WOODLAND HEALTH FOR YOUTH (WHY)

AN EVALUATION OF PHYSICAL HEALTH BENEFITS DERIVED FROM OUTDOOR LEARNING IN NATURAL ENVIRONMENTS (LINE) FOR SCHOOL-AGE CHILDREN

Contents

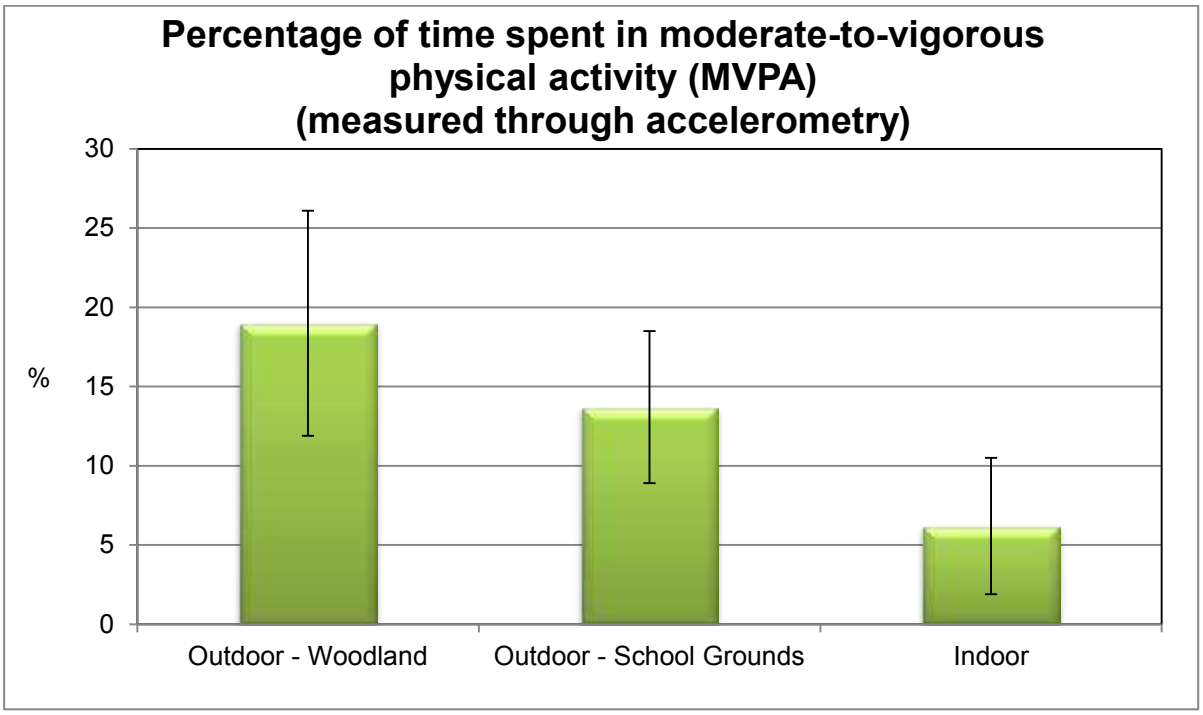
Executive Summary

This report outlines the Woodland Health for Youth (WHY) action research project, with the purpose to inform funders and stakeholders of the research process and the project findings and to contribute to the evidence base of the health benefits derived from learning outside the classroom in natural environments (LINE) for school children. LINE is being supported through a Natural Connections' Demonstration Project that aims to increase outdoor learning in local natural environments in schools located in deprived areas. The WHY project comprised a cross-sector partnership between health, education and natural environment teams to explore the physical health benefits of LINE.

The specific project aim was to evaluate the physical health benefits of LINE in a year 2 class in a local Natural Connections primary school, using the following methods:

- measuring the participants' physical activity (PA) levels during LINE and compare to indoor lessons, using accelerometry
- measuring their BMI and compare to previous measurements
- collecting qualitative observational/reflective data to provide context to the quantitative data

The WHY project research findings demonstrate that the children were significantly more active during outdoor LINE sessions than during indoor lessons, and that they were especially active when LINE was held in the nearby woodland as opposed to the school grounds.



BMI calculations showed that the majority of the participants had reduced their BMI from Reception to year 2, and that 80% were of healthy weight. Although childhood obesity is complex and there are lots of factors influencing children's BMI, the WHY project findings suggest that PA through LINE forms one of the contributing factors to reversing the negative trend generally seen in children's BMI levels. Furthermore, it may offer a more equitable and consistent way of increasing overall physical activity levels compared to targeted interventions or increases in breaktime, avoiding stigmatisation of overweight children or compounding sedentary patterns that persist in free play.

Observational and reflective evidence highlighted the multitude of skills that developed through LINE, and the joy that came with being active in the outdoors. The children's experience of outdoor learning in the local woodland will be further explored through the action research project 'A qualitative study of the physical health benefits and well-being outcomes associated with outdoor learning in natural environments (LINE) for school-age children' which is funded through Good from Woods, and will be presented at a later stage this year.

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Woodland Health for Youth (WHY): an evaluation of physical health benefits derived from outdoor learning in natural environments (LINE) for school-age children

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Introduction

Woodland Health for Youth (WHY) was an action research partnership between Plymouth City Council (Stepping Stones to Nature[1]), Plymouth University (School of Nursing & Midwifery and the Institute of Education), Plymouth Community Healthcare, Good from Woods[2] and a Natural Connections school (Mayflower Community Academy), aiming to integrate whole-school health promotion and education policy through children's 'learning outside the classroom in natural environments' (LINE).

