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Associations between participation in organised physical activity in the school or community outside school hours, and neighbourhood play with child physical activity and sedentary time: a cross-sectional analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-017588
Article Type:	Research
Date Submitted by the Author:	02-May-2017
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Primary Subject Heading:	Public health
Secondary Subject Heading:	Paediatrics
Keywords:	Physical activity, children, accelerometer, extra-curricular, play

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Manuscripts

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3 1 Associations between participation in organised physical activity in the school or community
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5 2 outside school hours, and neighbourhood play with child physical activity and sedentary
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7 3 time: a cross-sectional analysis
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27
28 28 **Word count:** Manuscript = 2979 words

29
30 **Abstract** = 298 words

1
2
3 30 **ABSTRACT**
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6 31 **Objectives:** Assess the extent to which participation in organised physical activity in the
7
8 32 school or community outside school hours, and neighbourhood play, were associated with
9
10 33 children's physical activity and sedentary time.
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12 34 **Design:** Cross-sectional study.
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14 35 **Setting:** Children were recruited from 47 state funded primary schools in Southwest England.
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17 36 **Participants:** 1223 8-9 year old children.
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19 37 **Outcome measures:** Accelerometer-assessed moderate-to-vigorous-intensity physical
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21 38 activity (MVPA) and sedentary time.
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25
26 40 **Methods:** Children wore an accelerometer and mean minutes of MVPA and sedentary time
27
28 41 per day were derived. Children reported their attendance at organised physical activity in the
29
30 42 school or community outside school hours, and neighbourhood play, using a piloted
31
32 43 questionnaire. Cross-sectional linear and logistic regression were used to examine if
33
34 44 attendance frequency at each setting (and all settings combined) was associated with
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36 45 moderate-to-vigorous-intensity physical activity (MVPA) and sedentary time. Multiple
37
38 46 imputation methods were used to account for missing data and increase sample size.
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42 47
43
44 48 **Results:** Children who attended clubs at school 3-4 days per week obtained an average of
45
46 49 7.58 (95% CI: 2.7 to 12.4) more minutes of MVPA per day than children who never attended.
47
48 50 Report of participation in the three other non-school-based activities were similarly
49
50 51 associated with MVPA. Evidence for associations with sedentary time was generally weaker.
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53 52 Associations were similar in girls and boys. When the four different contexts were combined,
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55 53 each additional 1-2 activities participated in per week increased participants' odds (OR: 1.18,
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3 54 95% CI: 1.12 to 1.26) of meeting the Government recommendations for 60 minutes of
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5 55 MVPA per day.
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10 57 **Conclusion:** Participating in organised physical activity at school and in the community is
11
12 58 associated with greater physical activity and reduced sedentary time among both boys and
13
14 59 girls. All four types of activity contribute to overall physical activity, which provides parents
15
16 60 with a range of settings in which to help their child be active.
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21
22 62 **Key words:** Physical activity, children, accelerometer, clubs, extra-curricular, play
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3 63 **ARTICLE SUMMARY**
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6 64 **Strengths and limitations of this study**
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8
9 65 **Strengths**

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11 66 • Accelerometer data from a large sample of Year 4 children.
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13 67 • Detailed information on organised physical activity in the school or community
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15 outside school hours, and neighbourhood play.
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17 68
18 69 • Multiple imputation models to provide estimates for participants with missing data.
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24 71 **Limitations**
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27 72 • Cross-sectional study design.
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29 73 • Data are from a single UK region.
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74 INTRODUCTION

75 Physical activity is associated with improved mental well-being, reduced risk of obesity and
76 lower blood pressure among children.[1] Sedentary time may also be a risk factor for non-
77 communicable diseases but it is not clear if this effect is independent of physical activity.[2-
78 4] The UK Chief Medical Officers recommend that all children and young people should
79 engage in at least an hour per day of moderate-to-vigorous-intensity physical activity
80 (MVPA) and limit sedentary time,[5] however considerable proportions of children do not
81 meet these guidelines.[6] For example, data from the nationally-representative Millennium
82 cohort showed that only 51% of 7-8 year olds met the recommendation.[7] The amount of
83 time children spend engaged in MVPA gradually declines with age, while sedentary time
84 increases.[6 8-11] Strategies to increase children's physical activity are needed.

