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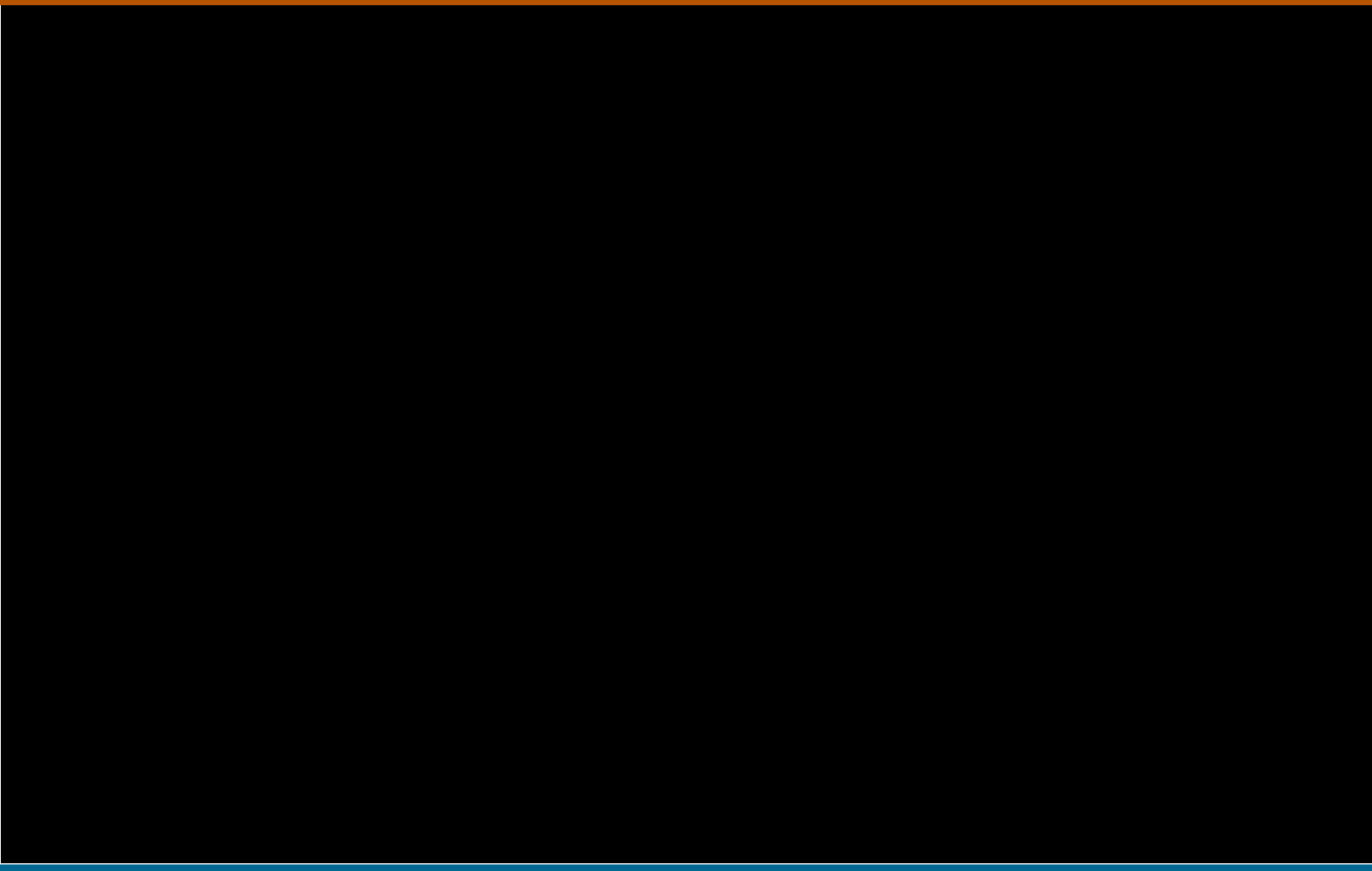

OBJECTIVELY MEASURED PHYSICAL ACTIVITY LEVELS OF SCOTTISH CHILDREN: ANALYSIS FROM A SUB-SAMPLE OF 10-11 YEAR OLDS IN THE GROWING UP IN SCOTLAND STUDY

Growing Up in Scotland

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SCOTTISH GOVERNMENT

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Any enquiries regarding this publication should be sent to us at
The Scottish Government
St Andrew's House
Edinburgh
EH1 3DG

ISBN: 978-1-78851-109-4 (web only)

Published by The Scottish Government, August 2017

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS269286 (08/17)

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Date: 2017

ACKNOWLEDGEMENTS

First and foremost, the authors would like to thank all the families, and in particular the children, who have kindly engaged in the study. It is a large undertaking and for that we are extremely grateful.

Without the assistance of our colleagues at Scotcen, this study would not have been possible. For their continued support and partnership, we are very thankful.

To those who helped in the preparation of the report, we extend our most gracious thanks. We owe a great deal of gratitude to our colleagues at SPHSU, particularly David Walker, Claire Anderson, Matthew Tolan, and the rest of the SPACES team for all the hard work invested in getting the data ready for the report. We are also grateful to Natalie Nicholls and Ana Perez for their assistance in statistical analyses in an earlier stage of the project.

Responsibility for the opinions expressed in this report, and for all interpretation of the data, lies solely with the authors.

CONTENTS

EXECUTIVE SUMMARY

Introduction

This report is an exploration of objectively measured and self-reported physical activity and sedentary levels in Scottish 10-11 year old participants in the longitudinal Growing Up in Scotland (GUS) study. We present these activity levels using two differing approaches: self-reported (questionnaire based), and objectively measured (i.e. using activity monitors) physical activity. A key objective of this report was to explore the socio-economic and gender patterning of activity and assess whether these patterns differ by alternative physical activity measurement assessment approaches. The analyses presented within the report form part of a wider academic study exploring the environmental determinants of physical activity in young people that also incorporates GPS data on where young people are most active[1].

Research questions

1. What are the objectively measured physical activity and sedentary levels of Scottish 10-11 year old children?
2. What proportion of Scottish 10-11 year old children meet the current nationally recognised physical activity guidelines of accumulating at least 60 minutes of moderate to vigorous (MVPA) per day when objectively measured?
3. Do differences in physical activity/sedentary levels and proportion of children meeting the guidelines exist by gender and area level deprivation?
4. Do gender or socio-economic patterns differ by whether self-reported or objective methods are used to assess physical activity?

The Growing Up in Scotland study

The Growing Up in Scotland (GUS) study is a nationally representative cohort study that began in 2005 with an aim of tracking the lives of children through childhood and beyond. Fieldwork for the present report took place between May 2015 and May 2016. From an invited sample of 2,162 children, 774 (36%) provided valid data for the analysis in this report. Data was weighted to address response bias, and therefore ensure the representativeness of the sample to the wider population of 10-11 year old children living in Scotland.

Measurement of Physical activity

Physical activity was measured through two separate methods: (i) objectively through an accelerometer activity monitor (ActiGraph GT3X+), and (ii) via self-report using the Physical Activity Questionnaire for Children (PAQ-C). Physical activity monitors were requested to be worn on a belt around the waist for 8 consecutive days (with a minimum of five days, including one weekend day, required to be included in this report) and data from the devices were used to classify the level of children's activity throughout the day as time spent (a) Sedentary or (b) in Moderate to Vigorous Physical Activity (MVPA). Time spent in MVPA was used to estimate the proportion of children who currently meet the UK's joint Chief Medical Officers (CMO) recommended physical activity guidelines of at least 60 minutes of MVPA *every* day (the 'threshold' approach). In addition, a proportion was calculated for those who spent *on average* 60 minutes or more per day in MVPA (the 'averaging' approach).

1 SPACES – Studying Physical Activity in Children's Environments across Scotland. http://spaces.sphsu.mrc.ac.uk/

The self-reported questionnaire was used to create a measure of 'general levels'[2] of physical activity resulting in an activity score between 1 and 5 (with 5 representing higher levels of activity).

Although the nature of the self-report measure did not allow assessment of guideline adherence that could be compared with the objective measure, both measures were compared for how they classified active versus non-active children.

Both the objective measure and the self-report measure were used to examine differences in activity level by gender and area deprivation.

Main findings

Activity levels of 10-11 year olds in Scotland

- On average, children were sedentary for 7.5 hours per day (7.7 hours during weekdays and 7.1 hours on weekends) - *objectively measured*.
- On average, children spent 73 mins in moderate to vigorous physical activity (MVPA) per day (76 minutes per weekday and 64 minutes per weekend day) - *objectively measured*.
- 11% of children achieved the current recommended levels of daily MVPA when analysed with the requirement of at least 60 minutes of MVPA *every day* ('threshold approach') - *objectively measured*.
- 60% of children achieved the current recommended levels of daily MVPA when analysed with the requirement of at least 60 minutes MVPA per day *on average* ('averaging approach') - *objectively measured*.
- On average, children scored 3.12 on the Physical Activity Questionnaire for Children (PAQ-C) – *self-reported***.** This is similar to data from English children which found a mean PAQ-C score of 3.10 in children aged 10-11 years old.[3] A number of 'cut- off' levels have been introduced with scores of 3.0 being consistently recognised as 'high activity'. On average, Scottish 10-11 year olds, as measured by the PAQ-C thus demonstrate high activity levels.

Differences by Gender

- No statistically significant differences in objectively measured sedentary behaviour were found by gender (7.6 hours vs. 7.4 hours, girls and boys respectively) - *objectively measured*.
- Yet boys spent significantly more time in objectively measured MVPA than girls (78 minutes vs. 68 minutes) - *objectively measured*.
- No statistically significant gender differences were found in the 'threshold' approach to guideline adherence (12% boys and 11% girls); however, a significantly higher proportion of boys met the guidelines than girls when using the 'averaging' method (69% vs. 52%) - *objectively measured*.
- Boys scored significantly higher on the PAQ-C than girls (3.19 vs. 3.05)[4] - *self-reported*.

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2 The self-report questionnaire is designed to provide a general measure of how much physical activity features in a respondent's daily lifestyle. It is not intended to measure frequency, intensity, or duration.

3 N>300, (Voss, Ogunleye, & Sandercock, 2013)

4 This gender difference is comparable to that observed in the East of England Healthy Hearts Study (Voss, et al., 2013) of English children (boys 3.2, and girls 3.04) of a similar age

Differences by level of Deprivation

- No statistically significant differences in sedentary time were found across quintiles of the Scottish Index of Multiple Deprivation (SIMD) - *objectively measured*.
- No statistically significant differences in MVPA were found by SIMD quintile - *objectively measured*.
- No statistically significant differences in PAQ-C scores were found by SIMD quintile - *self-reported*.
- It is of interest to note that when these children were aged 6, mothers' reports of physical activity also did not differ greatly by area deprivation.

Difference in gender and socioeconomic patterning by method of assessment

- Both objective and self-reported methods identified gender differences in physical activity (MVPA and PAQ-C score).
- Both objective and self-reported methods identified little patterning by either MVPA or PAQ-C score by SIMD quintiles.

Discussion and conclusions

Discussion and debate exists within the field of physical activity measurement regarding the differences between what is objectively known (e.g. accelerometry) and what is self- reported (e.g. questionnaire), with self-reported methods often considered as an inferior set of measurement approaches. Our report illustrates that both methods of measuring physical activity are able to identify gender differences in this age group, whilst also demonstrating similar socioeconomic patterns. Depending on the reason for conducting large scale population surveillance studies (e.g. to track the potential social inequalities in physical activity across time using SIMD quintiles), there is an argument, if the data supports the intended outcomes, to use self-reported physical activity levels from the PAQ-C. This has a number of logistical and financial benefits including ease of administration (and potentially low participant burden) and lower set up and operating costs.

Our report highlights a continuation of a long standing issue within the physical activity literature, namely the discrepancy between the objectively measured proportion of children who meet the current physical activity guidelines (and their multiple methods of analytical approach), and that which is derived from self/proxy-reported measurement. Our results suggest that either 11% or 60% of 10-11 year old Scottish children meet the current recommended daily guidelines of physical activity. Additionally, depending on the approach used, boys are more likely to meet the guidelines than girls at this age. These figures are lower than that reported at a national level (e.g. the Scottish Health Survey and Health Behaviour in School-aged Children survey), and further research should investigate the discrepancy between methods.

chapter 1

INTRODUCTION

The generation of robust data on children's physical activity levels provides policy makers with accurate data to inform government policies and priorities; for example, the accurate capture of inequality in physical activity, if it exists, in gender and across the socio-economic spectrum. Previous children's physical (in)activity investigations using data from Growing up in Scotland (GUS) have asked the main carer to recall activity levels on the children's behalf. At age 6, there was no clear social inequality in the patterning of children's physical activity. However, it is possible that this was due to the type of methodology used to collect the data (i.e. using the memory recall of the main carer). This report is an exploration of objectively measured and self-reported physical activity and sedentary levels in Scottish 10-11 year old children. Its primary purpose is to report baseline physical activity levels from children involved in GUS. We present these activity levels using two differing approaches: self-reported, and objectively measured (i.e. using activity monitors) physical activity. Importantly, a key objective of this report was to explore the socio-economic and gender patterning of activity as measured by each methodological approach as a means to inform future methods and policy. The analyses presented within the report form part of a wider academic study exploring the environmental determinants of physical activity in young people that also incorporates GPS data on where young people are most active[5].

1.1 Research questions

1. What are the objectively measured physical activity and sedentary levels of Scottish 10-11 year old children?
2. What proportion of Scottish 10-11 year old children meet the current nationally recognised physical activity guidelines of accumulating at least 60 minutes of moderate to vigorous (MVPA) per day when objectively measured?
3. Do differences in physical activity/sedentary levels and proportion of children meeting the guidelines exist by gender and area level deprivation?
4. Do gender or socio-economic physical activity patterns differ by whether self-reported or objective methods are used to assess physical activity?