The specific project aim was:

- to evaluate the physical health benefits of LINE, in order to:
    - Create healthier school environments for school-age children
    - Identify barriers to outdoor health promotion in greenspace
    - Improve parental and child involvement in healthy weight management strategies

The project objectives were:

- To measure children's physical activity (PA) levels during LINE and compare to indoor lessons, using accelerometry
- To measure children's Body Mass Index (BMI) and compare to previous measurements
- To collect qualitative observational/reflective data to provide context to the quantitative data

[1] **Stepping Stones to Nature** (SS2N) is a multi-agency partnership project designed to improve local green spaces and facilitate green space use in areas of high deprivation (SS2N annual report, 2012)
[2] **Good from Woods** is a lottery funded research project, led by The Silvanus Trust and The University of Plymouth, aiming to explore how people are benefitting from woodland activities (The Silvanus Trust website, http://www.silvanustrust.org.uk)

This end of project report presents the background to the project and the methods that were used, and discusses the main findings. Recommendations for future practice and research are presented at the end. The purpose of this report is to inform funders and stakeholders of the research process and the project findings.

Background

Recent policy directives push towards creating healthy and sustainable communities where healthy choices are made easier. The public health white paper Healthy lives, healthy people (Department of Health (DH), 2010) and the Public Health Outcomes Framework (DH, 2012[b]) are two of the drivers for an integrated approach to promoting good health, creating sustainable communities and reducing health inequalities. The Marmot review (Marmot, 2010) highlights the link between the sustainability of our built and natural environment and equitable access to healthy lifestyle opportunities for children and families. Children living in deprived areas are nine times less likely than those living in affluent areas to have access to green space, places to play and environments with better air quality (National Children's Bureau (NCB), 2013). Locally, child poverty levels are higher in Plymouth than in England overall; 22.4% of children under 16 in Plymouth live in poverty (Public Health England (PHE), 2014). The link between deprivation and poorer health outcomes is well documented and addressing this problem is a public health concern. This is especially pertinent to specialist community public health nurses (SCPHN)/school nurses with regards to developing local approaches to public health and taking a leadership role in promoting good health and addressing inequalities (DH, 2012[a]) and to schools supporting the healthy child agenda.

One of the most urgent public health priorities that SCPHN/school nurses are faced with is prevention and management of childhood obesity - a key component of the school nurse vision Getting it right for children, young people and families (DH, 2012[a]). The National Child Measurement Programme (NCMP) identifies children at risk of obesity and is delivered by Public Health England, locally via school nursing teams linked to primary schools. However, current school nursing capacity means the service is limited to the physical height and weight measurement of children, with the result that the health promotion and health prevention aspects of the school nurse role are rarely realised. As noted above, the link between childhood obesity and deprivation is well documented (NCB, 2013) and local data shows an inequality gap with higher levels of childhood obesity in more deprived neighbourhoods (Public Health, Plymouth City Council (PCC), 2013). National and local data also demonstrates an increase in childhood obesity year-on-year, with one in four of children in Reception being overweight or obese, increasing to one in three children being overweight or obese by year 6 (Public Health, PCC, 2013).

Tackling the social determinants of obesity-related behaviours is complex; however the school environment offers great opportunities for health interventions reaching all children regardless of their socioeconomic background, hence providing equitability. Recent research stresses the importance of schools to develop sustainable partnerships with outside organisations, in order to implement obesity prevention interventions (Greaney et al., 2014). The recent Report of the Children and Young People's Health Outcomes Forum (Lewin et al.,2014) highlights the need for

collaboration between the education sector and the health service as this will reduce the burden on the NHS while ensuring children and young people have optimal opportunities to attend school and concentrate on achieving good academic results. Similarly, there is recent evidence of successful partnership working towards community access to green space and an association with health improvement (Aronsson, 2013; Tighe et al., 2013; Richardson et al., 2013).

The WHY project comprised a cross-sector partnership between health, education and environment sectors, to explore the physical health benefits of learning outside the classroom in natural environments (LINE) for school children. LINE is being supported through an ongoing Natural Connections Demonstration Project funded by Natural England, DEFRA and English Heritage and led by Plymouth University. The project involves 200 schools in areas of high multiple deprivation across the southwest of England and aims to significantly increase the number of school aged children experiencing the full range of benefits that come from learning in natural environments (Growing Schools, 2014). The benefits of outdoor learning are well established and include educational attainment and child mental health and wellbeing indicators (Waite, 2011; Dillon and Dickie, 2012; Roe and Aspinall, 2012), however until WHY, the physical health benefits associated with outdoor curricular learning had not been explored within the Natural Connections project. The WHY project filled this research gap by evaluating levels of physical activity during outdoor learning compared to indoor lessons and the impact of this on school-aged children's overall physical health. A recent systematic review by Langford et al. (2014) highlights physical activity as a public health priority linked to obesity prevention strategies in schools. Through WHY, an initial exploration of the public health scope of school nursing service was materialised and the leadership role was explored, as recommended in the Healthy Child Programme 5-19 (DH, 2009).

Methods

Research design and sample group

An interdisciplinary action research design was chosen that supported a recursive spiral of planning, acting, observing and reflecting (Robinson, 2011). A reflective log was kept throughout the project, which included observations, discussions, and thoughts and ideas that evolved throughout the project. These emergent reflections fed into the research cycle and informed the research process. Robinson (2011) argues that action research is particularly appropriate for change management in a clinical practice setting, such as the shift in SCPHN/school nurse practice that was proposed within the WHY project.

The study was carried out in Mayflower Community Academy, one of the local LINE ‘beacon schools’. Beacon schools are those who have developed some outdoor learning practice that they are willing to share with other schools. Mayflower Community Academy’s school profile shows high levels of deprivation and the majority of children coming from families of vulnerable young parents needing substantial state support. The school is situated next to Ham Woods, one of the main sites that have been subject to improvement by Stepping Stones to Nature (SS2N). SS2N have improved the accessibility in and around the woodland through capital work such as creating paths, designing signposts and repairing bridges, as well as organising and supporting community walks, litter picking and family events in the

woodland. Mayflower Community Academy utilises both Ham Woods and their green school grounds for LINE.