85
86 The majority of interventions to increase children's physical activity have been delivered
87 during school time.[12 13] These interventions have included strategies such as changes to
88 the physical education provision and new educational programmes based on information
89 sharing and personal goal setting.[12-14] Overall, these programmes have tended to report no
90 effect, weak effects or moderate effects in sub-groups.[12-16] Potential reasons for this are
91 the difficulty faced in adding interventions to already full school-curricula and the lack of
92 skills and training that teachers have for delivering a range of activities to engage the
93 majority of children.[17] As such, there is a need to understand the potential of organised
94 physical activity outside school hours to increase MVPA.

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96 After-school programmes have the potential to facilitate physical activity for children, as
97 schools have space in which children can be active, staff who can be trained, and many
98 parents welcome programmes that provide childcare.[16 18-21] Although a number of studies

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3 99 have examined the potential of delivering such sessions, it is not clear whether attendance at
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5 100 the programmes currently provided by schools is associated with higher overall levels of
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7 101 MVPA.[18-21] There is also a lack of information about how attendance at community-based
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9 102 physical activity clubs contributes to overall MVPA. Furthermore, as not all children attend
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11 103 after-school programmes, it is not clear how other activities such as playing in the
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13 104 neighbourhood or at home in the garden contribute to overall MVPA. A key question,
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15 105 therefore, is whether the frequency of participation in organised physical activity in the
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17 106 school or community after school hours, neighbourhood play or home play is associated with
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19 107 the MVPA and sedentary time of children. Since some children will be active in all four
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21 108 settings, it would also be informative to examine collective participation across all settings.
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110 The aim of this study was to assess among children (8-9 years of age) the extent to which
111 participation in organised physical activity in the school or community outside school hours,
112 and playing with friends or family near the home or in the garden were associated with
113 MVPA and sedentary time. A secondary aim was to examine if there was a cumulative
114 association between participation in the four different types of activities with both MVPA
115 and sedentary time.

116

117 **METHODS**

118 The current analyses used data from the B-Proact1v study, which has been described in detail
119 elsewhere.[11 22 23] Briefly, the study aimed to examine physical activity behaviours of
120 children and their parents over the course of primary school. Between 2012 and 2013, data
121 were collected from 1299 Year 1 children (5-6 years of age) from 57 schools in Bristol (UK).
122 Between March 2015 and July 2016, all 57 schools were approached to re-join the study
123 when the children were in Year 4 (8-9 years of age), with 47 schools agreeing to take part

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3 124 (1223 children). The current analyses used data from the Year 4 assessments. The study
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5 125 received ethical approval from the School for Policy Studies Ethics Committee at the
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7 126 University of Bristol, and written parent consent was received for all participants.
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12 128 ***Data collection***

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14 129 Data were collected at schools, with children asked to complete a brief questionnaire. As
15
16 130 indicators of organised physical activity outside school hours in school and in the community
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18 131 respectively, we asked “How often do you attend... a) a sport or exercise club at school (NOT
19
20 132 including PE)? and b) a sport or exercise club at places other than your school (like a football
21
22 133 club or ballet)?” To indicate neighbourhood play outside and within the home we asked
23
24 134 “How much do you play with your friends and family... a) outside near your home? and b) in
25
26 135 your home or garden?”. These questions each had four response options: “Never”, “1-2 days
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28 136 per week”, “3-4 days per week” or “5 days per week”. We assigned these 0, 1, 2 and 3 points
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30 137 respectively and summed responses to derive an overall activity score ranging from 0 to 12,
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32 138 with a higher value indicating a higher frequency of activity participation.
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38 140 Child height was measured to the nearest 0.1cm using a SECA Leicester stadiometer (HAB
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40 141 International, Northampton). Weight was recorded to the nearest 0.1kg using a SECA 899
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42 142 digital scale (HAB International, Northampton). Child Body Mass Index ($BMI = kg/m^2$) was
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44 143 then calculated and converted to an age- and gender-specific standard deviation score.[24 25]
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46 144 Children wore a waist-worn ActiGraph wGT3X-BT accelerometer for five days including
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48 145 two weekend days. Parents provided demographic information via a questionnaire, including
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50 146 child gender and date of birth. Where children’s date of birth was missing (20.5% of
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52 147 children), they were assigned the median age of 9.0 years. Indices of Multiple Deprivation
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54 148 (IMD) scores, based upon the English Indices of Deprivation
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3 149 (<http://data.gov.uk/dataset/index-of-multiple-deprivation>), were assigned to each child based
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5 150 on their reported home postcode, where higher IMD scores indicate a greater level of
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7 151 deprivation.
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11 153 *Accelerometer data reduction*