1.2 Background

Physical inactivity is the fourth leading cause of death worldwide (Kohl et al., 2012). Being inactive is a significant predictor of mortality and morbidity, including cardiovascular disease, type 2 diabetes, obesity, some cancers, poor skeletal health, mental health, and poor quality of life (Hallal et al., 2012). Immediate and future benefits of a physically active lifestyle in children are plentiful and include the strengthening of bones, and the reduction in the incidence of metabolic risk factors such as hypertension and obesity - two strong predictors

5 SPACES – Studying Physical Activity in Children's Environments across Scotland. http://spaces.sphsu.mrc.ac.uk/

of the aforementioned conditions and illnesses (Hallal, Victora, Azevedo, & Wells, 2006). There is also an increasing recognition that sedentary behaviour has a significant influence on cardiometabolic risk in children, independent of total physical activity (Vaisto et al., 2014). The concern over sedentariness is amplified as sedentary time in childhood has been shown to track into adulthood (Biddle, Pearson, Ross, & Braithwaite, 2010; Magnussen et al., 2010).

1.2.1 Policy Context

Physical activity has been supported at national policy level for a number of years (HEBS, 1997) but with a growing body of evidence pointing to the health risks associated with physical inactivity and the benefits of being active for people of all ages, there has been an increased focus by the Scottish Government, building particularly on the success of the Commonwealth Games in 2014. The Scottish Government is committed to increasing rates of physical activity and through the Active Scotland Outcomes Framework[6] and Physical Activity Implementation Plan[7]. Scotland is leading the way in its strategic response to the challenge of increasing physical activity and reducing sedentary behaviour.

The Active Scotland Outcomes Framework sets out Scotland's ambitions for a more active Scotland. Success will rely on the collective efforts of communities, individuals and a wide range of partners in areas such as health and social care, education, environment, transport, communities and sport and active recreation. The outcomes will be achieved through the delivery of the Physical Activity Implementation Plan, which adapts key elements of the 2010 gold standard advocacy tool, the Toronto Charter for Physical Activity (Bull et al., 2010), to Scotland. Oversight of the Active Scotland Outcomes Framework sits with the National Strategic Group for Sport and Physical Activity (NSG), chaired by the Minister for Public Health and Sport. The Active Schools Network and the National Walking Strategy ('Let's Get Scotland Walking', 2014) highlight some of the cross theme work that is being conducted in Scotland.

A range of indicators track progress on the Active Scotland Outcomes Framework, using data from the Scottish Health Survey (SHeS) and other sources. The importance of physical activity is also recognised through the National Performance Framework[8], where National Indicators are used to monitor the Government's progress towards sixteen designated National Outcomes. One of the National Indicators is to 'increase physical activity'. Physical activity is also relevant to a number of other National Performance Framework indicators, such as active travel, educational attainment and mental wellbeing.

1.2.2 Physical Activity Assessment

Physical activity assessment is a challenging undertaking. This is largely because physical activity is a complex behaviour characterised by multiple dimensions and domains: frequency, duration, intensity, and type are all dimensions that can, and arguably should, be measured; leisure time, transportation, in-school, and after-school physical activity are all domains that could be considered important to measure. No one measurement tool exists that can measure all four dimensions of physical activity accurately and reliably (Trost, 2007). Self-report methods are convenient and relatively inexpensive to administer, and are often the most practical and feasible method to use in population surveillance. They have however

6 http://www.gov.scot/Topics/ArtsCultureSport/Sport/Outcomes-Framework
7 http://www.gov.scot/Topics/ArtsCultureSport/Sport/MajorEvents/Glasgow-2014/Commonwealth-games/Indicators/PAIP
8 http://www.gov.scot/About/Performance/purposestratobjs

been subject to criticism: self-reported tools measure perceptions of physical activity rather than physical activity per se and can therefore overestimate levels and prevalence of physical activity (Basterfield et al., 2008); they rely heavily on a respondent's ability to recall activity which may be age-dependent (Baranowski et al., 1984); and the quality of self-reported data is reliant upon the questions asked being matched to the cognitive capabilities of the respondent (Biddle, Gorely, Pearson, & Bull, 2011). The main group of alternative methods to measure physical activity fall under what is considered 'objective measurement' i.e. activity monitors, such as accelerometers, which are small, unobtrusive, and robust battery operated devices that can measure and record movement of the body (or limb). Common places for these to be worn are on the wrist or around the waist. Quite simply, these devices measure and record 'movement' (more precisely, acceleration) and it is this movement that can be translated into useful information such as frequency, intensity, and duration of physical activity. As such, these devices record 'actual' activity, and can provide valid and reliable estimates of physical activity levels in a number of different population groups, including children (Trost, 2007). Although viewed as a promising tool for quantifying physical activity levels in children, this type of method is accompanied by a number of challenges: i) these devices are rarely waterproof and so normally require to be removed before water based activities; and ii) the increased energy expenditure associated with stair ascent, cycling, lifting or carrying objects are often underestimated (a single waist mounted device will not measure upper body activity for instance). However, the contribution of these activities to overall physical activity is assumed to be relatively small (i.e. hip mounted activity monitors will capture the majority of total body movement) and these devices often produce strong positive correlations with energy expenditure as measured in concurrent validity studies (Freedson, Pober, & Janz, 2005; Trost, 2007).

1.2.3 What is currently known about levels of PA among Scottish children?

Information on physical activity levels in Scotland come from a small number of sources. Primarily, the Scottish Heath Survey (SHeS) is used to monitor children's activity levels - where parents are interviewed and asked to recall their children's activity - and provides comparable historical data that allows trends to be monitored. The SHeS is the key source of data for the Active Scotland Outcomes Framework, and in 2015, it showed that 73% of all children were sufficiently active to meet the current national physical activity guidelines (Hovald, 2016) as set out by the Chief Medical Officers of the UK - engaging in physical activity of at least moderate intensity for 60 minutes every day (Department of Health, 2011). It also showed that boys were more likely to meet the guidelines than girls (77% v 69%, 2015 data, including school based activity). Activity levels tend to decrease in the adolescent years, particularly among females; data from the 2014 SHeS showed that 82% of children aged 5-7 and 8-10 met the physical activity guideline of 60 minutes, and by age 13-15 this had dropped to 63%. The reduction was most pronounced between the ages of 11-12 (77%) and 13-15 (63%), particularly for girls (a drop from 73% to 53%; including school activity 2014 data; (Gill, 2015). Taking the period from 1998 to 2014, the SHeS has found little significant differences between area level deprivation categories and the proportion of children meeting the physical activity guidelines, although there have been increases in physical activity *levels* since 2008 that vary significantly by area deprivation, with the greatest increases seen among children living in the middle (third most deprived) quintile (Gill, 2015).

Other data sources exist but are limited to specific age groups, e.g. the Health Behaviour in School-aged Children Survey (HBSC) (11, 13, and 15 year olds)[9], and the Millennium Cohort Study (MCS; ages 7 and soon to be 14 years old)[10]. Self-reported data from the HBSC study shows an age related decline in physical activity (from 11 through to 15 years old), in addition to a gender gap at age 11 (29% of boys and 21% of girls meet the guidelines of at least 60 minutes of moderate to vigorous physical activity (MVPA) per day). HBSC also indicated the existence of socio-economic inequalities where boys and girls from more affluent families were more likely to achieve 60 minutes of MVPA. The MCS is one of the few studies that has objectively measured physical activity (accelerometry) in a representative sample of UK children at age 7 (Griffiths et al., 2013). Boys were shown to be more active at this age, both in terms of time spent in MVPA and likelihood of meeting the 60 minute guideline, which was 63.6% vs. 37.8% amongst girls. But no clear socioeconomic differences in physical activity levels were apparent.

9 http://www.hbsc.org/
10 http://www.cls.ioe.ac.uk/page.aspx?sitesectionid=851

chapter 2

METHODS

2.1 Sample

The Scottish Government and Scotcen Social Research have worked in partnership to provide the MRC/CSO Social and Public Health Sciences Unit (SPHSU), University of Glasgow with access to - subject to consent from families - the GUS Birth Cohort 1 (BC1) sample. GUS is a longitudinal cohort study that began in 2005 with an aim of tracking the lives of children through childhood and beyond. BC1 is the first of two GUS birth cohorts to have been followed from age 10 months. Now aged 10 years, the cohort form the sample for this report[11].

The data collection for this study took place between May 2015 and May 2016, following the eighth sweep of the GUS main interview stage[12]. Ethical approval was provided by the College of Social Sciences, University of Glasgow.

As part of the GUS sweep eight interviews, respondents were provided with brief information about a sub-study, Studying Physical Activity in Children's Environments across Scotland - SPACES[13] being conducted by SPHSU and asked if their contact details could be passed on to SPACES staff. From a possible 2,402 children who had participated in sweep 8 of GUS, 90% (n=2,162) consented to be contacted by SPHSU. This number represents 41% of the original sweep 1 families (n=5217).

Those who consented to be contacted were similar to the GUS sweep 8 sample, with very slight differences across certain socioeconomic demographics: the consenting sample contained slightly lower proportions of children from mothers with no educational qualification (4.6% compared to 5.1% in those consented to be contacted), and slightly higher proportions of children from families with household income between £38,000-£44,000 (8.6% compared to 8.1% who consented). No differences existed in Body Mass Index (BMI).

2.1.1 Sample Characteristics

From the 2,162 GUS children who consented to be contacted, 1,096 children took part in the data collection, representing 46% of the overall GUS sweep 8 phase 1 sample. From these 1,096 participants, 859 children sent data back to SPHSU for processing, representing 40% of the possible recruitment sample. 774 children (mean age of 11.1 years old; representing 36% of possible recruitment sample and 71% of those who participated) provided at least 4 weekdays and 1 weekend day data, of which 417 (54%) were girls and 357 (46%) were boys. All weighting procedures and statistical analyses were based on these 774 participants (see Analysis section)[14].

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11 Available from: http://doc.ukdataservice.ac.uk/doc/5760/mrdoc/pdf/5760_userguide_cohort1_sweep1.pdf

12 The cohort is split across two academic years. This study focused on the children who started Primary 6 in August 2014 (approximately 3/4 of the full BC1) and who took part in the first phase of sweep 8.

13 http://spaces.sphsu.mrc.ac.uk/

14 See Appendix B for the technical note regarding the survey weights developed for this sample.

Unweighted demographic characteristics of those who returned valid data are summarised in Table 1. Means and standard deviations are presented for numerical variables and proportions for categorical variables.

The average height was 140.4cm (girls 140.0 cm, boys 140.9 cm). The average weight across the sample was 35.4kg (girls 35.4, boys 35.4). Just under half (47%) of the children in the sample lived in households where at least one adult had a degree level qualification, while 4% of the sample came from a household where the parents/carers had no qualifications or lower level qualifications. Around two fifths (42%) of the children lived in households where the annual income was over £50,000, and a small proportion (1.4%) lived in a household with an annual income of less than £10,000 per year. In relation to the child's location as defined by the Scottish Government Urban Rural Classification[15], approximately 31% of the children lived in a Large Urban Area (a settlement of over 125,000 people) and around 10% were classified as living in a remote rural area (a settlement of less than 3,000 people and with a drive time of over 30 minutes to a settlement of 10,000 or more). In our sample, over one-third of the children lived in the least deprived areas and 8.3% in the most deprived areas.

Compared to the full sweep 8 phase 1 distribution (2,402 children), the sample contained slightly lower proportions of children classified as obese (13.0% compared to 17.3% in full sample), but greater proportions of children within the healthy weight (68.7% compared to 65.2%). Children whose parent/carer had no educational qualifications (1.8% compared to 5.1%), Lower level Standard Grades (2.2% compared to 4.4%), and Upper level Standard Grades (14.2% compared to 20.2 %) were underrepresented in the sample; children whose parent/carer held degree level qualifications (47.0% compared to 36.2%) were overrepresented. Compared to the sweep 8 phase 1 distribution, the sample within this report contained slightly lower proportions of children from households earning less than £9,999 (1.4% compared to 2.8%), £10,000-£19,999 (9.4% compared to 15.2%), and £20,000-£28,999 (10.6% compared to 13.2%), but contained higher proportions of children from households earning £38,000-£49,999 (16.8% compared to 14.7%) and households earning over £50,000 (42.0% compared to 33.1%).