Ethical approval for the study was obtained from the Education Research Ethics Sub-committee (Plymouth Institute of Education). At the time of the study, the school offered LINE in two classes; the chosen one (a year 2 class) was more suitable from time scheduling reasons. All parents/carers of the 25 children in the class were provided with consent forms and the first ten forms (of equal gender distribution) returned with a parent/carer signature were included in the study. Due to one girl's parent later withdrawing her from the study, a boy took her place which meant there were six boys and four girls participating in the study. Outdoor curricular learning had been offered to children at Mayflower Community Academy through LINE since September 2013, but prior to that through Forest School activities had been taking place in Ham Woods and on school site since the school opened in 2009. The main distinction between Forest School and LINE is greater alignment with curricular subjects, but the pedagogical approach is similar, encouraging active learning.

Accelerometry

Action research has the potential to employ both qualitative and quantitative methods to address the research question (Mukherji and Albon, 2010). This study collected quantitative data of physical activity (PA) of a small sample of children through accelerometry. An accelerometer is a device that measures acceleration of movement, which can be translated into PA levels. This provides a solid objective measurement of PA and has been used in a number of studies of children across diverse cultures around the world (Sherar et al., 2011). This study used GENEActiv accelerometers (ActivInsights, Kimbolton, www.geneactiv.co.uk) which are wrist-worn accelerometers that have been validated to measure PA in children, and have associated activity cut-points developed by Phillips et al. (2011) to determine the intensity of children's PA. The ten participants wore their accelerometers one day per week during school hours for 5 weeks. Due to absence of children on a few occasions, the total number of data collection days amounted to 45. The accelerometers were attached to each child's wrist of choice after gaining oral consent every morning of data collection. Comparison with the school timetable allowed data to be analysed according to physical activity levels during indoor and outdoor lessons and breaktimes throughout the day.

Epoch length

The accelerometry raw data was downloaded using the GENEActic PC software (version 2.2) and converted into epochs. An epoch is a unit that summarises the data collected during a set time period. An epoch size of 60 seconds is conventionally used; however research has shown that children's movements are more sporadic and intermittent than that of adults, and therefore collecting accelerometer data in shorter rather than longer epochs may capture the short bursts of activity in children more accurately (Colley et al, 2014; Rowlands et al., 2006). However; Schaefer et al. (2013) suggest that very short epochs may capture movements that are not purposeful movement such as hand movement from reading. It was therefore thought that 5 seconds would be a suitable epoch length - short enough to capture children's energy burst without capturing movements of the wrist that are not purposeful. To explore how different epoch sizes would affect the reported amount of time spent in different PA levels, the data from one boy and one girl were randomly

chosen for a trial. Four different epoch sizes were compared: 1s, 5s, 15s and 60s. The result is displayed in tables 1-4 (with the mean values highlighted).

Table 1: Proportion of time spent in sedentary and MVPA phases measured with 1s epoch size

Type of lesson	Sedentary Mean	Sedentary SD	Sedentary Sig.	MVPA Mean	MVPA SD	MVPA Sig.
Indoor	67.90%	5.50	P= 0.000	6.02%	2.86	P= 0.001
Outdoor	53.66%	8.42		13.28%	4.79	

Table 2: Proportion of time spent in sedentary and MVPA phases measured with 5s epoch size

Type of lesson	Sedentary Mean	Sedentary SD	Sedentary Sig.	MVPA Mean	MVPA SD	MVPA Sig.
Indoor	58.47%	7.29	P= 0.002	5.59%	3.85	P= 0.000
Outdoor	44.63%	9.72		15.50%	6.28	

Table 3: Proportion of time spent in sedentary and MVPA phases measured with 15s epoch size

Type of lesson	Sedentary Mean	Sedentary SD	Sedentary Sig.	MVPA Mean	MVPA SD	MVPA Sig.
Indoor	54.18%	9.51	P=0.005	5.32%	4.20	P= 0.000
Outdoor	38.89%	11.48		15.96%	6.71	

Table 4: Proportion of time spent in sedentary and MVPA phases measured with 60s epoch size

Type of lesson	Sedentary Mean	Sedentary SD	Sedentary Sig.	MVPA Mean	MVPA SD	MVPA Sig.
Indoor	50.05%	13.29	P= 0.005	5.83%	5.84	P= 0.003
Outdoor	31.15%	13.05		16.69%	8.15	

While it has been suggested that higher epoch size will underestimate time spent in MVPA for children (Colley et al, 2014), this trial study found that the proportion of time spent in MVPA increased with increasing epoch size during outdoor lessons. The time spent in MVPA during indoor lessons did not differ much depending on epoch sizes. Time spent in sedentary phase decreased with increased epoch size during outdoor lesson as well as indoor lessons, which is consistent with previous studies (Colley et al., 2014).

The time spent in MVPA was significantly higher during outdoor lessons than during indoor lessons regardless of the epoch size (p-values range from 0.000 – 0.003). The time spent in sedentary phase was significantly lower during outdoor lessons than indoor lesson regardless of the epoch size (p-values range from 0.000 – 0.005). This supports the hypothesis that children are more active during outdoor lessons than during indoor lessons - regardless of epoch size.

The trial suggested that the epoch size did not substantially affect reported PA levels but the decision to use 5 s epochs was kept since previous research has tended to use shorter intervals with children and this would therefore aid comparability with other studies.

Cut-points

Previously validated movement count cut-points (Phillips et al., 2011) were used to determine the proportion of time spent in sedentary, light, moderate and vigorous activity. Cut-points are thresholds applied to the accelerometry 'activity counts' that

are used to convert the accelerometer raw data into physical activity levels. To develop cut-points to use for children there are calibration experiments where children have participated in age-typical activities and accelerometry have been used to determine the activity count for an activity that is sedentary (e.g. sitting down) / light (e.g. walking slowly) / moderate (e.g. walking briskly) / vigorous (e.g. running). Different studies use different sets of activities when they conduct calibration experiments; the study by Phillips et al. (2011) was chosen for the purpose of this project because they used the GENEActiv accelerometers and looked at children close in age to the children participating in the WHY project.

