shhp/y_path.shtml). It is important to note that those in the control condition carried on their usual PE and school programme without any researcher input during the pilot study.

Measurements

Measurements were taken at the beginning of the school year in September 2011 (pre), at the end of the school year in May 2012 (post), and at 3 months follow-up in September 2012 (retention). Three lead researchers administered periodic training workshops to 12 field staff to ensure that measurement assessment standards were met continuously during data collection (Berkson et al., 2013).

Body Mass Index: Weight was measured to the nearest .1 kg using the Seca 761 dual platform weighing scales. Standing height was measured to the nearest .1 cm using a portable stadiometer. BMI was calculated using the equation; weight (kg)/ height (m^2). The Cole et al., (2000) cut off points for normal, overweight and obese participants were applied to the data in order to calculate BMI class.

Accelerometry: PA was measured using ActiGraph GT1M and GT3X accelerometers, stored in a standardized 10-second epoch to capture the intermittent and sporadic behavior (Esliger, Copeland, Barnes, & Tremblay, 2005) of adolescent youth. During the first day of data collection, each participant was given an accelerometer by one of the trained field staff under the supervision of one lead researcher. If a participant felt that the device was uncomfortable, the elastic belt was adjusted accordingly to ensure secure fit. This process ensured that participants could wear the accelerometer independently for the subsequent days of data collection. To further enhance accelerometer compliance, a reminder text message was sent each morning which has been shown to improve the number of students wearing monitors to school (Belton et al., 2013). Each participant was asked to wear an accelerometer during all waking hours for nine consecutive days. To account for subject reactivity where participants may artificially increase their activity with the device, the first day of data was omitted from the analysis (Esliger et al., 2005).

Accelerometer data gathered was screened using stringent inclusion criteria of a minimum of three weekdays and one weekend day (Gorely, Nevill, Morris, Stensel, & Nevill, 2009; Nyberg, Ekelund, & Marcus, 2009) with 600 minutes wear time per day (Anderson, Hagstromer, & Yngve, 2005). Strings of "0" counts in bouts of ≥20 min were considered non-wear periods (Yildirim et al., 2011), and activity count values of <0 and ≥15,000 counts per minute were excluded as these values were deemed biologically implausible (Esliger et al., 2005). The average time spent in daily MVPA was calculated by applying the Evenson age specific cutpoints (Evenson, Catellier, Gill, Ondrak, & McMurray, 2008) to the Actilife 6.4 software data reduction programme.

Self-Report: PA was further measured using the Youth Physical Activity Questionnaire (YPAQ) self-report questionnaire which has been previously validated against accelerometry (concurrent validity coefficient r = .42, $p < .05$) with 12 to 13 year olds (Corder et al., 2009). Reported test-retest reliability coefficients for the YPAQ ranged from .86 to .92 (Corder et al., 2009). The variable for daily minutes of MVPA was calculated by averaging the total summed minutes of MVPA across the 7 days. Participants completed the questionnaire within their class groups under the supervision of one lead researcher and four trained field staff members. If a participant was unsure of any questionnaire component or had difficulty completing the task, they were assisted upon request by one of the research team present. Participants completed questionnaires using the online tool "Survey Monkey".

Fundamental Movement Skills: The following 15 FMS were assessed: run, skip, gallop, slide, leap, hop, horizontal jump and vertical jump (locomotor; maximum score of 66); kick, catch, overhand throw, strike, underhand roll and stationary dribble (object control; maximum score of 48); balance (stability; maximum score of 10). Each of the 15 gross motor skills were assessed in conjunction with the guidelines from the Test of Gross Motor Development (TGMD), Test of Gross Motor Development-2 (TGMD-2) and the Victorian Fundamental Motor Skills manual (Department of Education Victoria, 1996; Ulrich, 1985, 2000). To ensure that adolescent performance was constant over time across the 15 selected FMS, trained field staff conducted a 48 hour time sampling test-retest reliability measurement amongst a sample of 35 participants aged 12 - 13 years old. The FMS coefficients reached .75 (locomotor subtest), .78 (object control subtest) and .91 (overall gross motor skill subtest), showing the scores across the range of FMS to be stable over time. During the data collection, one trained field staff member provided every 5 participants with an accurate demonstration and verbal description of the skill to be performed. To ensure participant consistency within skill performance, no feedback from any of the trained field staff were given during the testing. Participants performed the skill on 3 occasions including 1 familiarization practice and 2 performance trials. Video cameras were used to record each participant's performance and execution of the selected 15 FMS. The FMS scoring process was completed at a later date by the trained field staff. The trained field staff were required to reach a minimum of 95% inter-observer agreement for all 15 skills on a pre-coded data set.