15 http://www.gov.scot/Publications/2014/11/2763

Table 1 - Sociodemographic characteristics of the participants who returned valid data (unweighted)

Variable	Girls (n=417)	Boys (n=357)	all (n=774)
Height in cm ± SD	140.0 ± 6.8	140.9 ± 9.8	140.4 ± 8.3
Weight in kg ± SD	35.4 ± 8.1	35.4 ± 7.8	35.4 ± 7.9
Highest level of education of primary carer/parent			
Missing*	3 (0.7%)	0 (0.0%)	3 (0.8%)
No qualifications	7 (1.7%)	7 (2.0%)	14 (1.8%)
Other	1 (0.3%)	2 (0.6%)	3 (0.4%)
Lower level Standard Grades and Vocational	9 (2.2%)	8 (2.2%)	17 (2.2%)
Upper level Standard Grades/Intermediate Vocational	65 (15.6%)	45 (12.6%)	110 (14.2%)
Higher grades /Upper level vocational	157 (37.6%)	106 (29.7%)	263 (34.0%)
Degree level academic and vocational	175 (42.0%)	189 (52.9%)	364 (47.0%)
SIMD quintile			
1 (most deprived)	35 (8.4%)	29 (8.1%)	64 (8.3%)
2	55 (13.2%)	44 (12.3%)	99 (12.8%)
3	96 (23.0%)	73 (20.4%)	169 (21.8%)
4	110 (26.4%)	97 (27.2%)	207 (26.7%)
5 (least deprived)	121 (29.0%)	114 (31.9%)	235 (30.4%)
Urban/rural indicator			
Large urban areas	124 (29.7%)	115 (32.2%)	239 (30.9%)
Other urban areas	125 (30.0%)	98 (27.5%)	223 (28.8%)
Accessible small towns	47 (11.3%)	33 (9.2%)	80 (10.3%)
Remote small towns	19 (4.6%)	7 (2.0%)	26 (3.4%)
Accessible rural	67 (16.1%)	64 (17.9%)	131 (16.9%)
Remote rural	35 (8.4%)	40 (11.2%)	75 (9.7%)
Household income category			
Missing	22 (5.3%)	19 (5.3%)	41 (5.3%)
<£3,999-£9,999 pa	6 (1.4%)	5 (1.4%)	11 (1.4%)
£10,000-£19,999 pa	34 (8.2%)	39 (10.9%)	73 (9.4%)
£20,000-£28,999 pa	42 (10.1%)	40 (11.2%)	82 (10.6%)
£29,999-£37,999 pa	62 (14.9%)	50 (14.0%)	112 (14.5%)
£38,000-£49,999pa	80 (19.2%)	50 (14.0%)	130 (16.8%)
£50,000 pa	171 (41.0%)	154 (43.1)	325 (42.0%)

*Missing = 'Don't know', 'Refusal', or 'No Information'

Percentage figures rounded to 1 decimal place

2.2 Recruitment to the Study

For each group of participants, study information, registration documents, and consent forms were issued by post using the main parent/carer as primary contact. The primary contact was asked to return registration documents and consent forms back to SPHSU before their son/daughter could be enrolled on the study. SPHSU staff phoned the primary contact one week following the postal date to check that participants had received the documentation. SPHSU staff were able to enrol participants over the phone if required (although completed consent forms were still required to be returned before any data could be used) and a start date for study equipment to be delivered to the home (or most appropriate location) was organised.

2.3 Data Collection

Participants were sent all necessary equipment through the post. Packaging and contents had been carefully prepared and piloted to ensure the contents would fit through most letterboxes. A pre-paid envelope was provided to return the study materials upon completion of the protocol.

2.4 Physical Activity Measurement

Physical activity was measured through two separate methods: objectively through an accelerometer activity monitor (the ActiGraph GT3X+), and through self-report, using the Physical Activity Questionnaire for Children (PAQ-C), which had the terminology and language adapted for use in the UK.

2.4.1 ActiGraph GT3X+ accelerometer

The ActiGraph GT3X+ (ActiGraph, Pensacola, Florida) is an activity monitor that measures acceleration across three axes[16]. Small (4.6 x 3.3 x 1.5cm), lightweight (19g), and unobtrusive, the ActiGraph is worn at the hip by way of an elastic band. The acceleration signal is digitised and then processed to provide information regarding frequency, intensity, and duration of activity performed. Participants were asked to wear the device, during waking hours, for 8 consecutive days.

Participants were required to wear the devices for 10 hours on a week day, and 8 hours on a weekend day to be classified as having sufficient data (i.e. wear time) to create a reliable estimate of daily physical activity. We assumed that a device was not being worn if there were 60 consecutive minutes of no acceleration recorded by the device and these periods were removed from any analyses. Following the International Physical Activity and the Environment Network (IPEN), adolescent accelerometer data collection protocol[17], children who provided at least five days including one weekend day were included in the analyses.

2.4.2 Outcomes measured

The activity monitors were used to extract three main outcomes:

1. A measure of total physical activity that integrates all movement that is recorded through the device. These are measured in a metric called 'counts'. To take into

16 Acceleration is detected and recorded across three planes of movement: in the vertical axis (axis 1), the horizontal axis (axis 2), and the perpendicular axis (axis 3).

17 http://ipenproject.org/

consideration the length of time which a device is worn, we standardise these 'counts' to 'counts per minute' (CPM).

2. Estimates of time spent in different physical activity intensities as categorised using count thresholds:

   - Time spent sedentary, and in MVPA is presented as an absolute measure (e.g. hours or minutes).

   - There is a continuing debate within the literature regarding the appropriate 'cut points' at which to classify children's physical activity data into sedentary, light, moderate, and vigorous. Cut points use the CPM outcome to classify activity into the varying intensity levels. The Evenson (2008) count threshold was used within this analysis as it has been shown to accurately represent physical activity across all levels (sedentary, light, moderate, and vigorous; see Table 2) in children between 7 and 15 years old (Trost, 2007; Loprinzi, Moore, & Pfeiffer, 2011). As a reference point, the MCS conducted their own calibration study to ascertain the appropriate cut points to be used within their study population (7 years old). 'Counts' of less than 100CPM were classified as sedentary time and counts of more than 2296CPM were classified as MVPA. As can be seen below, these are similar to those reported by Evenson.

Table 2- Classification of different physical activity intensities (and sedentary) using the Evenson (2008) cut point thresholds

Intensity Classification	Counts per minute (CPM)
Sedentary	≤100
Light	101-2295
Moderate	2296-4011
Vigorous	≥4012

3. Measuring the proportion of children who meet the CMO physical activity guidelines (Table 3)

   - Two approaches were taken to measure the proportion of children who met the current CMO physical activity guidelines – specifically a minimum of 60 minutes of MVPA per day: i) Children had to meet, or surpass, 60 minutes of MVPA on each day that they wore their accelerometer – termed the 'Threshold' method; ii) Children's average MVPA per day, across all days that they wore their accelerometer, had to be greater than or equal to 60 minutes – termed the 'Averaging' method.

Table 3 - Description of the two approaches used to measure the proportion of children who meet the CMO physical activity guidelines

Prevalence estimate	Description
Threshold Estimate	Must meet at least 60 minutes of at least moderate intensity activity on each valid day to be identified as meeting the guidelines.
Average Estimate	MVPA will be averaged across valid days and participants with a mean time ≥60mins/day marked as meeting the guidelines.

2.4.3 Physical Activity Questionnaire - Children (PAQ-C)

There are number of things to consider when choosing a questionnaire to assess population level physical activity in children, not least the age of the child (Biddle, et al., 2011). Trost (2007) has suggested that this type of method may not be appropriate for children under 10 years old as recall and cognition issues may affect the validity and reliability of the data. However, the PAQ-C has been designed to address some of these concerns, particularly the issue of cognitive capabilities (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997). This is largely due to the greater weight being placed on measuring 'general' physical activity levels, rather than trying to extract reliable data on complex constructs such as 'intensity'. Designed in the USA by Peter Crocker and colleagues, the PAQ-C is a 7-day recall questionnaire that asks a number of questions to assess physical activities engaged in over the previous 7 days. It encompasses questions that assess levels of physical activity during school intervals, lunch, P.E classes, after-school, evenings, and weekend and results in a summary score ranging from one to five (see Appendix A for questionnaire).

PAQ-C scoring

- The questionnaire provides a summary physical activity score derived from nine items, each scored on a 5-point scale.
- Each of the nine items will have a score between 1 and 5 and the overall PAQ-C activity summary score is the mean of all 9 items.
- 1 denotes low physical activity
- 5 denotes high physical activity

2.5 Comparison between ActiGraph & PAQ-C

The ActiGraph accelerometer, for the purposes of this report, was considered to be a 'criterion' method of analysis. That is to say it was considered to be the measurement approach that most accurately captures levels of physical activity – to which we wanted to compare the questionnaire. An important question being asked by this report was whether self-reported approaches can demonstrate similar - ideally the same - results and patterns as an objectively measured approach (i.e. an accelerometer). Specifically, the PAQ-C and accelerometer outputs were compared to assess their ability to extract similar physical activity levels, and patterns of activity between gender, and quintiles of SIMD. As the questionnaire and accelerometer do not produce the same type of outputs, we ranked the

scores from the accelerometer (average time spent in MVPA) and questionnaire to see if a relationship existed between both. This was tested by the Spearman's rank order correlation test.

2.6 Analysis

All analyses allowed for the stratification and clustered survey design of GUS, and the data was weighted using cross-sectional weights developed and supplied by Scotcen[18], to compensate for potential response bias in the sample. General Linear Modelling (GLM, IBM SPSS 21) was used to investigate statistical differences between boys and girls, and sociodemographic characteristics (SIMD), across the outcome measures (CPM, MVPA, sedentary time, and PAQ-C scores). These analyses were adjusted for season of measurement, device wear time, and number of valid days worn.

18 See Appendix B for the technical note regarding the survey weights developed for this sample.

chapter 3

FINDINGS

3.1 Objective Measurement of physical activity

3.1.1 Overall Activity Levels – weekday and weekend activity by gender

When assessing total physical activity, counts per minute (CPM) were used as a means of exploring gender differences in overall activity levels. During weekdays, total physical activity was significantly higher in boys (674.2 CPM) than girls (627.6 CPM). Although boys had higher total activity across all valid days, this was not statistically significant (two tailed, p=0.09). Moreover, no differences existed on weekends (Table 4).

3.1.2 Time spent Sedentary and in MVPA - weekday and weekend activity by gender

Time spent sedentary and in moderate to vigorous physical activity (MVPA) was analysed using the mean score derived from all valid days for each individual (i.e. the mean was calculated from the valid days of an individual and then averaged across the sample). On average, children spent 7.5 hours sedentary each day (Table 4). Although no large difference was evident between boys and girls, girls tended to be more sedentary and the difference seen during weekday sedentary time approached statistical significance (p=0.06). On average, children spent 73 mins per day in MVPA, with boys exhibiting significantly higher levels than girls on both weekdays (81.1 vs. 70.2 mins) and weekend days (67.6 vs. 60.0 mins).

Table 4 - Time spent sedentary and in specific intensities of physical activity by gender and overall

	Girls	Boys	Overall
Counts per Minute (CPM)			
Weekdays**	634.0 (607.0 - 661.0)	662.7 (639.0 - 687.0)	648.5 (627.0 - 669.9)
Weekends	627.6 (601.9 - 653.3)	674.2 (652.0 - 696.4)	650.6 (630.7 - 670.4)
	639.0 (586.3 - 691.6)	634.2 (591.1 - 677.3)	637.4 (595.8 - 678.9)
Sedentary (in hours)	7.6 (7.5 - 7.7)	7.4 (7.3 - 7.6)	7.5 (7.4 - 7.6)
Weekdays	7.7 (7.6 - 7.9)	7.6 (7.4 - 7.7)	7.7 (7.5 - 7.8)
Weekends	7.1 (7.0 - 7.3)	7.1 (6.9 - 7.3)	7.1 (7.0 - 7.3)
MVPA (in minutes)***	67.7 (64.5 - 71.0)	77.5 (74.1 - 81.0)	72.6 (70.0 - 75.3)
Weekdays***	70.2 (66.7 - 73.7)	81.1 (77.7 - 84.5)	75.7 (72.9 - 78.4)
Weekends*	60.0 (55.4 - 64.7)	67.6 (62.3 - 72.9)	63.8 (60.0 - 67.7)
Bases			
Weighted	*414*	*359*	*773*
Unweighted	*417*	*357*	*774*

Statistically significant difference between boys and girls: *p <0.05, **p<0.01, ***p<0.001
Significance testing adjusted for season of measurement, mean wear time, and number of valid days
Figures are Estimated Marginal Means (95% CI)
Figures rounded to 1 decimal place

3.1.2.1 Sedentary time - Area deprivation and Gender

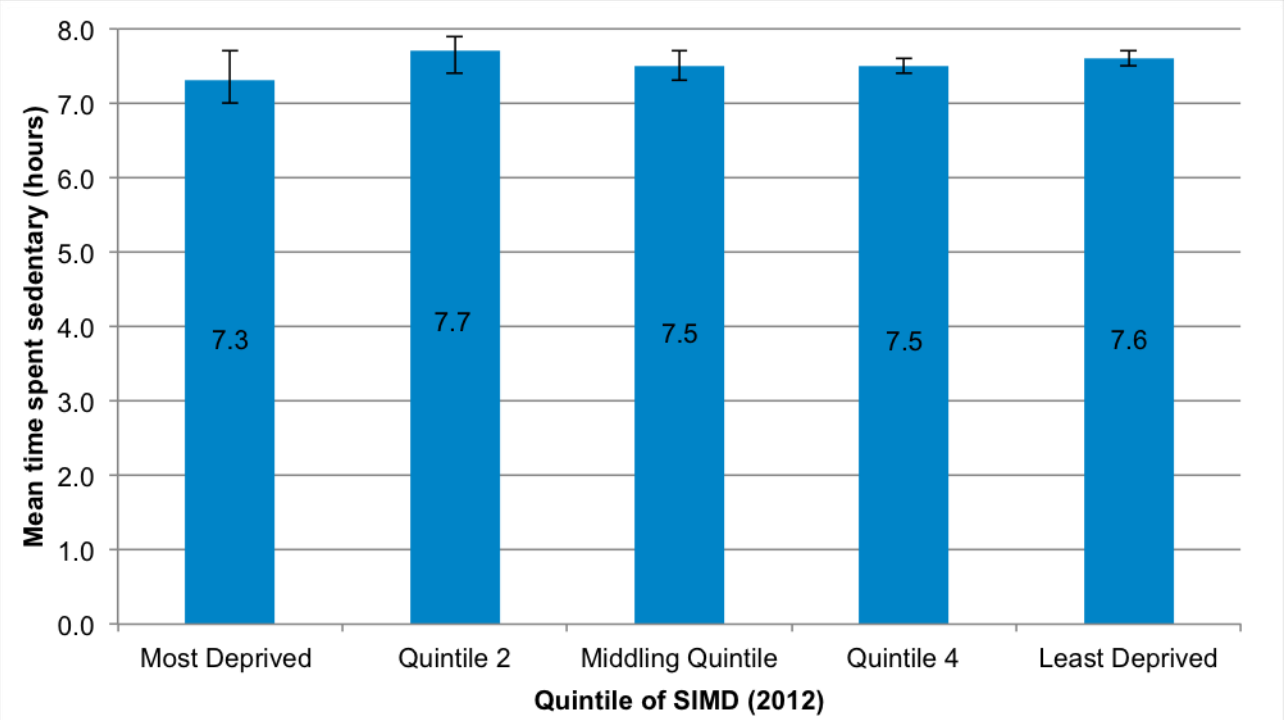
Mean time spent sedentary per quintile of the Scottish Index of Multiple Deprivation (QSIMD) is summarised in Table 5. Data is further analysed as mean time spent sedentary per individual during weekdays and weekend days per QSIMD. There were no statistically significant differences between quintiles of SIMD, either for all participants or for boys and girls separately. Participants in all quintiles (both boys and girls) spent, on average, greater than 7 hours sedentary per day. Figure 1 shows a slight tendency for those in more deprived areas to spend less time sedentary per day but there were no statistically significant differences found. The pattern was similar for weekday and weekend day analyses, with lower levels across all quintiles during the weekend compared to weekdays.