While Phillips et al. (2011) measured activity at a frequency of 80Hz and used 1s epochs, this study used a sampling frequency of 10 Hz and 5s epochs; thus the cut-points were calculated by multiplying Phillip et al.'s cut-points with 5 and divide by 8 (10Hz/80Hz).
This resulted in the following cut-points:

Sedentary: <3.75
Light: 3.75 - 13.44
Moderate: 13.44-35
Vigorous: >35
[SPSS (IBM, Version 21) was used for all statistical analysis.]

BMI
In addition to the accelerometry, children's height and weight were measured and their BMI calculated. This was done by the practitioner-researcher, who is a public health nurse with school nurse background, assisted by the school nurse team linked to Mayflower Community Academy, adhering to the National Child Measurement Programme Operational Guidance (PHE, 2014). The children's Body Mass Index (BMI) was calculated using the UK-WHO growth chart (http://www.nhs.uk), which presents children's BMI on a centile. The measurements were compared to the measurements done by the school nursing service two years earlier, in Reception year, through the NCMP. These were accessed through agreement with the local Public Health service and following consent from the parents to use this data for research purposes.

Findings

Reflective evidence
The reflective evidence focused on observational data collated during LINE, as well as feedback and comments made by children. Observational data indicated that children had high levels of PA during LINE: when allowed, the children would run rather than walk, climb on fallen trees and tree stumps, throw stones in the stream, jump between rocks, use a stick to dig in the soil etc. The children's body language together with their comments mirrored the joy that these activities and the outdoor environment provided. This is likely to be a combination of the well documented mental health benefits that come with accessing the outdoors (Townsend et al., 2010; Wood et al., 2011) and the positive effects that being physically active will have on the mental health (PHE, 2013). Some of the spontaneous comments made by the children in the group included:

'This is fun!' (girl looking for insects on a tree)
'I love nature' (boy in the woodland)
'I can feel the sun in my face and the fresh air' (girl in the woodland)
'I feel tired now from all that running around' (boy on way back from woodland)

Observational data also highlighted the multitude of skills that developed through LINE, including gross and fine motor skills; risk-taking behaviour and safe practice; curricular learning such as literacy and biology; creative activities such as art and imagination; social skills such as listening, taking turns and working together on a project; and building confidence and self-efficacy.

Some of the children mentioned how they use the woodland after school hours. For example, one girl said that she goes to the woodland with her family; another girl explained that she passes through the woodland every day walking to/from school.

Accelerometry

The main focus of the accelerometry measurements was to compare the moderate-to-vigorous physical activity (MVPA) levels of children during outdoor lessons compared to indoor lessons, as there is a national target for children aged 5-18 to spend 60 minutes or more a day in moderate to vigorous intensity PA (DH, 2011). However, the national recommendation and recent evidence (Stone and Faulkner, 2014) highlights the value of minimising sedentary behaviour in addition to increasing MVPA. Thus, this study also compares the proportion of time spent in sedentary phase during outdoor lessons compared to indoor lessons.

Table 5 shows that children spent a significantly larger proportion of the time in MVPA during LINE sessions (17.0% ± 6.7 SD*) than during indoor lessons (6.2% ± 4.3), p=0.000. Table 6 demonstrates that children spent a significantly smaller proportion of their time being sedentary during LINE sessions (44.2% ± 11.6) than during indoor lessons (60.4% ± 11.0), p=0.000.

*the Standard Deviation measures the amount of variation from the average value in the study sample.

Table 5. Comparison between proportions of time spent in MVPA phase

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
1.00	45	6.2378	4.34861	.64825	4.9313	7.5442	1.29	19.61
2.00	45	16.9584	6.71390	1.00085	14.9414	18.9755	5.42	32.34
Total	90	11.5981	7.79038	.82118	9.9664	13.2298	1.29	32.34

Group 1=Indoor lessons
Group 2= LINE session

Table 6. Comparison between proportions of time spent in sedentary phase

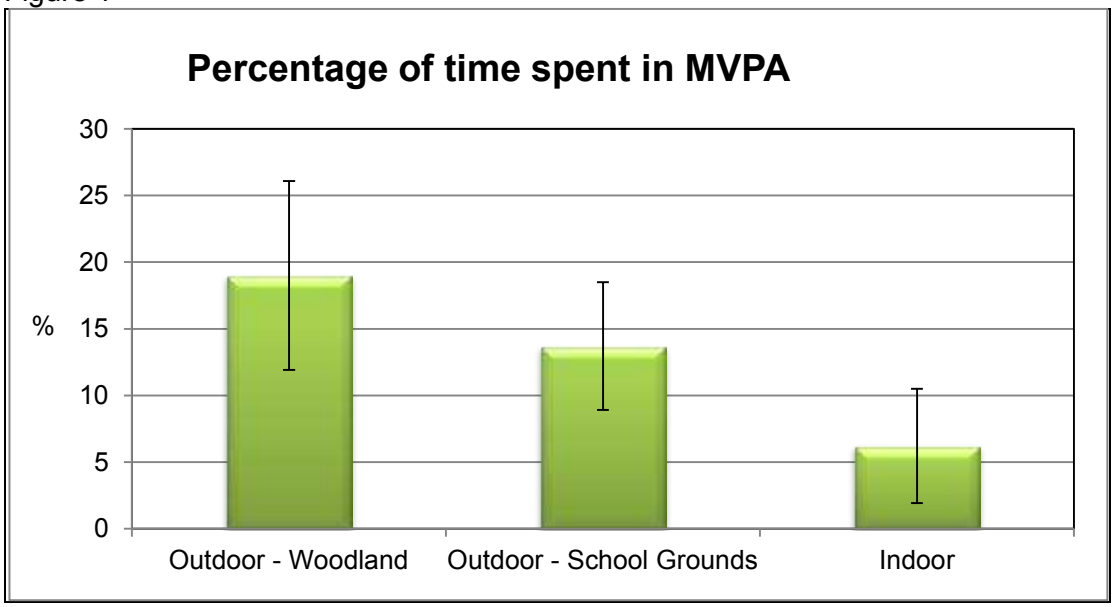
					95% Confidence Interval for Mean			
Group	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
1.00	45	60.4204	11.00069	1.63989	57.1155	63.7254	43.29	81.18
2.00	45	44.1791	11.58004	1.72625	40.7001	47.6581	24.36	67.78
Total	90	52.2998	13.88558	1.46367	49.3915	55.2081	24.36	81.18