Data Analysis

Data were analyzed using SPSS version 17.0 for Windows. Descriptive statistics and frequencies for the anthropometric characteristics, objective PA and self-report PA over time were calculated. Differences in BMI mean scores at pre, post and retention according to gender and school type were analyzed using two-way repeated measures ANOVA.

Chi-square tests for independence were used to identify from the self-report data whether percentage differences in meeting the ≥60 minutes MVPA guideline according to school type existed at pre, post and retention. For FMS analysis, the binary variable "mastery and near mastery" (MNM) was created. "Mastery" was defined as correct performance of all skill components on both trials. "Near Mastery" was defined as correct performance of all components but one on both trials (Van Beurden et al., 2003). Pre, post and retention FMS scores were calculated for all 15 FMS and subtests for the intervention group relative to the control using independent t-tests.

Individual two-way repeated measures ANOVA were conducted to explore the impact of gender and school type (intervention group relative to control) over time (pre, post and retention) on objective daily MVPA minutes, self-report daily MVPA minutes, and FMS gross motor skill proficiency. Statistical significance was set at $p < .05$.

Results

Study Sample

One hundred and ninety two participants from two schools were invited to participate in this study in September 2011 with consent from 174 participants provided (91% of total sample, n = 119 intervention, n = 55 control group). Of these 174 participants, only those who had full data sets available across all three time periods were included in the statistical analysis.

Body Mass Index and Physical Activity

BMI characteristics, objective PA and self-report PA descriptive statistics at pre, post and retention phases, for both the control and intervention groups, are summarized in **Table 1**. There were no significant differences between gender and school type for BMI across the three time periods.

Accelerometer Physical Activity

Based on the inclusion criteria applied to the accelerometer data, 23% of participants had fully available PA data across three time periods. There was a significant interaction between school and time for PA (F (2, 38) = 6.177, $p = .005$) with both schools showing an increase in daily MVPA over the three time periods, with a significantly greater increase in daily MVPA occurring within the intervention school.

Self-Report Physical Activity

Figure 1 illustrates the percentage of participants who accumulated ≥60 minutes of MVPA each day according to the self-report data. There was no school type differences observed in the overall percentage accumulating the ≥60 minutes MVPA guideline ($p > .05$) according to self-reported data at pre, post or retention phases. When comparing self-reported minutes of daily MVPA according to school type (intervention, control) and gender over time (pre, post and retention), no significant interaction between school attended, gender and self-reported minutes of PA over time was found.

Table 1.
The anthropometric characteristics and mean (SD) values for average accelerometer and self report daily minutes of MVPA of Irish post-primary adolescent youth from 2011-2012 (pre, post and retention data collection phases) according to intervention and control condition.

Time	BMI (kg/m^2)	Accelerometer Daily MVPA[1]	Self-Report Daily MVPA
Pre			
Intervention	(n = 103)	(n = 61)	(n = 70)
	20.36 ± 3.38	51.38 ± 20.70*	85.17 ± 66.00
Control	(n = 51)	(n = 34)	(n = 49)
	20.35 ± 3.26	43.48 ± 13.96*	91.78 ± 55.70
Post			
Intervention	(n = 89)	(n = 39)	(n = 70)
	20.69 ± 3.37	47.76 ± 17.72	80.48 ± 45.64
Control	(n = 46)	(n = 36)	(n = 49)
	20.50 ± 3.11	55.20 ± 20.52	88.40 ± 39.76
Retention			
Intervention	(n = 89)	(n = 30)	(n = 70)
	20.72 ± 3.26	59.17 ± 19.33	71.83 ± 46.57**
Control	(n = 51)	(n = 34)	(n = 49)
	20.96 ± 3.25	51.95 ± 17.89	93.21 ± 36.90**

Note: **n** = number of participants with available data. * = $p < .05$; ** = $p < .01$; **MVPA** = moderate to vigorous physical activity; **BMI** = body mass index.