Table 5 - Sedentary time by QSIMD

Sedentary time in minutes	Girls	Boys	Overall
All days			
Most deprived	7.6 (7.1 - 8.0)	7.1 (6.7 - 7.5)	7.3 (7.0 - 7.7)
2	7.7 (7.3 - 8.1)	7.6 (7.3 - 7.9)	7.7 (7.4 - 7.9)
3	7.4 (7.3 - 7.6)	7.5 (7.2 - 7.9)	7.5 (7.3 - 7.7)
4	7.5 (7.4 - 7.7)	7.5 (7.3 - 7.7)	7.5 (7.4 - 7.6)
Least deprived	7.6 (7.5 - 7.7)	7.7 (7.5 - 7.8)	7.6 (7.5 - 7.7)
Weekdays			
Most deprived	7.7 (7.3 - 8.2)	7.2 (6.7 - 7.6)	7.4 (7.1 - 7.8)
2	7.8 (7.4 - 8.2)	7.6 (7.3 - 8.0)	7.7 (7.5 - 8.0)
3	7.6 (7.4 - 7.8)	7.6 (7.3 - 8.0)	7.6 (7.4 - 7.8)
4	7.7 (7.5 - 7.9)	7.6 (7.4 - 7.8)	7.7 (7.4 - 7.7)
Least deprived	7.8 (7.7 - 7.9)	7.8 (7.6 - 8.0)	7.8 (7.7 - 7.8)
Weekends			
Most deprived	7.1 (6.6 - 7.7)	7.0 (6.5 - 7.5)	7.1 (6.7 - 7.4)
2	7.4 (6.9 - 7.8)	7.3 (7.0 - 7.6)	7.3 (7.0 - 7.6)
3	7.0 (6.7 - 7.3)	7.2 (6.7 - 7.6)	7.1 (6.8 - 7.3)
4	7.1 (6.9 - 7.3)	6.9 (6.6 - 7.2)	7.0 (6.8 - 7.2)
Least deprived	7.1 (6.9 - 7.2)	7.3 (7.1 - 7.5)	7.2 (7.0 - 7.3)
Bases			
Weighted	*84*	*81*	*164*
	81	*59*	*139*
	84	*59*	*143*
	86	*80*	*166*
	80	*81*	*161*
Unweighted	*35*	*29*	*64*
	55	*44*	*99*
	96	*73*	*169*
	110	*97*	*207*
	121	*114*	*235*

Statistically significant difference between quintile levels in 'Overall' 'Boys' and 'Girls': *p <0.05, **p<0.01, ***p<0.001
Bonferroni correction applied
Significance testing adjusted for season of measurement, mean wear time, and number of valid days
Figures are Estimated Marginal Means (95% CI)
Figures rounded to 1 decimal place

Figure 1 - Mean time sedentary per Quintile of Deprivation (SIMD) - ALL DAYS



Error Bars: 95% CI

3.1.2.2 MVPA - Area deprivation and Gender

Mean time spent in MVPA per quintile of the Scottish Index of Multiple Deprivation (QSIMD) is summarised in Table 6. Data is further analysed as mean time spent per individual in MVPA during weekdays and weekend days per SIMD quintile. There were no statistically significant differences between quintiles of SIMD, either for all participants or for boys and girls separately. Participants in all quintiles (both boys and girls) engaged in, on average, more than 60 minutes of MVPA per day. Figure 2 shows a tendency for those in more deprived areas to engage in higher level of MVPA per day but there were no significant differences found. The pattern was similar for weekday and weekend day analyses.

Table 6 - MVPA by QSIMD

MVPA in minutes	Girls	Boys	Overall
All days			
Most deprived	69.7 (59.6 - 79.7)	80.8 (70.2 - 91.4)	75.2 (67.7 - 82.7)
2	65.8 (57.0 - 74.6)	77.8 (71.6 - 84.0)	71.8 (66.1 - 77.5)
3	71.2 (64.8 - 77.6)	75.2 (68.7 - 81.7)	73.2 (68.7 - 77.8)
4	65.3 (59.7 - 70.9)	77.5 (71.5 - 83.5)	71.4 (67.2 - 75.6)
Least deprived	67.0 (63.3 - 70.7)	76.2 (71.5 - 80.8)	71.6 (68.3 - 74.9)
Weekdays			
Most deprived	73.1 (61.4 - 84.8)	83.2 (73.2 - 93.3)	78.2 (70.1 - 86.3)
2	69.1 (60.1 - 77.3)	84.5 (76.7 - 92.2)	76.8 (71.1 - 82.5)
3	73.3 (66.9 - 80.1)	78.7 (72.1 - 85.3)	76.0 (71.4 - 80.6)
4	66.7 (61.9 - 71.7)	79.8 (74.0 - 85.6)	73.3 (69.2 - 77.3)
Least deprived	68.9 (65.2 - 72.5)	80.1 (75.1 - 84.8)	74.4 (71.1 - 77.7)
Weekends			
Most deprived	60.1 (46.4 - 73.9)	71.0 (54.2 - 87.9)	65.6 (54.4 - 76.8)
2	56.3 (41.4 - 71.3)	62.6 (56.1 - 69.1)	59.5 (51.4 - 67.5)
3	64.0 (55.3 - 72.8)	65.1 (55.0 - 75.3)	64.6 (58.0 - 71.2)
4	59.6 (50.0 - 69.2)	72.0 (62.6 - 81.2)	65.8 (58.6 - 72.9)
Least deprived	60.7 (55.5 - 65.8)	65.8 (60.1 - 71.6)	63.2 (59.1 - 67.3)
Bases			
Weighted	*84*	*81*	*164*
	81	*59*	*139*
	84	*59*	*143*
	86	*80*	*166*
	80	*81*	*161*
Unweighted	*35*	*29*	*64*
	55	*44*	*99*
	96	*73*	*169*
	110	*97*	*207*
	121	*114*	*235*

No Statistically significant difference between quintile levels in 'Overall' 'Boys' and 'Girls'

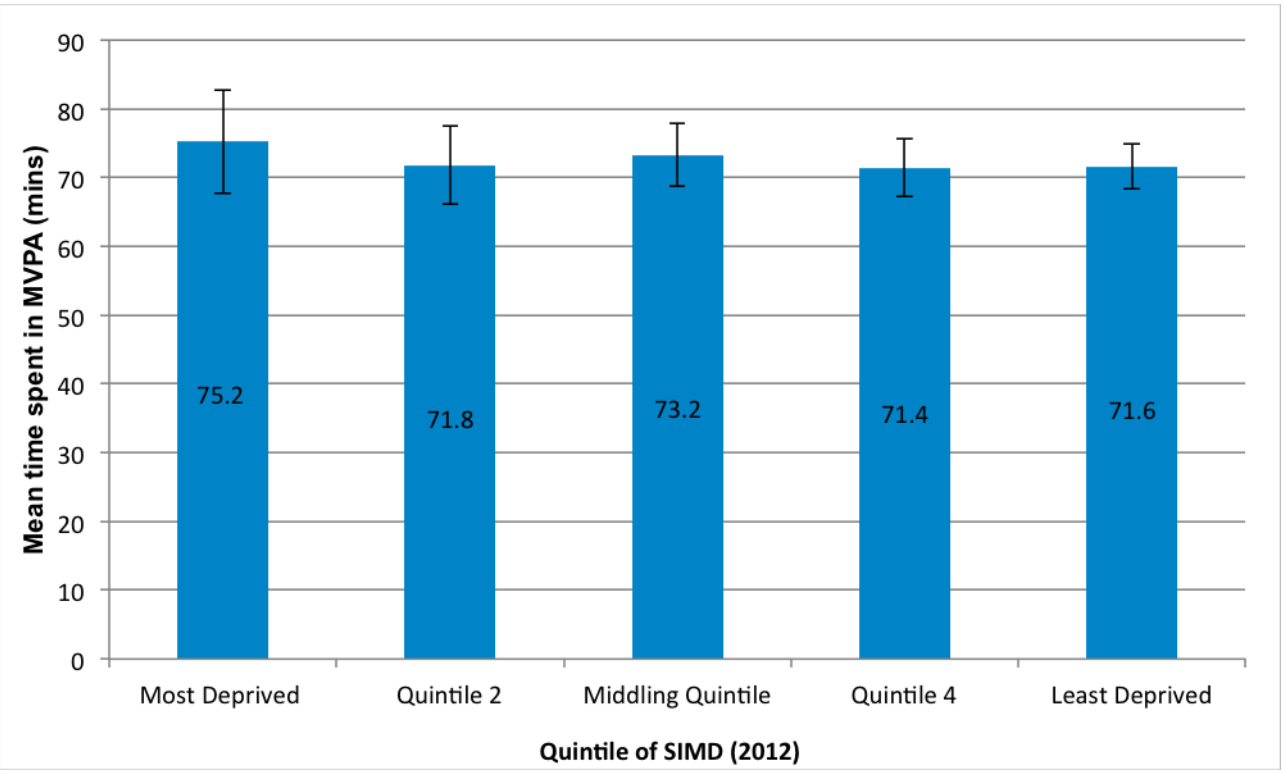
Bonferroni correction applied

Significance testing adjusted for season of measurement, mean wear time, and number of valid days

Figures are Estimated Marginal Means (95% CI)

Figures rounded to 1 decimal place

Figure 2 - Mean time in MVPA per Quintile of deprivation rank (SIMD) - ALL DAYS



Error Bars: 95% CI

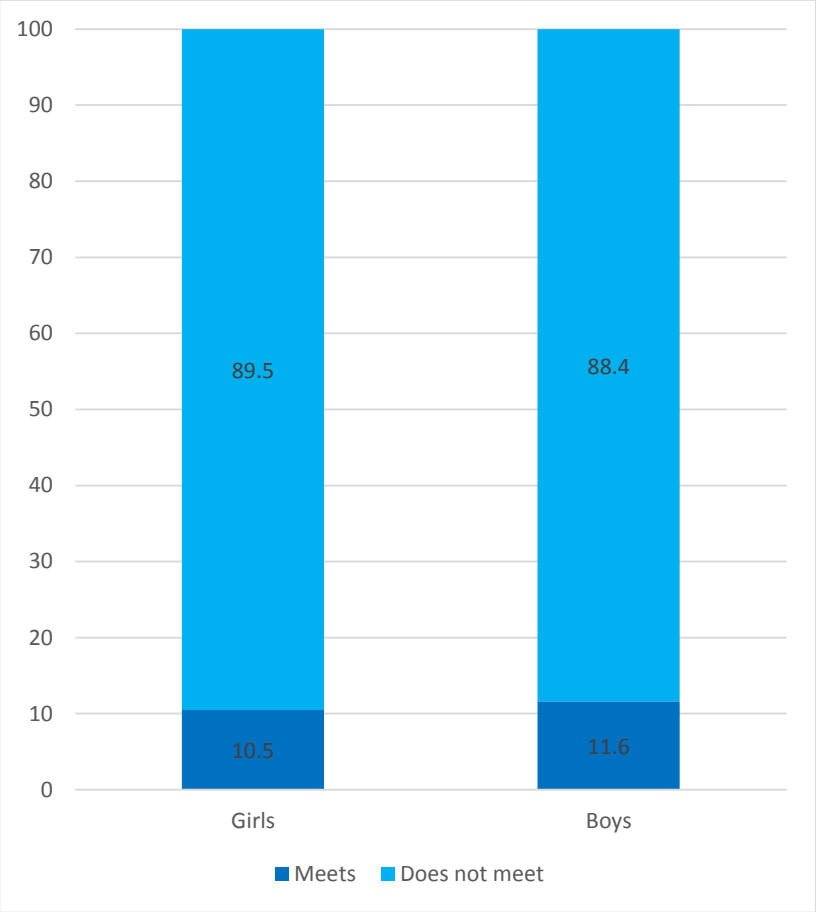
3.1.3 Meeting the PA guidelines using 'Threshold' approach

Using a threshold approach to physical activity guidelines adherence, as described in section 3.3.2, only 12% of boys and 11% of girls meet the levels of activity recommended for their age group (that is at least 60 minutes in moderate to vigorous physical activity per day, across valid days (see Table 7 & Figure 3). No statistically significant differences existed between boys and girls.