Group 1=Indoor lessons
Group 2= LINE session

In addition to comparing outdoor and indoor activity, analysis of accelerometry data found that the most active part of the school day was during play time and lunch (33.0% ± 17.3), which concurs with previous studies exploring physical activities during the school day (Fairclough et al., 2008; Rauh, 2013). Comparison between gender concluded that boys are generally more active than girls during outdoor lessons: boys spent 20.6% ± 6.5 in MVPA compared to 14.7% ± 7.1 for girls, p=0.09. However there was no significant difference between proportion of time in MVPA during indoor lessons for boys (5.7% ± 2.6 for boys and 4.7% ± 3.0 for girls). The analysis also looked at activity levels during LINE depending on if the lesson was held in the woodland or in the school ground, and found a significantly higher proportion of time spent in woodland LINE than in school ground LINE: 19.0% ± 7.1 in woodland LINE, 13.7% ± 4.8 in school ground LINE, p=0.01.

Figure 1 shows the difference between the proportion of time children spent in MVPA depending on if they were engaged in woodland LINE, school grounds LINE, or an indoor lesson.

Figure 1



BMI

All ten children were measured and were on average 120.2 ± 3.5 cm tall and weighed 24.6 ± 3.0 kg. Eight out of ten children were of healthy BMI (between the 25th and 75th centiles), while two were classified as overweight (between the 91st and the 98th centiles). None of the children were underweight (below the 2nd centile) or obese (above the 98th centile). Two years ago, in Reception, nine out of the ten children took part in the NCMP, and were on average 107.6 ± 2.5 cm tall and weighed 19.4 ± 1.8 kg. At that time, seven children were of healthy BMI while two were classified as overweight. None of the children were underweight or obese.

The result is shown in Table 7 below.

Table 7: Comparison between BMI in Reception year and year 2

Child no	Gender	BMI classification (Reception)	BMI classification (year 2)	BMI lower or higher
1	m	Healthy weight	Healthy weight	Lower
2	m	Healthy weight	Healthy weight	Lower
3	m	Healthy weight	Healthy weight	Lower
4	m	Healthy weight	Healthy weight	Lower
5	m	Healthy weight	Healthy weight	Same
6	f	Healthy weight	Healthy weight	Higher
7	f	Healthy weight	Overweight	Higher
8	m	Overweight	Healthy weight	Lower
9	f	Overweight	Overweight	Lower
10	f	Not measured	Healthy weight	Unable to compare

Discussion

Project aim

The WHY project aim was to evaluate the physical health benefits of LINE in order to:

- Create healthier school environments for school-age children
- Identify barriers to outdoor health promotion in greenspace
- Improve parental and child involvement in healthy weight management strategies

These three areas are discussed below.

Creating healthier school environments for children

The WHY project was successful in contributing to the evidence base for the multiple benefits that LINE entails: the study demonstrated that there are physical health benefits derived from LINE in terms of increased PA levels. Previous studies have concluded that children who spend more time outside are more active (Stone and Faulkner, 2014; Cooper et al., 2010). Concurringly, this study demonstrated higher levels of PA during LINE than during indoor lessons. Boys were generally more active during outdoor lessons than girls; however both boys and girls were more active in the outdoors in total.

The highest levels of PA seen in this study were during break time and lunch; however, great variations were noted between individual children, presumably due to greater individual choice of activity during free time. Fairclough et al. (2008) noted more gender differences in activity levels during recess, and Rush et al. (2012) found that the gap in PA levels between the most active children than the least active children was bigger during recess than during the rest of the school day. This tends to suggest that breaktime does not represent equitable increased PA. Outdoor curricular activities may be a more equal and consistent way of increasing overall PA levels. This is especially pertinent in schools located in areas of deprivation, where some children may not be equipped with the appropriate clothes and footwear for rainy days, therefore going out to play during recess in bad weather may be restricted, whereas in this case appropriate equipment was provided to all children during LINE and overcame socioeconomic differences in equipment.

The WHY project demonstrated that children were more active during outdoor sessions than indoors, with particularly high levels of PA during woodland LINE. Fjortorf (2004) explains how natural environments represent increased opportunities to children in terms of rough surface, topography and vegetation providing movement challenges which enhances play, PA and motor development. Ham Woods offers a bigger space to move around in and is less familiar than the school grounds, hence more interesting to explore. There are also increased opportunities for diverse activities such as climbing on trees and wading in the stream. Passy and Waite (2011) identify a range of benefits to woodland LINE including greater freedom, wilder and more natural space, child-led learning, negotiated boundaries, created activities and managed risk.

In the early stages of project planning for the WHY project an audit of school grounds and Ham Woods was carried out in partnership with SS2N (Plymouth City Council's Natural Infrastructure Team). The audit highlighted the work that SS2N has undertaken in Ham Woods in terms of accessibility and building community capacity, and highlighted the suitability of Ham Woods as a place for outdoor learning. Previous research demonstrate that green school grounds promote PA (Dyment and Bell, 2007), and while agreeing that this offers a good option and is especially important in areas where there is no nearby green space for schools to use, this study argues that when possible, nearby natural sites should be used for the purpose of outdoor learning and health promoting activities as these promote higher levels of MVPA.