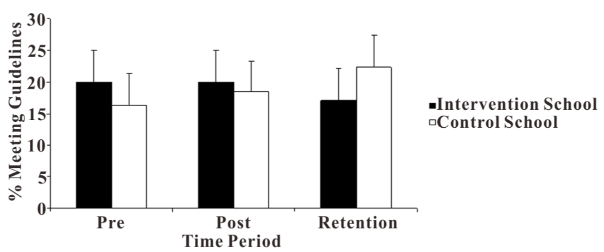

Figure 1.
Percentage of participants self-reporting ≥60 minutes of MVPA on all 7 days per week at pre, post and retention.

Fundamental Movement Skills

The mean scores for each of the 15 FMS and the associated subtests at pre, post and retention phases, for both the control and intervention groups, are summarised in **Table 2**. At pre-test, school-specific profiles differed with the control group displaying significantly greater proficiency in the vertical jump ($p < .01$), the object control subtest ($p < .05$), and total gross motor skill proficiency ($p < .05$).

There was a significant difference in improvement from pre-test to retention test between both intervention and control condition for gross motor skill proficiency (F (2, 100) = 4.132,

[1]*Those who had available accelerometer data and met the inclusion criteria at each phase of data collection* (*pre, post and retention*).

Table 2.
FMS (n = 15) raw mean scores at pre, post and retention phases for intervention group relative to control.

Skill/Condition	Pre FMS mean score		Post FMS mean score		Retention FMS mean score	
Run (max score 8)						
Intervention	7.69		7.63		7.77	
Control	7.71		7.66		7.68	
Gallop (max score 8)						
Intervention	6.45		6.41		6.78	
Control	6.29		6.92		6.71	
Hop (max score 10)						
Intervention	8.48		8.55		9.59	
Control	8.66		8.12		9.37	
Slide (max score 8)						
Intervention	6.71		6.84		7.39	
Control	6.58		7.08		6.97	
Leap (max score 6)						
Intervention	3.67		4.27		4.63	
Control	4.03		4.53		4.42	
Vertical Jump (max score 12)						
Intervention	9.09	$p < .01^{**}$	10.13		10.62	$p < .01^{**}$
Control	10.32		10.63		11.39	
Horizontal Jump (max score 8)						
Intervention	3.94		5.61		6.53	
Control	4.45		5.55		6.51	
Skip (max score 6)						
Intervention	5.03		5.48		5.21	
Control	5.18		5.32		5.26	
Locomotor Subtest Total (max score 66)						
Intervention	51.06		54.91		58.52	
Control	53.21		55.79		58.32	
Kick (max score 8)						
Intervention	7.71		7.05		7.63	
Control	7.63		6.58		7.05	
Bounce (max score 8)						
Intervention	6.86		7.28		7.59	
Control	6.73		7.24		7.74	
Catch (max score 6)						
Intervention	5.73		5.68		5.63	
Control	5.71		5.84		5.61	
Strike (max score 10)						
Intervention	8.27		8.45		9.06	
Control	8.79		7.82		8.87	
Overhand Throw (max score 8)						
Intervention	6.27		2.89		6.95	
Control	6.76		3.32		6.87	
Underhand Roll (max score 8)						
Intervention	5.59		6.03		7.05	
Control	6.11		6.26		6.71	
Balance (max score 10)						
Intervention	7.45		7.45	$p < .05^{*}$	7.97	
Control	7.76		6.63		7.63	
Object Control Subtest (max score 48)						
Intervention	40.42	$p < .05^{*}$	37.38		43.91	
Control	41.74		37.05		42.84	
Total Gross Motor Skills (max score 124)						
Intervention	98.94	$p < .05^{*}$	99.73		110.39	
Control	102.71		99.47		108.79	

p = .019) with a significantly greater increase occurring within the intervention school over time.