Table 7 – Meeting the physical activity guidelines: Threshold approach

60 min MVPA per day	Girls	Boys	Total	P value
NO	371 89.5%	317 88.4%	688 89.0%	
YES	44 10.5%	42 11.6%	85 11.0%	
Total	415 (100%)	359 (100%)	773 (100%)	0.769
Bases **Weighted** **Unweighted**	 *415* *417*	 *359* *357*	 *773* *774*	

Figure 3 - Meeting the guidelines according to threshold approach



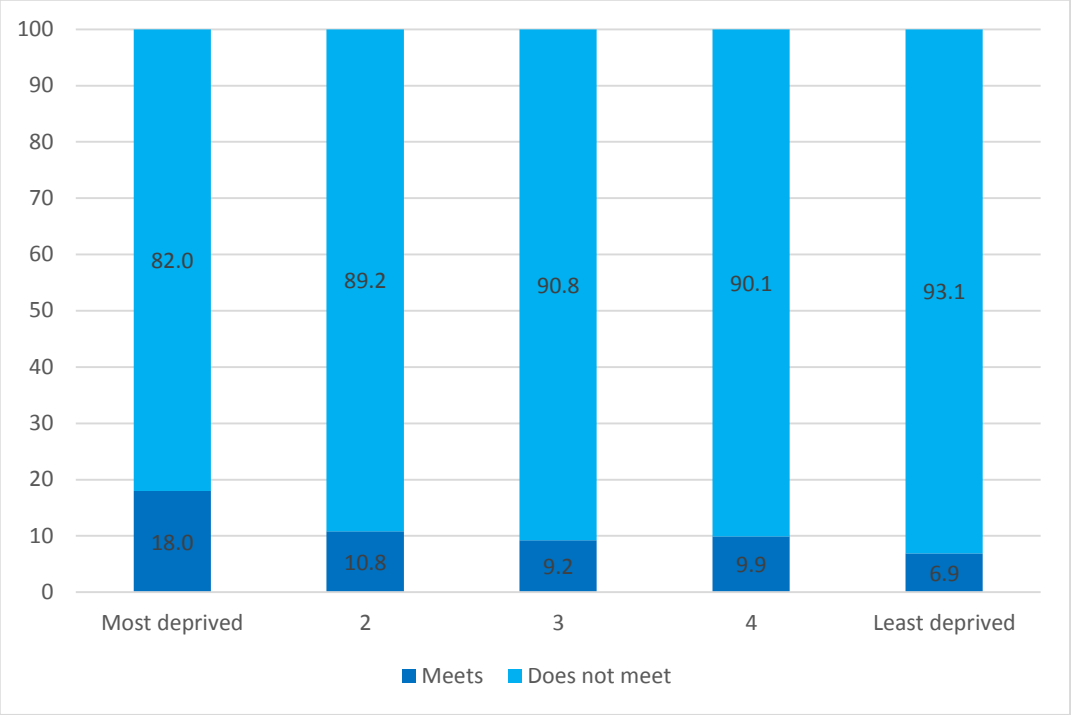
3.1.3.1 Guideline adherence by area deprivation – Threshold approach

There was no significant pattern by area deprivation for a higher likelihood of meeting the guidelines when using the 'threshold' approach to guideline adherence, as can be seen in Table 8 and Figure 4. A higher proportion of those in the most deprived areas met the guidelines, but the difference between quintiles was not statistically significant using a Pearson chi^2 test.

Table 8 - Meeting the physical activity guidelines: Threshold approach by QSIMD

	QSIMD					P value
Meets guidelines	1 (Most deprived)	2	3	4	5 (Least deprived)	
NO	135 (82.0%)	124 (89.2%)	130 (90.8%)	150 (90.1%)	150 (93.1%)	
YES	30 (18.0%)	15 (10.8%	13 (9.2%)	16 (9.9%)	11 (6.9%)	0.30
Bases **Weighted** **Unweighted**	 *164* *64*	 *139* *99*	 *143* *169*	 *166* *207*	 *161* *235*	

Figure 4 - Meeting the guidelines by Quintile of area deprivation (SIMD) – Threshold approach



3.1.4 Meeting the PA guidelines using 'Averaging' approach

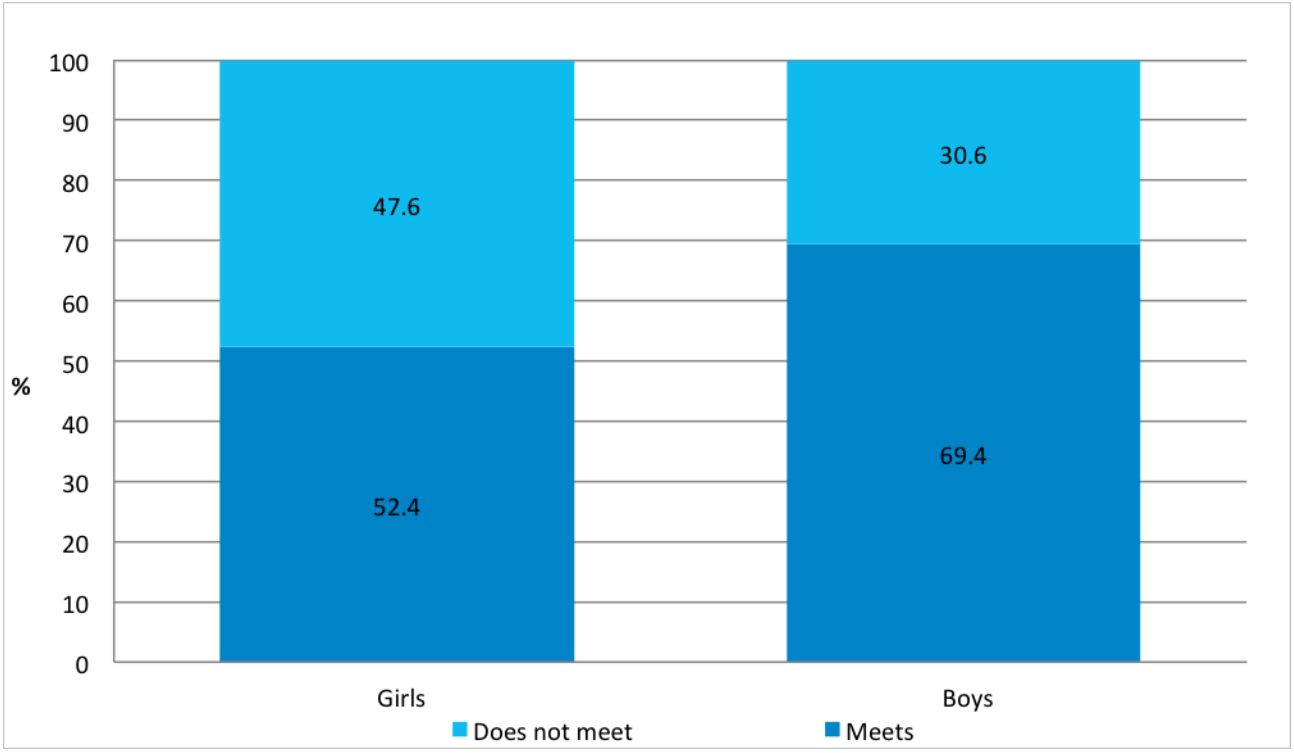
Another approach to look at adherence to guidelines is to obtain an average across all valid days with more than 1 min MVPA. That is, minutes spent in MVPA were averaged across valid days and participants with at least 60 mins per day were marked as meeting the guidelines. As shown in Table 9 and Figure 5, this approach substantially increases the proportion of children meeting the guidelines. Using this method, 60% of the children overall meet the recommended daily guidelines, and boys are significantly more likely to meet the guidelines than girls (69.4% vs. 52.4%, p <0.001).

Table 9 - Meeting the physical activity guidelines: Average approach

Meets guidelines	Girls	Boys	Overall
NO	197 (47.6%)	110 (30.6%)	307 (39.7%)
YES *	217 (52.4%)	249 (69.4%)	466 (60.3%)
Total	414 (100%)	359 (100%)	773 (100%)
Bases **Weighted** **Unweighted**	 *415* *417*	 *359* *357*	 *773* *774*

* Statistically significant difference between girls and boys p<0.001

Figure 5 - Proportion meeting UK Chief Medical Officers PA guidelines using Averaging method



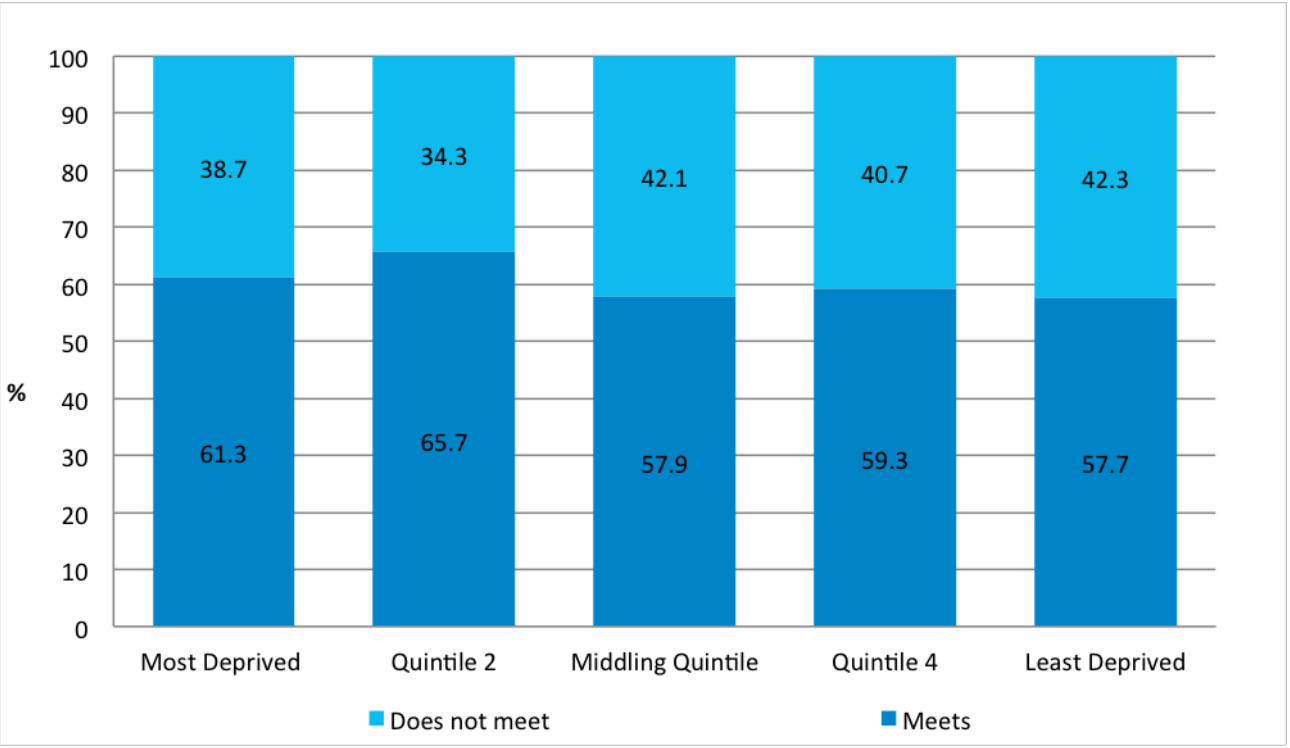
3.1.4.1 Guideline adherence by area deprivation – Averaging approach

There was no clear pattern by area deprivation in meeting the guidelines in one quintile or another when using the 'averaging' approach to guideline adherence, as can be seen in Table 10 and Figure 6. The difference between quintiles was not statistically significant using a Pearson chi^2 test.

Table 10 - Meeting the physical activity guidelines: Average approach by QSIMD

	QSIMD					P value
Meets guidelines	1 (Most deprived)	2	3	4	5 (Least deprived)	
NO	64 (38.7%)	48 (34.3%)	60 (42.1%)	68 (40.7%)	68 (42.3%)	
YES	100 (61.3%)	91 (65.7%)	83 (57.9%)	98 (59.3%)	93 (57.7%)	0.811
Bases						
Weighted	*164*	*139*	*143*	*166*	*161*	
Unweighted	*64*	*99*	*169*	*207*	*235*	

Figure 6 - Meeting the guidelines by Quintile of area deprivation (SIMD) – Averaging approach



3.2 Self-reported physical activity

The first part of this section describes the ability of the PAQ-C to accurately measure physical activity levels in this age group using the accelerometer data as the reference (or criterion from which we can compare). This is followed by the gender and socio-economic analyses by PAQ-C score.

3.2.1 Validation of PAQ-C

As previously noted, the PAQ-C did not provide information that permitted direct comparison with the accelerometer output - the questionnaire does not provide time spent in MVPA or counts per minute. This meant that we could not measure the direct agreement between both measures (i.e. do both measures produce identical outcomes). However, we were able to assess the ability of the PAQ-C to measure physical activity by assessing the monotonic/ linear relationship between the accelerometer (which we termed the criterion) and the questionnaire.

We tested the relationship between the two measures by way of the Pearson correlation coefficient (r), and the Spearman's rank order correlation coefficients (rho). The first analysis tested for a linear relationship between both methods (i.e. the change in one variable being associated with a proportional change in the other variable); whereas the second analysis tested for a monotonic relationship (i.e. both measures increase/decrease concurrently but not necessarily at the same rate) using ranked scores rather than raw data. The scatter plots that visually demonstrate these analyses can be seen in Appendix C; the scores presented in the following sections describe the strength of the relationship (0 = no relationship, +/-1 = perfect positive or negative monotonic/linear relationship).