Identifying barriers to outdoor health promotion in green space

There are strong links between deprivation and reduced access to green space (NCB, 2013). Socioeconomic barriers to outdoor health promotion in green space are effectively broken down by offering outdoor learning as part of the curriculum through LINE; all children regardless of socio-economic background are given the same opportunity to access natural environments and enjoy the multiple benefits that come with this, including higher levels of PA and associated positive long-term health outcomes. Moreover, children who become familiar with natural spaces through LINE can impose a change in attitude on their parents. A study by Damerell et al. (2013) demonstrates that environmental education aimed at children will affect the knowledge of their parents and the behaviour of the family. This has the potential to overcome the risk-adverse culture that has developed in the UK (Huggins and Wickett, 2011). WHY project participants told us that they visit the woodlands with their family outside of school hours, which indicates that they are influencing family behaviour, leading to an overall increase in use of the local woodland.

Improving parental and child involvement in healthy weight management strategies

Children's feedback on LINE was usually captured at the end of session, through discussion or a simple game where the children did thumbs up / thumbs down / in between. Informal feedback through children's comments and body language also fed into lesson planning. Parents and carers were invited to one LINE session per term to participate in children's activities and provide feedback, which might inform school's planning process. Although there were plans to hold a parent session as part of the WHY project, this did not materialise; hence this study is unable to report on parental feedback. However, informal encounters with parents in the woodland

suggested parents were supportive of LINE and inspired to use the woodlands. An extended research project funded by Good from Woods is building on this aspect of the WHY project to further explore children's, parents'/carers' and staff/volunteers' views and experiences of woodland LINE.

Research design

The action research study design was found valuable as it allowed findings through reflection to inform the research process and facilitated the collaborative working through its flexibility, previously described by Richardson and Grose (2013). The inbuilt element of practice change (Robinson, 2011) materialised through the practitioner-researcher's role as a change agent, reclaiming the public health leadership role of SCPHN/ school nursing which is highlighted in the school nurse vision (DH, 2012[a]). The joined-up working between a range of disciplines brought valuable aspects into promoting a whole-school approach to health, in line with the Odense Statement (2013).

This included working together with the school nurse team to carry out height and weight measurements of the children in the WHY project, and also keeping the school nurse lead and the designated SCPHN/school nurse for Mayflower Community Academy informed and involved in the research progress. Due to the high demands on local school nurses the collaboration with their team was limited; however this report will be shared with them and aims to inspire to further SCPHN/ school nurse involvement in environmental initiatives and together with allied Stepping Stones to Nature research (Aronsson, 2013, Tighe et al 2013, Richardson et al 2012) to embed a public health partnership approach to health promotion in schools.

Accelerometry

Accelerometry proved to be useful as a component in holistic school nurse health assessment as it offered an easy way of obtaining an objective measurement of PA. This study dedicated considerable time to the methodology associated with accelerometry, assessing the suitability and deciding on appropriate epoch size, cut-points etc for children. This was an important contribution since the GENEActiv accelerometers are relatively new on the market compared to the Actigraph accelerometers, which have been used for much longer and have many studies attached to them (http://www.actigraphcorp.com/). This study found that the GENEActiv accelerometers were well accepted by the participants: the children were always happy to have them attached in the mornings of the data collection days and did not seem to mind wearing them. Hopefully, the results from the WHY project - albeit small scale - will contribute to the evidence base for GENEActiv, and inform future research.

BMI

Through NCMP, school-aged children are measured in Reception year and year 6. The WHY project provided an interim measurement of the participants in year 2. Conducting an interim measurement is likely to be useful as a quicker feedback of interventions aimed to reduce childhood obesity. While national and local data demonstrate an increase in childhood obesity year-on-year (Public Health, PCC, 2013), the result of this study - albeit small scale - contradicts this trend: six children out of a total of nine children who were measured both in Reception and year 2 had

reduced their BMI from Reception to year 2, one child was on the same BMI centile now as in Reception, and only two children had increased their BMI during this time period. 80% of the children were of healthy weight and 20% were overweight, none of the children were underweight or obese. It is possible that the participants are of healthy weight because their parents/carers were keener to let their children participate in research about outdoor learning than parents/carers of for example obese children. However, observation of the whole class suggests that there are no obese children in the class. A recent systematic review by Langford et al. (2014) highlighted the link between PA interventions and a BMI reduction. Although childhood obesity is complex and there are lots of factors influencing children's BMI, the WHY project suggests that PA through LINE forms one of the contributing factors to reversing the negative trend generally seen in children's BMI levels. Furthermore, it may offer a more equitable and consistent way of increasing overall physical activity levels compared to targeted interventions or increases in breaktime, avoiding stigmatisation of overweight children or compounding sedentary patterns in free play.

Limitations

A limitation of this study is that PA was only measured during the course of a day during the five data collection days, not taking to account possibly compensatory behaviour. It could be that children are less active after a school-day where they have had LINE, because they are physically tired. However, evidence extracted from the reflective log suggests that children spend time in the woodland with their family after school, which would entail being physically active (walking to and within the woods, and probably engaging in activity through playing in the woods). This may be due to families increased interest, knowledge and confidence in accessing the woodland through LINE. Concurrent research has shown that children who are active during the school day are also more active after school (Rauh, 2013). Hence this study proposes that children may in fact be inspired by LINE to spend more time outdoors outside of school, consequently increasing the total amount of PA. As stated in the government's call for increased physical activity Moving More, Living More (HM Government, 2014): encouraging PA amongst children and young people is key to turning the tide on inactivity, as good habits established when young can last a lifetime. This study is limited by the small sample size, the lack of control groups and the context specificity of action research, which impacts ability to generalise to the wider school-aged population. Nevertheless the study findings will have relevance to other schools in similar circumstances. Multi-agency partnership working for child health improvement is a valuable process outcome of this project. It is expected that the benefits of partnership working through LINE in relation to physical activity will apply to children in other schools located in areas with high deprivation.