Discussion

The preliminary results from this pilot study suggest that it may be possible to increase 12 to 14 years old participation in daily MVPA within a one year time frame, through a collaborative, school-based PE intervention. In the present study, participants in the intervention school appeared to accumulate 7.2 minutes more daily MVPA (when measured by accelerometry) than participants in the control school at the retention phase of the intervention (see **Table 1**). Similar increases in PA reported from this study correspond to a previous school based intervention on adolescents after one year (Haerens et al., 2006), where female intervention participants accumulated 6.4 minutes more daily MVPA than those in the control group. Another recent study, by Kriemler et al. (2010) evaluating the effect of a school based PA programme on children found that intervention participants successfully obtained 11 more minutes of daily MVPA than control participants. Similar to previous interventions (Dishman et al., 2004; Jamner, Spruijt-Metz, Bassin, & Cooper, 2004; McKenzie et al., 2004; Pate et al., 2005; Slootmaker, Chinapaw, Seidell, van Mechelen, & Schuit, 2010), results of this study are comparable in that the Y-PATH multi-component school-based PE intervention can contribute positively towards increasing and sustaining adolescent youth PA. There is now strong evidence under the behavioral and social approaches to increasing PA that school-based programmes are effective amongst children and adolescent youth (Garn et al., 2013; Lavelle et al., 2012; Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007; Vasques et al., 2013).

Due to the small number of participants with full objective accelerometer data, it was important to consider the self-report data to compliment MVPA findings. Consistent with previous studies (Prince et al., 2008; Slootmaker, Schuit, Chinapaw, Seidell, & van Mechelen, 2009), the mean minutes of self-report MVPA was substantially higher over time compared to the objective accelerometer findings (see **Table 1**). The original study hypothesis was that the intervention school participants would self-report greater MVPA over time, however, results showed no significant differences between groups. This is in contrast to other recent school based PA programmes, which highlighted significantly greater self-report minutes of MVPA at follow-up for those exposed to intervention conditions (Haerens et al., 2007; Taymoori et al., 2008). In terms of considering why the intervention school was not significantly more effective in the increase of self-report minutes of MVPA, it is important to note that children and youth (both intervention and control) often have difficulty accurately recalling PA participation (Hands et al., 2006; Townsend, 2012; Trost, 2007). In addition, a previous study by Trost et al. (2000) investigated children's (mean age 9.8 ± .3 years) understanding of PA, in which the results found that 60% of participants had difficulty in differentiating between sedentary activities and active pursuits. Based on this finding, it appears that young people may be unable to accurately quantify time spent in MVPA through self-report. This may explain why no significant differences in self-reported MVPA existed between intervention and control group over time, and again emphasises the importance of using objective measures of PA where possible.

It is plausible that the greater self-reported minutes of daily MVPA in the control group at follow-up may in part be attributed to the fact that, while both groups received the same amount of PE time (80 minutes) each week over the course of the school year, control participants received an additional 120 minutes "games class" per week for one school year (Sept 2011-May 2012). This additional 120 minutes of activity time was a specific school policy which was beyond the control of the research team. Yet despite this school policy, it is important to note that the control school did not self-report significantly higher MVPA over time compared to the intervention school, indicating that the intervention participants may have participated in more activity outside of school to "make-up" for the reduced activity time they were exposed to as part of their school PE curriculum.