3.2.1.1 Accelerometer and PAQ-C - MVPA

All graphs demonstrated a positive relationship between PAQ-C scores and time spent in MVPA (r = 0.39, rho=0.39). That is, as one of the measures increases, so does the other. This remains the case for both boys and girls when analysed separately, (girls: r=0.38, rho=0.34; boys: r=0.37, rho=0.39). The questionnaire was designed to measure activities within the MVPA range, and therefore should demonstrate a reasonable relationship with accelerometry derived MVPA; our results supported this. When we removed MVPA from the analysis and substituted three other physical activity outcomes (light, moderate, and vigorous activity), the correlations were weaker: light (r=0.14), moderate (r=0.30) and vigorous (r=0.37) and all were all lower than the r=0.39 reported for MVPA, indicating a stronger relationship between PAQ-C scores and accelerometry derived MVPA.

3.2.1.2 Accelerometer and PAQ-C - counts per minute (CPM)

When analysing the relationship between PAQ-C scores and CPM (considered to represent 'overall' physical activity), a similar relationship, as with MVPA, was evident (r=0.36, rho=0.38) overall, and for boys (r=0.35, rho=0.36) and girls (r=0.37, rho=0.39). There was a strong positive correlation between MVPA and CPM (r=0.92) so the similarity between MVPA and CPM is expected. The 'counts per minute construct' integrates all activity data that has been recorded and includes physical activity of all intensities. It is therefore a useful measure to demonstrate 'total' PA of an individual. The PAQ-C questionnaire, in addition to MVPA, will inevitably capture time spent in light activity, and as such, the CPM construct was included to assess its relationship with PAQ-C scores.

3.2.1.3 PAQ-C scores between those who do and do not meet the CMO guidelines – Averaging method

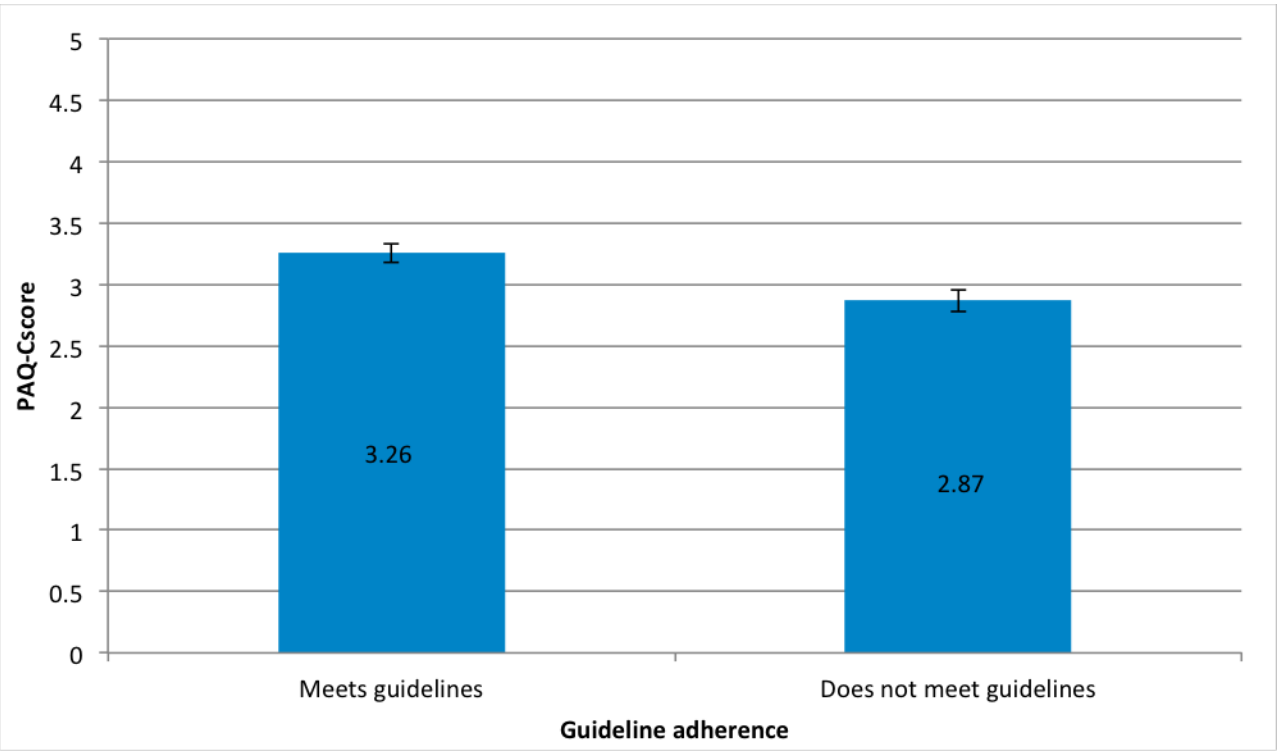
We investigated whether PAQ-C detected differences in scores dependent on whether participants met, or did not meet the PA guidelines (using the averaging approach). As can be seen in Table 11 and Figure 7, PAQ-C scores were significantly higher in those participants who met the guidelines compared to those who didn't, further demonstrating the questionnaire's ability to discriminate between MVPA activity levels.

Table 11 PAQ-C score by those who meet and do not meet the physical activity guidelines: Average approach

Average MVPA per day	Girls	Boys	Overall
Meets Guidelines	3.23 (3.14-3.32)	3.30 (3.19-3.41)	3.26 (3.18-3.33)
Does not Meet Guidelines	2.82 (2.71-2.94)	2.90 (2.74-3.05)	2.87 (2.78-2.96)
Bases			
Weighted	*361*	*317*	*678*
Unweighted	*375*	*321*	*696*
P value	<0.001	<0.001	<0.001

Statistically significant difference between those who meet and do not meet the CMO guidelines – overall, boys, and girls
Significance testing adjusted for season of measurement. Figures are Estimated Marginal Means (95% CI). Figures are rounded to two decimal places

Figure 7 - PAQ-C scores as a function of guideline adherence grouping



Error Bars: 95% CI

3.2.2 PAQ-C scores – Overall, by Gender, and by SIMD

The previous section provides support on the use of the PAQ-C as an acceptable method to capture physical activity in children of this age group. We then used the questionnaire to investigate its ability to capture potential differences between boys and girls, and across quintiles of deprivation.

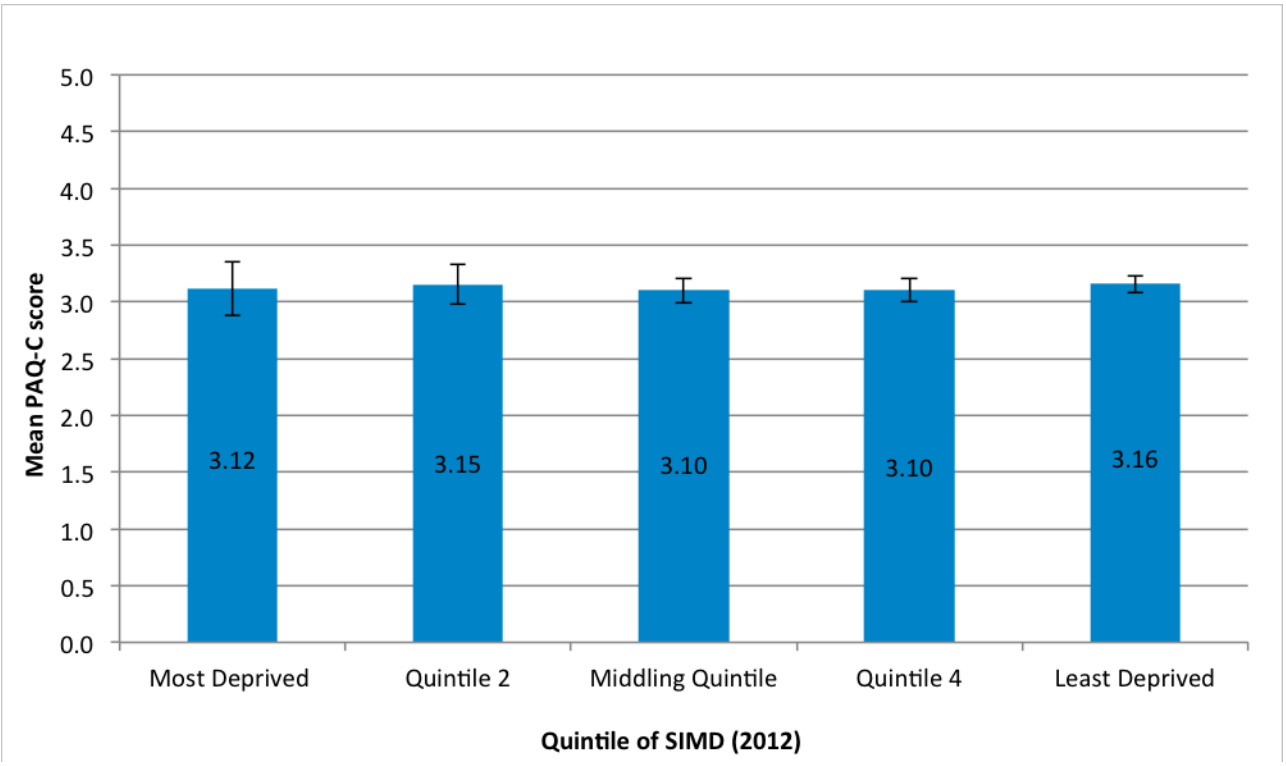
Boys scored higher on the PAQ-C than girls (3.19 vs. 3.05); this was statistically significant. There were no statistically significant differences for the mean PAQ-C scores between quintiles of SIMD (Table 12 and Figure 8). Both results were similar to those demonstrated by the accelerometers.

Table 12 PAQ-C score by QSIMD and Gender

	Girls	Boys	Overall
PAQ-C scores*	3.05 (2.99 - 3.12)	3.19 (3.10 - 3.23)	3.12 (3.06 - 3.19)
QSIMD			
Most deprived	3.07 (2.83 - 3.32)	3.16 (2.83 - 3.49)	3.12 (2.88 - 3.35)
2	3.04 (2.89 - 3.18)	3.27 (2.97 - 3.55)	3.15 (2.98 - 3.33)
3	3.12 (2.94 - 3.30)	3.08 (2.92 - 3.22)	3.10 (2.99 - 3.21)
4	3.00 (2.84 - 3.10)	3.23 (3.09 - 3.36)	3.10 (3.00 - 3.20)
Least deprived	3.07 (3.00 - 3.20)	3.24 (3.13 - 3.34)	3.16 (3.08 - 3.23)
Bases (Gender)			
Weighted	361	317	678
Unweighted	375	321	696
Bases (Gender*SIMD)			
Weighted	*64*	*74*	*138*
	77	*48*	*124*
	72	*52*	*123*
	77	*72*	*149*
	72	*71*	*143*
Unweighted	*29*	*23*	*52*
	52	*39*	*91*
	86	*67*	*153*
	99	*90*	*189*
	110	*100*	*210*

Statistically significant difference between boys and girls: *p <0.05, Bonferroni correction applied,
Significance testing adjusted for season of measurement. Figures are Estimated Marginal Means (95% CI). Figures are rounded to nearest two decimal places

Figure 8 - PAQ-C scores by quintile of deprivation (SIMD)



Error Bars: 95% CI

chapter 4

DISCUSSION AND CONCLUSIONS

The purpose of this report was to investigate the physical activity levels of Scottish children; using objective and self-reported PA data collected from a cohort of children drawn from the Growing Up in Scotland study. A key objective of this report was to explore the gender and socio-economic patterning of activity and assess whether these patterns differed by the physical activity measurement assessment used.

The project successfully collected objectively measured and self-reported physical activity levels in a large, nationally representative, sample of Scottish 10-11 year old children employing a study protocol that was based on a postal method: contact with participants was either by phone, or traditional paper-based materials delivered by post. The overall response rate was 40%, with 36% of the possible sample providing sufficient data to be included in this report. The data presented are likely to be broadly representative of the children in Scotland who will be making the transition into secondary schooling and the availability of this data will prove to be a valuable longitudinal resource to understand health and health behaviours as this cohort of children age.

4.1 Overall physical activity levels by accelerometry and self-report

Overall physical activity levels were measured using the standardised unit of counts per minute (CPM). For this age group, this value was 648CPM. This is consistent with accelerometry data from over 27,500 children using the International Children's accelerometry database (ICAD) which holds data from 20 studies in 10 countries (Cooper et al., 2015). Individual studies from the ICAD database can be seen in Table 13, alongside the setting, age group, and mean CPM. These studies include UK examples from different parts of England, such as East Anglia (SPEEDY; Corder, van Sluijs, Ekelund, Jones, & Griffin, 2010); Bristol (PEACH; Page, Cooper, Griew, Davis, & Hillsdon, 2009) (ALSPAC; Riddoch et al., 2007); European studies such as the European Youth Heart Study (EYHS; Riddoch et al., 2004); and studies from the USA (NHANES; Troiano et al., 2008).

Table 13 - Descriptive information from large UK and international physical activity studies

Study name	Setting	Year measured	Mean age (years)	Sample size	Mean CPM
SPACES	Scotland wide	2015-2016	11.1	774	648
SPEEDY	South East England	2007	10.2	1,862	665
PEACH	South West England	2006-2008	10.9	1,300	642
NHANES	USA	2003-2004	8.5	597	607
ALSPAC	South West England	2003-2005	11.8	5,595	580
EYHS	Europe	1997-1998	9.6/15.4	2,185	717/553
MCS	UK (Scotland Sample)	2008-2009	7.5	761	615

SPACES: Studying Physical Activity in Children's Environments across Scotland
SPEEDY: Sport, Physical activity and Eating behaviour: Environmental Determinants in Young people
PEACH: Personal and Environmental Associations with Children's Health
NHANES: National Health and Nutrition Examination Survey
ALSPAC: Avon Longitudinal Study of Parents and Children
EYHS: European Youth Heart Study
MCS: Millennium Cohort Study

The consistency across studies with regard to the main physical outcome of CPM suggests that the use of accelerometry in Scottish 10-11 year old children is a valid method of measuring physical activity.