Conclusion

The WHY project linked school-based initiatives and access to green space with increased physical activity levels, which suggests possible positive long-term health outcomes. To be effective, sustainable and equitable, LINE needs to become a regular feature of schooling, perhaps even enshrined in the national curriculum, in order to give all children regardless of socio-economic background equal opportunity

to access natural environments and to enjoy the multiple benefits that come with this. This study suggests that strong partnerships between health, education and environmental sectors are required. This study has evidenced the benefits of appointing a SCPHN/school nurse researcher with local knowledge of partnership working between public health, nursing and education for outdoor health promotion in schools. Further research on a larger scale and over a longer period, with appropriate use of accelerometry, coupled with an exploration of the leadership role in promoting physical activity, would enable robust evidence to be gathered to develop and inform wider partnership approaches to whole school health promotion.

References

Aronsson, J. (2013) How can SCPHN/school nurses contribute to the sustainability agenda? *Community Practitioner* **86**(7), 38-40.

Colley, RC., Harvey, A., Grattan, KP. and Adamo, K. (2014) Impact of accelerometer epoch length on physical activity and sedentary behaviour outcomes for preschool-aged children. *Statistics Canada Catalogue no. 82-003-X Health Reports*, **25**(1), 3-9.

Cooper, AR., Page, AS., Wheeler, BW., Hillsdon, M., Griew, P. and Jago, R. (2010) Patterns of GPS measured time outdoors after school and objective physical activity in English children: the PEACH project. *International Journal of Behavioral Nutrition and Physical Activity*. **7**(1), 1-9. DOI:10.1186/1479-5868-7-31.

Damerell, P., Howe, C. and Milner-Gulland, E.J. (2013) Child-orientated environmental education influences adult knowledge and household behaviour. *Environmental Research Letters* **8**(1), 015016. DOI:10.1088/1748-9326/8/1/015016.

Department of Health (2012[a]) *Getting it right for children, young people and families - Maximising the contribution of the school nursing team: Vision and Call to Action.* Available from: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_133011 [Accessed August 2013].

Department of Health (2009) *Healthy Child Programme 5-19*. London: Department of Health.

Department of Health (2010) *Healthy lives, healthy people: our strategy for public health in England*. Norwich: The Stationary Office.

Department of Health (2012[b]) *Improving outcomes and supporting transparency - a public health outcomes framework for England, 2013-2016*. Available from: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_132559.pdf [Accessed August 2013].

Department of Health (2011) *Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers*. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf [Accessed June 2014].

Dillon, J. and Dickie, I. (2012) *Learning in the Natural Environment: Review of social and economic benefits and barriers.* Natural England Commissioned Reports, Number 092.

Dyment, J. and Bell, A. (2007) Active by Design: Promoting Physical Activity through school Ground Greening. *Children's Geographies,* **5**(4), 463 – 477.

Fairclough, SJ., Butcher, ZH. and Stratton, G. (2008) Primary school children's health enhancing physical activity patterns: the school as a significant environment?

Education 3-13: International Journal of Primary, Elementary and Early Years Education, **36**(4), 371-381.

Fjørtoft, I. (2004) Landscape as Playscape: The Effects of Natural Environments on Children's Play and Motor Development. *Children, Youth and Environments*, **14**(2), 21-44.

Greaney, ML., Hardwick, CK., Spadano-Gasbarro, JL., Mezgebu, S., Horan, CM., Schlotterbeck, S., Austin, SB. and Peterson, KE. (2014) Implementing a Multicomponent School-Based Obesity Prevention Intervention: A Qualitative Study. *Journal of Nutrition Education and Behavior,* 27 May 2014, 1499-4046. DOI: http://dx.doi.org/10.1016/j.jneb.2014.04.293.

Growing Schools (2014) *Natural Connections Demonstration Project*. Available at: http://www.growingschools.org.uk/about/natural-connections [Accessed May 2014].

HM Government (2014) Moving More, Living More - The Physical Activity Olympic and Paralympic Legacy for the Nation. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/279657/moving_living_more_inspired_2012.pdf [Accessed May 2014].

Huggins, V. and Wickett, K. (2011) Crawling and toddling in the outdoors: very young children's learning. In: S. Waite (ed.) *Children Learning Outside the Classroom from birth to eleven*. pp.20-34. London: SAGE.

Langford, R., Bonell, CP., Jones, HE., Pouliou, T., Murphy, SM., Waters, E., Komro, KA., Gibbs, LF., Magnus, D. and Campbell, R. (2014) *The WHO Health Promoting School framework for improving the health and well-being of students and their academic achievement*. Cochrane Database of Systematic Reviews 2014, Issue 4. Art. No.: CD008958. DOI: 10.1002/14651858.CD008958.pub2.

Lewis, I. and Lenehan, C. (2014) *Report of the Children and Young People's Health Outcomes Forum 2013/14*. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/307011/CYPHOF_Annual_Report_201314_FORMAT_V1.5.pdf [Accessed June 2014].

Marmot, M. (2010) *Fair society, healthy lives: strategic review of health inequalities in England post-2010*. London: The Marmot Review.

Mukherji, P. and Albon, D. (2010) *Research Methods in Early Childhood, An Introductory Guide*. London: Sage.

National Children's Bureau (NCB). (2013) *Greater Expectations - Raising aspirations for our children*. London: NCB.

Passy, R. and Waite, S. (2011) School gardens and Forest Schools. In: S. Waite (ed.) *Children Learning Outside the Classroom from birth to eleven*. pp. 162-175. London: SAGE.

Phillips, L., Parfitt, G. and Rowlands, A. (2012) Calibration of the GENEA accelerometer for assessment of physical activity intensity in children. *Journal of Science and Medicine in Sports.* Available from http://dx.doi.org/10.1016/j.jsams.2012.05.013 [Accessed February 2014].

Public Health England (PHE). (2014) *Child Health Profile*. Available from: http://www.chimat.org.uk/resource/view.aspx?RID=101746&REGION=101635 [Accessed June 2014].

Public Health England (PHE). (2013) *How healthy behaviour supports children's wellbeing*. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/232978/Smart_Restart_280813_web.pdf [Accessed June 2014].