Recent intervention results highlight a significant positive association between participation in school based movement skill programmes and FMS proficiency (Logan et al., 2011). FMS performance in a PE setting has previously found significant intervention effects for children and early adolescents (Kalaja et al., 2012; Lemos et al., 2012; Martin et al., 2009; Mitchell et al., 2013). Preliminary results from this pilot study are consistent with these FMS findings, indicating that adolescents exposed to a prescribed FMS climate during PE as part of the Y-PATH programme significantly improved in their overall movement skill proficiency relative to their control counterparts. It is particularly encouraging from a research perspective that these findings have emerged over the course of 12 months and even more so, when we consider that at baseline (pre-test), control school participants displayed significantly greater overall gross motor skill proficiency. Previous research highlights that younger children can achieve greater gains in motor skill proficiency (Mitchell et al., 2013) compared with older participants and hence, childhood is a critical period for FMS development (Gallahue & Ozmun, 2006; Hardy et al., 2010; Lemos et al., 2012; Zask et al., 2012). Findings from this study suggest that adolescent youth aged 12 to 14 years old can significantly improve in FMS performance through a teacher led education intervention over one year. This finding is in line with other intervention programmes which have demonstrated significant improvements in FMS proficiency for children and adolescents through the school environment (Kalaja et al., 2012; Martin et al., 2009; Mitchell et al., 2013; Van Beurden et al., 2003). Such improvements in adolescent FMS proficiency are crucial to helping ensure a successful transition to more advanced skills in the specialized movement stage during adolescence (Department of Education Victoria, 1996; Gallahue & Ozmun, 2006). The well informed opinion of Loitz (2013) suggests that the development of FMS during childhood and adolescence will help individuals to participate in PA and gain additional health benefits.

In light of this pilot study, it is important to consider that the effects of the intervention may be attributed to confounding factors other than the Y-PATH programme such as individual school characteristics or physical fitness levels etc. As both the control and intervention school had similar socio economic status (SES) and are situated in the same rural Irish setting, results of this study cannot be generalised without further research. For these reasons, the next stage of the Y-PATH research programme will undertake a definitive randomised controlled trial (RCT) in 22 mixed gender post-primary schools in September 2013. This robust surveillance of Y-PATH will precisely evaluate the overall intervention effectiveness for adolescent PA promotion.

Study Limitations and Strengths

Specific limitations of this study design were the use of two mixed-gender schools only, resulting in a small number of participants involved in the study. In terms of matching criteria, both schools were selected for inclusion based on geographical location and gender distribution; in terms of sample size, however, the control school was not an exact match to the intervention which is acknowledged as a limitation. The control school having an additional 120 minutes games class per week compared to the intervention school can similarly be viewed as a limitation. Further details regarding participant characteristics and measurement variables such as nutrition, body fatness and cardio-respiratory fitness level would have allowed the researchers to explore the effectiveness of the intervention more robustly. The stringent inclusion criteria for accelerometer analysis was applied in order to obtain a detailed, representative pattern of objectively measured habitual adolescent PA behavior but these research decisions had a significant adverse effect on the number of participants with available data for inclusion at each time point.

A unique aspect of this research was the involvement of all teaching staff, parents and guardians within this whole-school approach towards adolescent PA promotion in the Y-PATH programme. A novel component of Y-PATH was the integrative approach of HRA and FMS in the PE environment for adolescents. Intervention and control settings were matched based on gender and age distribution, furthermore, there were no differences in SES between participants. The use of accelerometry in conjunction with self-report questionnaire heightened the strength of PA measurement accuracy. Finally the measurement of 15 FMS will contribute significantly to the previously published literature in adolescent movement skill competency (Barnett et al., 2011; Barnett, Van Beurden, Morgan, Brooks, & Beard, 2010; Hardy et al., 2010, 2013; Kalaja et al., 2012; Mitchell et al., 2013; Okely & Booth, 2004).

Conclusion

In the wake of the positive objective PA findings over time in this study, preliminary findings advocate for the simultaneous integration of HRA and FMS in school PE class, along with parent and teacher involvement, in efforts to improve the overall PA levels of adolescent youth. Preliminary findings of the Y-PATH intervention suggest that adolescent FMS proficiency can significantly improve through a one-year-teacher-led intervention component. Recent evidence on the health benefits of FMS competency in children and adolescents (Lubans et al., 2010) found that 11 of the 13 identified studies indicated strong positive relationships between skill ability and PA components. Teaching children and young people during school PE classes to become competent and confident performers of FMS may lead to a greater willingness to participate in PA which in turn, may provide additional opportunities to improve physical fitness levels and reduce the risk of increased weight status (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2008; Cliff et al., 2011; Morano, Colella, & Caroli, 2011). In light of the Y-PATH intervention, preliminary findings extend the knowledge on total PA participation among adolescents. Further longitudinal data are warranted to support these initial positive findings.

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