Although total physical activity takes into consideration all activity, all levels of intensity, including sedentary time, MVPA is very specific to those periods where children are being active at a level that is optimal for health and well-being. On average, children spent 73 mins per day in MVPA (76 mins per day weekday and 64 mins per day weekend. The comparison of the results within this report with other studies is difficult due to the inconsistent approaches used to identify intensity classifications. However, the MCS study (Griffiths, et al., 2013), which used similar methods but with younger children (7 year olds), found that Scottish children spent 61.8 mins in MVPA, which was slightly more than Wales (61.6 mins), and England (60.6 mins) and around 9% higher than children in Northern Ireland (56.6 mins). Cooper and colleagues (2015) presented MVPA data as a relative measure (i.e. percentage of wear time that is spent in MVPA) across 7 countries (9-10 year olds) and found a range of between 5-10%. With results from this report suggesting that Scottish 10-11 year old children spend 8% of their wear-time in MVPA, the results are internationally comparable for a similar age group.

With children only spending 8% of their waking day in MVPA, they must spend the rest of their time in either light activity or sedentary activity. Indeed, we found that Scottish children

are sedentary for 7.5 hours, higher than that observed in the Scottish sample of the MCS where 7-year old children spent 6.4 hours sedentary (Griffiths, et al., 2013). Cooper and colleagues (2015) have identified a significant positive age-related trend where sedentary time increases by 20-25% from children aged 5-6 through to 17-18 years old. The higher sedentary time presented in this report could be a reflection of this age related increase. Evidence from other, similarly aged children, provides support for our findings. For example, the ALSPAC study reported a mean sedentary time of just over 7 hours in 9 year old boys and girls, and the SPEEDY study reported a mean time of approximately 7.6 hours in 10 year old children. These figures, therefore, compare equally across the UK, provide support for the measurement method in Scottish children, and provide useful data on current levels of sedentary behaviour among Scottish 10-11 year old children.

In addition to providing data on overall physical activity levels, the objectively measured approach provided an opportunity to investigate the proportion of children who met the Chief Medical Officers physical activity guidelines. As outlined, the method used had a large impact on the outcome. When using the threshold approach, where all valid days per person were required to be over 60 minutes of MVPA on valid days before being classified as meeting the guidelines, only 11% of children were classified as meeting the guidelines. Another way of calculating the proportional outcome is by removing the necessity to accumulate 60 minutes of MVPA *every* day. Instead, if children have an average of 60 minutes or more across their valid days then this would constitute adherence to the guidelines. In situations where participants may accumulate 55 or 58 minutes on any given day, this approach seems to provide a fairer representation. When taking this approach, the proportion of children who met the guidelines increased from 11% to 60%. These figures are however lower than those presented in the SHeS for children aged 8-10 (81% vs. 83%, boys and girls respectively). Objective measures have, in recent years, demonstrated that the proportions of children who meet the physical activity guidelines are lower than those reported in national surveys such as the SHeS (Cooper, et al., 2015). At this point it should be noted that both approaches are completely different, and therefore cannot be compared like for like; the accelerometer used in this report measures body acceleration, whereas SHeS measures physical activity behaviours as recalled by the parent of child. However, with regards to the SHeS, a number of factors can provide possible explanations for the apparent discrepancy: i) parents act as a proxy and report on their child's behalf – this may introduce an element of reporting error due to parents recalling the physical activity behaviours of their children; ii) potentially most importantly, the SHeS automatically considers any activity as at least MVPA – this will introduce misclassification error due to light activity being incorrectly classified as MVPA. Results from this report suggest that children spend 4.2 hours in light activity so it could be argued that more children would be categorised as meeting the guidelines using an objective method if light activity were to be included in the classification. Similarly, if light activity were to be removed from the calculations in the SHeS, there is a considerable possibility that the proportion of children who meet the physical activity guidelines would decrease substantially. The Health Behaviour in School-Aged Children (HBSC) survey[19] is a national source of self-reported physical activity data in Scotland that aims to remove light activity from its calculations. Instead of including *all* activity as MVPA, it specifically asks about activity that is at least of moderate intensity. Results are still higher (30% of boys and 21% of girls; 11 years old) than the accelerometry data presented in this report but lower than those reported by the SHeS. There is a pressing need to investigate

19 http://www.cahru.org/content/03-publications/04-reports/hbsc_nr14_interactive_final.pdf

both approaches and the findings of this report suggest that further work to reduce the discrepancy between measures is warranted.

Although self-reported approaches have their drawbacks, we introduced a self-report method of measurement within this study for very good reasons. Conducting large scale, objective measures of physical activity across a whole country are costly and involve a number of logistical issues in administrating such studies and can involve an increased burden on participants compared to wholly self-reported methods. If an appropriate self-report questionnaire is chosen, particularly one which takes cognitive ability and respondents' burden into account, self-reported methods should be able to return valuable data, i.e. to differentiate physical activity patterns in gender or across socioeconomic groups. Initially, we assessed the ability of the PAQ-C questionnaire to capture physical activity levels in children of this age group. Overall, it performed moderately well. Validity coefficients were acceptable and this type of self-reported questionnaire was able to accurately record general levels of physical activity. This was further confirmed by the questionnaire's ability to discriminate those who met and those who did not meet the CMO physical activity guidelines - the mean PAQ-C scores were significantly lower in those who did not meet the guidelines. Recent data from England (Voss, et al., 2013) has found mean PAQ-C scores of approximately 3.10 in 10 year olds, and 2.90 in 11 year olds. Another study in England found a mean score of 3.49 in children aged 9-11 years. Internationally, Spanish data in 10-11 year old children have demonstrated a mean score of 3.24 (Benitez-Porres et al., 2016). All scores reported are similar to that found in this study (mean PAQ-C score of 3.10) which suggest comparability nationally and internationally. Currently, there are no uniform and meaningful thresholds that can be applied to differentiate youth based on their activity levels, although, internationally, PAQ-C scores of less than 2 have been considered low activity, 2-3 as moderate activity, and more than 3 as high activity in children between 8 and 12 years old (Chen, Lee, Chiu, & Jeng, 2008). The next stage for the PAQ-C questionnaire could be to try to develop activity thresholds to categorise youth in Scotland.

4.1.1 Gender differences in physical activity by accelerometry and self-report

Results from this report suggest that boys are more active than girls. This pattern was present across most of the outcome variables and measurement approaches. Boys were more active than girls on weekdays using CPM as an outcome (674 CPM vs 628 CPM), MVPA on both weekdays (81.1 vs. 70.2 mins) and weekend days (67.6 vs. 60.0 mins), and the PAQ-C also found significant differences between boys and girls (3.19 vs. 3.05, boys and girls respectively). Regarding the proportion of children meeting the CMO physical activity guidelines, boys were also more likely to meet these guidelines (69%) compared to girls (52%) when using the averaging approach.

Interestingly, gender differences were not observed for overall physical activity at the weekend (634 CPM vs. 639 CPM, boys and girls respectively), and further work is required to explore potential reasons for differences in weekday and weekend activities.

The Scottish Health Survey reports little evidence of gender differences in physical activity guideline adherence for either the 8-10 years or 11-12 years age groups, with differences not emerging until the 13-15 year old age group. Our data suggests this difference exists earlier, within the 10-11 year old age group, and this finding has also been noted in international data using objectively measured PA (Cooper, et al., 2015). Findings that gender differences emerge earlier than previously suggested in studies of Scottish children suggest that there is a need to develop policies to reduce the gender gap at an earlier age.

4.1.2 Social patterning of physical activity using accelerometry

Both methods of physical activity measurement found little significant observable pattern/differences across the quintiles of SIMD in either physical activity levels or adherence to the CMO guidelines. This is similar to mothers' reports of the children's physical activity at age 6 (of the same children) which found no clear social gradient in the patterning of children's physical activity, and that reported by the Millennium Cohort Study (Griffiths, et al., 2013). We did however find that MVPA was slightly higher among children from the most deprived quintile compared to other quintiles. Further work is required to investigate the reasons for this pattern but one explanation may be that of active travel to school. It has been suggested that active travel and deprivation follow a 'U shaped' distribution, where active travel is high in the most deprived and the least deprived, and lower in between (GCPH, 2011). Transport Scotland produced a report in 2014 that suggested 59% of children in the lowest income category and 62% of the most deprived quintile of SIMD reported their usual mode of transport to school to be an active one (walk/bicycle). Both figures were higher than any other income category or deprivation quintile[20].

There are a small number of methodological or analytical limitations in our study, largely based around known limitations of accelerometers or the analysis of the data extracted. Waist mounted devices are typically poor at recording the acceleration associated with cycling or upper body dominant activities (e.g. throwing, lifting). In addition, the devices were removed for water-based activities and contact sports so there is the possibility that we have underestimated these activities and their associated activity level. Furthermore, the threshold cut points used for this study, although shown to be accurate and reliable in this age group (Trost, 2007), can misclassify motionless standing as sedentary due to the way 'counts' are used to classify intensity; motionless standing will record low 'counts' due to limited movement. However, this behaviour is not sedentary (defined as "any waking behaviour characterised by an energy expenditure ≤ 1.5 metabolic equivalents (METs) while in a sitting or reclining posture" (Owen, Healy, Matthews, & Dunstan, 2010)). Finally, as previously noted, using a different threshold classification will influence the resulting physical activity outcomes. As such, MVPA may have been over or underestimated depending on the threshold used. Importantly, the threshold used in all analyses is one that has demonstrated accuracy across all levels of intensity and is being used internationally with similar aged children to those in this report (Cooper, et al., 2015; Trost, 2007).

4.2 Conclusions

Valid and reliable measurement methods are crucial for the ongoing accurate assessment of physical activity; the outcomes of which are of significant importance to the development and evaluation of various initiatives, strategies, and policies in Scotland. Accelerometry is viewed as one of the most valid methods we have at our disposal for measuring actual levels of physical activity, however, the self-report method used within this report was able to identify similar patterns and differences, or lack thereof, across gender and area based categories of deprivation. This suggests that the PAQ-C could be used in future surveys of the GUS children, particularly where identifying potential differences by gender or area deprivation is important.

20 http://www.transport.gov.scot/sites/default/files/documents/rrd_reports/uploaded_reports/j389989/j389989.pdf

The physical activity levels of Scottish 10-11 year olds tell a positive story if framed in average time spent in MVPA per day. However, depending on the definition used in investigating the proportion of children who meet PA guidelines, either 11% or 60% of Scottish 10-11 year olds meet the current UK recommendations. These figures highlight the continuing issue surrounding accurate physical activity measurement, and the need for careful consideration when using this type of data.

chapter 5

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chapter 6

APPENDICES

6.1 Appendix A

We are trying to find out about your level of physical activity from **the last 7 days** (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

Remember

1 There are no right or wrong answers
— this is not a test.

2 Please answer all the questions as honestly and accurately as you can
— this is very important.

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SPACES PAQ_C Questionnaire 1

1 **Physical activity in your spare time:**

Have you done any of the following activities in the past 7 days (last week) and if so, how many times?

Please tick **ONE BOX on each line**

	No	1 – 2 times	3 – 4 times	5 – 6 times	7 times or more
Skipping	☐	☐	☐	☐	☐
Rowing/canoeing	☐	☐	☐	☐	☐
Roller skating/blading	☐	☐	☐	☐	☐
Tag/Chases	☐	☐	☐	☐	☐
Walking for exercise	☐	☐	☐	☐	☐
Bicycling	☐	☐	☐	☐	☐
Jogging or running	☐	☐	☐	☐	☐
Aerobics	☐	☐	☐	☐	☐
Swimming	☐	☐	☐	☐	☐
Baseball, softball	☐	☐	☐	☐	☐
Dance	☐	☐	☐	☐	☐
Rugby	☐	☐	☐	☐	☐
Badminton	☐	☐	☐	☐	☐
Skateboarding	☐	☐	☐	☐	☐
Football	☐	☐	☐	☐	☐
Tennis	☐	☐	☐	☐	☐
Volleyball	☐	☐	☐	☐	☐

SPACES PAQ_C Questionnaire 2

Please tick **ONE BOX on each line**

	No	1 – 2 times	3 – 4 times	5 – 6 times	7 times or more
Hockey	☐	☐	☐	☐	☐
Basketball	☐	☐	☐	☐	☐
Ice skating	☐	☐	☐	☐	☐
Skiing/Snowboarding	☐	☐	☐	☐	☐
Ice hockey	☐	☐	☐	☐	☐
Other (please **write in**)					
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐

2 **In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)?**

Please tick **ONE BOX only**

- I don't do PE ☐
- Hardly ever ☐
- Sometimes ☐
- Quite often ☐
- Always ☐

SPACES PAQ_C Questionnaire 3

3 **In the last 7 days, what did you do most of the time AT INTERVAL/BREAK?**

Please tick **ONE BOX only**

- Sat down (talking, reading, doing schoolwork) ☐
- Stood around or walked around ☐
- Ran or played a little bit ☐
- Ran around and played quite a bit ☐
- Ran and played hard most of the time ☐

4 **In the last 7 days, what did you do most of the time AT LUNCH (besides eating lunch)?**