Public Health England (PHE) (2014) *National Child Measurement Programme Operational Guidance*. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/308248/NCMP_updated_operational_guidance_02052014__3_.pdf [Accessed March 2014].

Public Health, Plymouth City Council. (2013) *Plymouth's National Child Measurement Programme (NCMP) Report 2012/13.* Available from: http://www.plymouth.gov.uk/plymouths_national_child_measurement_programme.pdf [Accessed June 2014].

Rauh, EM. (2013) School-day physical activity in elementary school children: when and how much? MSc thesis, Colorado State University, Department of Health and Exercise Science, 83 pages; 1544836.

Richardson, J. and Grose, J. (2013) An action learning approach to partnership in community development: a reflection on the research process. *Action Learning: Research and Practice* **10**(3), 254-263. DOI: 10.1080/14767333.2013.840060.

Robinson, C. (2011) *Real world research*. Chichester: John Wiley & Sons Ltd.

Roe, J. and Aspinall, PA. (2012) Adolescents' Daily Activities and the Restorative Niches that Support Them. *International Journal of environmental Research and Public Health,* **9**(9), 3227-3244. DOI:10.3390/ijerph9093227.

Rowlands, AV., Powell, SM., Humphries, R. and Eston, R. (2006) The Effect of Accelerometer epoch on Physical Activity Output Measures. Journal *of Exercise Science & Fitness*, **4**(1), 51-57.

Rush, E., Coppinger, T., Obolonkin, V., Hinckson, E., McGrath, L., McLennan, S. and Graham, D. (2012) Use of pedometers to quantify less active children and times spent in moderate to vigorous physical activity in the school setting. *Journal of Science and Medicine in Sport*, **15**(3), 226-230.

Schaefer, CA., Nigg, CR., Hill, JO., Brink, LA. and Browning, RC. (2013) Establishing and Evaluating Wrist Cutpoints for the GENEActiv Accelerometer in Youth. *Medicine in Science in Sports and Exercise,* **46**(4), 826-33. DOI: 10.1249/MSS.0000000000000150.

Sherar, LB., Griew, P., Esliger, DW., Cooper, AR., Ekelund, U., Judge, K. and Riddoch, C. (2011) International children's accelerometry database (ICAD): Design and methods. *BMC Public Health.* **11:**485. DOI:10.1186/1471-2458-11-485.

Stone, MR. and Faulkner, GE**J**. (**2014**) Outdoor play in children: Associations with objectively-measured physical activity, sedentary behavior and weight status. Prev**entive** Med**icine** 65, 122-7. **DOI**: 10.1016/j.ypmed.2014.05.008.

The Odense Statement: Our ABC for equity, education and health. (2013) Available from: http://schools4health.dk/ [Accessed May 2014].

Tighe, M., Whiteford, A. and Richardson, J. (2013) Stepping Out: Enabling community access to green space through interdisciplinary practice learning in Plymouth, UK. *International Journal of Practice-based Learning in Health and Social Care* **1**(2), 8-22. DOI: 10.11120/pblh.2013.00013.

Townsend, M. and Weerasuriya, R. (2010) *Beyond blue to green: The benefits of contact with nature for mental health and well-being*. Melbourne, Australia. Melbourne, Australia: Beyond Blue Limited.

Waite, S. (2011) *Children Learning Outside the Classroom, from birth to eleven*. London: SAGE.

Wood, C., Hine, R. and Barton, J. (2011) The health benefits of the Youth Outdoor Experience (YOE) project. Available from: http://www.walkingforhealth.org.uk/sites/default/files/Yoe%20Report%20final%20version.pdf [Accessed June 2014].

Appendix: Conference, presentation and publications outputs

Project disseminations and consultations undertaken as part of WHY project

- 28.11.13 Project dissemination at Growing Plymouth's Health and Wealth through the Natural Environment conference (PCC Natural Infrastructure Team, Plymouth City Council)
- 12.01.14 Submitted response to a 'Healthy Lifestyles/ Obesity Care Pathway for School Nursing' consultation (Department of Health, 2014)
- 18.02.14 Project dissemination at the Sustainability, Society and Health Research cluster meeting (Plymouth University, 18/02/2014)
- 14.03.14 Project dissemination at Healthy Places Matter conference (Peninsula Public Health Network, 14/03/2014)
- 10.05.14 Submitted response to the 'Developing a national physical activity approach' consultation (Public Health England, 2014)
- 04.07.14 Project dissemination at Walking the Talk Conference (Outdoor and Experiential Learning Research Network, Natural Connections Demonstration Project and Good from Woods) Plymouth University
- 03.09.14 Project dissemination at European Outdoor Education conference: Under the open sky: Supporting young people´s Well-being through outdoor experiences in formal and non-formal education - European perspectives. Iceland.
- 20.11.14 Invited workshops for project dissemination at 14th British Heart Foundation National Centre annual conference, Physical health by stealth. Gaydon, Warwickshire.
- Case study in Allen, J. & Balfour, R. (2014) Natural solutions for tackling health inequalities. https://www.gov.uk/government/news/natural-solutions-for-tackling-health-inequalities-conference-report

Continuing partnership projects derived from the WHY project

- 'A qualitative study of the physical health benefits and well-being outcomes associated with outdoor learning in natural environments (LINE) for school-age children' - ongoing extended action research project through Good from Woods (Silvanus Trust and Plymouth University, 2014)
- Submitted Book Chapter – Waite, S. Aronsson, J, Tighe, M (2014) WHY Project Case Study in 'On the Move -Green Education' – in peer review
- Submitted JBI Systematic Review protocol on the impact of outdoor learning on the physical activity of school-aged children (M. Tighe, S. Waite, J. Aronsson, J. Richardson, S. Manzi – protocol in peer review (JBI-submitted)
- Planned guidelines for outdoor practice (to follow on Systematic Review)
- Funding bids x 2 (ESRC and Reaching Communities) + continued discussion re. future NIHR bid

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