Please tick **ONE BOX only**

- Sat down (talking, reading, doing schoolwork) ☐
- Stood around or walked around ☐
- Ran or played a little bit ☐
- Ran around and played quite a bit ☐
- Ran and played hard most of the time ☐

SPACES PAQ_C Questionnaire 4

5 **In the last 7 days, on how many days RIGHT AFTER SCHOOL did you do sports, dance or play games in which you were very active?**

Please tick **ONE BOX only**

- None ☐
- 1 time last week ☐
- 2 or 3 times last week ☐
- 4 times last week ☐
- 5 times last week ☐

6 **In the last 7 days, on how many EVENINGS did you do sports, dance or play games in which you were very active?**

Please tick **ONE BOX only**

- None ☐
- 1 time last week ☐
- 2 or 3 times last week ☐
- 4 times last week ☐
- 5 times last week ☐

7 **ON THE LAST WEEKEND, how many times did you do sports, dance, or play games in which you were very active?**

Please tick **ONE BOX only**

- None ☐
- 1 time ☐
- 2 – 3 times ☐
- 4 – 5 times ☐
- 6 or more times ☐

8 **Which ONE of the following describes you best for the last 7 days? Read ALL FIVE statements before deciding on the ONE answer that describes you.**

Please tick **ONE BOX only**

- **A** All or most of my free time was spent doing things that involve little physical effort. ☐
- **B** I sometimes (1 – 2 times last week) did physical things in my free time (like played sports, went running, swimming, bike riding, did aerobics) ☐
- **C** I often (3 – 4 times last week) did physical things in my free time ☐
- **D** I quite often (5 – 6 times last week) did physical things in my free time ☐
- **E** I very often (7 or more times last week) did physical things in my free time ☐

9 **Mark how often you did physical activity (like playing sports, games, doing or any other physical activity) for each day last week.**

Please tick **ONE BOX on each line**

	None	Little bit	Medium	Often	Very often
Monday	☐	☐	☐	☐	☐
Tuesday	☐	☐	☐	☐	☐
Wednesday	☐	☐	☐	☐	☐
Thursday	☐	☐	☐	☐	☐
Friday	☐	☐	☐	☐	☐
Saturday	☐	☐	☐	☐	☐
Sunday	☐	☐	☐	☐	☐

10 **Were you sick last week, or did anything prevent you from doing your normal physical activities?**

Please tick **ONE BOX**

Yes ☐

No ☐

If YES, what prevented you?

Please **WRITE IN**

_____

THANK YOU

Please ensure you have tried your best to complete all 10 questions and that you have not missed any by mistake.

SPACES PAQ_C Questionnaire 7

6.1 Appendix B - Note on weighting for SPACES project

GUS SPACES was a follow-up study for Phase 1 participants of GUS Sweep 8 hence there were three types of respondents, namely: participants in GUS SPACES, non-participants who were given a chance to take part and non-participants who weren't given a chance to participate (GUS Phase 2 sample members). To account for:

i) the fact that GUS SPACES is only based on phase 1 and full productives;

ii) (non-) consent to take part in follow-ups;

iii) (non-) response to GUS SPACES.

non-participants were treated as one group of GUS SPACES unproductives and one step calibration was made to adjust the achieved sample to totals. GUS sweep 8 longitudinal sample weights (w8_baby) were used as entry weights for calibration and development of longitudinal weights for GUS SPACES and the GUS sweep 8 cross-sectional weight.

As an outcome, two weights were developed for GUS SPACES.

1. **MRC_child:** A longitudinal weight for analysis of GUS SPACES data for children whose prime carer has responded at every earlier sweep of GUS
2. **MRC_fullC:** A cross-sectional weight that should be used for any cross-sectional (sweep 8/age 10) analysis of the GUS SPACES data (i.e. data collected about the child). All children that completed follow-up have a cross-sectional child weight.

For the purposes of describing the weighting, respondents in GUS SPACES have been named Sample A and Sample B. These samples are defined as follows:

- Sample A – children whose carers had responded at all previous sweeps 1-8
- Sample B – children whose carers had participated in GUS SPACES but had missed one or more interviews in GUS Sweeps 2-7.

The two samples were treated separately during the weighting. This is because the Sample B respondents are likely to have different characteristics to those in Sample A, as suggested by their much lower response rates. There were 737 Sample A respondents and 775 Sample A+B respondents.

Longitudinal weights (MRC_child)

Longitudinal weights were only generated for respondents in Sample A. Calibration weighting methods were applied which take the pre-calibrated weighted combined sample and adjusts the weights using an iterative procedure. The resulting weighting factors, when applied to the combined data, will make the survey estimates match a set of population estimates for a set of key variables. The population estimates in this instance are survey estimates from Sample A, weighted by the main GUS sweep 8 longitudinal weight (w8_baby). Since the longitudinal weight corrects for sampling error and non-response bias at each stage of GUS, the weighted Sample A estimates are the best population estimates available. The choice of the variables to use in the calibration was dictated by the bias remaining in the data after the SW8 longitudinal weights were applied to Sample A. The key variables used in the weighting are presented in the table below:

Variables used in the calibration of the longitudinal sample

- Respondent age (Ragegrp)
- Last known tenure (tenure)
- Family type (whether the respondent was a lone parent) (DhHGrsp04)
- Location of household (UR2FOLD)
- Scottish Index of Multiple Deprivation 15% most deprived data zones (SIMD15_12)

Cross-sectional weights (MRC_fullC)

Cross-sectional weights were generated for all GUS SPACES respondents (Sample A+B). Calibration weighting methods were applied which takes the pre-calibrated weighted combined sample and adjusts the weights using an iterative procedure. The resulting weighting factors, when applied to the combined data, will make the survey estimates match a set of population estimates for a set of key variables. The population estimates in this instance are survey estimates from Sample A+B, weighted by the GUS sweep 8 cross-sectional weight (w8_fullB). The choice of the variables to use in the calibration was dictated by the bias remaining in the data after the SW8 cross-sectional weights were applied to Sample A+B. As the difference between sample A and A+B is only of 38 observations the key variables used in the weighting are exactly same as for longitudinal solution.

Sample efficiency of GUS SPACES data

Adding weights to a sample can affect the sample efficiency. If the weights are very variable (i.e. they have very high and/or very low values) the weighted estimates will have a larger variance. More variance means standard errors are larger and confidence intervals are wider, so there is less certainty over how close the estimates are to the true population value.

The effect of the sample design on the precision of survey estimates is indicated by the effective sample size (neff). The effective sample size measures the size of an (unweighted) simple random sample that would have provided the same precision (standard error) as the design being implemented. If the effective sample size is close to the actual sample size then we have an efficient design with a good level of precision. The lower the effective sample size, the lower the level of precision. The efficiency of a sample is given by the ratio of the effective sample size to the actual sample size. The range of the weights, the effective sample size and sample efficiency for both sets of weights are given in the table below.

Range of weights and sample efficiency

	Minimum	Maximum	Mean	N	Neff	Efficiency
Longitudinal weight	0.35	8.05	1	737	363	49%
Cross-sectional weight	0.36	8.08	1	775	394	51%

Applying the weights

For any cross-sectional analysis, i.e. any analysis of GUS SPACES and GUS sweep 8 data only MRC_fullC weights should be applied.

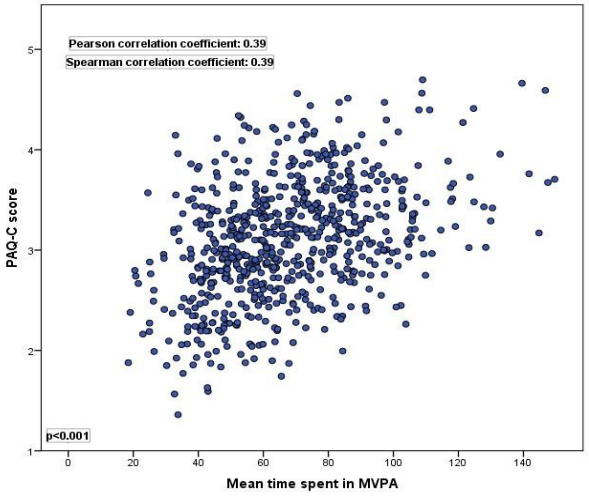
The longitudinal weight should be used for any analyses of GUS SPACES data with information from previous GUS Sweeps.

Description of weights variables in the data file

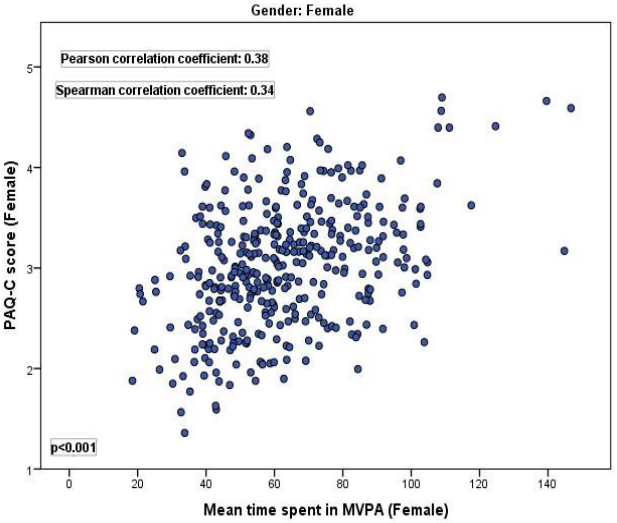
Variable name	Label
MRC_child	GUS SPACES Weights for LONGITUDINAL CHILD sample
MRC_fullC	GUS SPACES Weights for CROSS SECTIONAL CHILD sample

6.3 Appendix C – Scatterplots investigation relationship between MVPA/CPM and PAQ-C scores

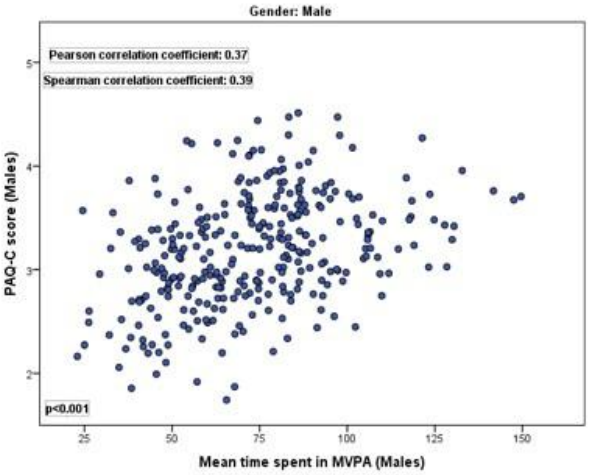
Scatterplot of PAQ-C scores and MVPA overall



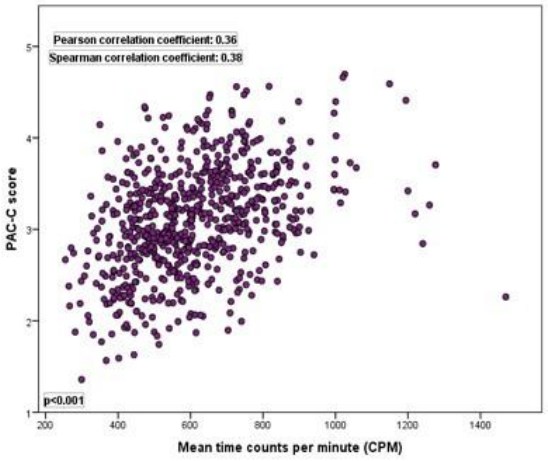
Scatterplot of PAQ-C scores and MVPA for girls



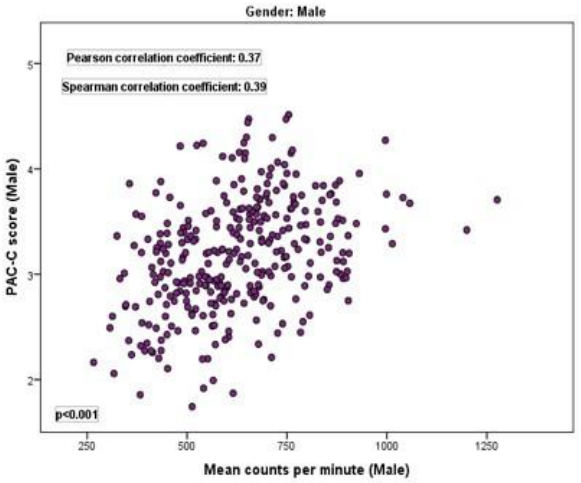
Scatterplot of PAQ-C scores and MVPA for boys



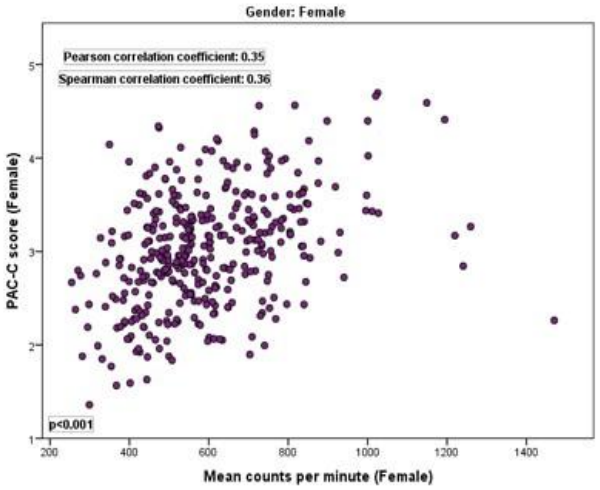
Scatterplot of PAQ-C scores and CPM overall



Scatterplot of PAQ-C scores and CPM for boys



Scatterplot of PAQ-C scores and CPM for girls



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ISBN: 978-1-78851-109-4

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Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS269286 (08/17)