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13
14 154 Accelerometer data were processed using Kinesoft (v3.3.75; Kinesoft, Saskatchewan,
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16 155 Canada). At least three valid days of data were required for accelerometer data to be
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18 156 considered complete for a given child and included in analysis, where a valid day was defined
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20 157 as at least 500 minutes of data, after excluding intervals of ≥ 60 minutes of zero counts
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22 158 allowing up to two minutes of interruptions. The child's average number of sedentary and
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24 159 MVPA minutes per day were derived using population-specific cut points for children.[26]
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26 160 We also derived a binary variable indicating whether the child's average daily MVPA was
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28 161 greater than the 60 minutes per day recommended by the UK government.[5]
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31 32 33 163 *Analysis*

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35 164 The associations of child characteristics (gender, age, BMI z-score, and IMD) with activity
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37 165 participation were examined in the observed data using t-tests, Pearson's correlation
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39 166 coefficients, chi-squared tests and one-way analysis of variance as appropriate.
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44 168 Multiple imputation of missing data was used to create 20 imputed datasets for the 1223 Year
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46 169 4 children. We used 20 cycles of regression switching and combined regression coefficients
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48 170 across datasets using Rubin's rules.[27] We imputed separately for boys and girls to allow for
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50 171 associations to differ by gender. All exposures (organised physical activity attendance and
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52 172 neighbourhood play), outcomes (sedentary time and MVPA), potential confounders (gender,
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54 173 age, BMI z-score, and IMD) and child's school were included in multiple imputation models,
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3 174 and achievement of the MVPA guideline and overall activity score were imputed passively.

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5 175 Any children with less than three valid days of accelerometer data had their accelerometer

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7 176 measures imputed.

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13 178 We examined the pairwise associations of the activity participation variables by

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15 179 dichotomising, cross-tabulating and fitting unadjusted logistic regression models of one

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17 180 frequency variable on another.

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23 182 We used linear regression models to examine the associations of activity participation and the

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25 183 overall activity score with the child's average sedentary and MVPA minutes per day, and

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27 184 logistic regression models to examine associations with achievement of the MVPA guideline.

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29 185 In Model 1 we adjusted for gender and age, and in Model 2 we adjusted additionally for BMI

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31 186 z-score and IMD. Robust standard errors were used to account for clustering of children

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33 187 within schools. Combined Wald tests were used to test for evidence of interaction between

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35 188 the child's gender and the exposure of interest.

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42 190 We predicted the children's mean number of sedentary and MVPA minutes per day by

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44 191 frequency of participation in each activity based on linear combinations of the regression

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46 192 coefficients from fully-adjusted models (Model 2).

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52 194 Regression analyses were repeated restricting to the children who had complete data for all

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54 195 exposures, outcomes and co-variables and compared with the multiple imputation analysis.

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3 196 We also produced scatter plots of sedentary time and MVPA by the overall activity score in
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5 197 the observed data.
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9 199 A sensitivity analysis was performed including accelerometer data for any children who had
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11 200 at least one valid day of measures to assess whether only including accelerometer data for
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13 201 children who recorded at least three valid days influenced our results. All analyses were
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15 202 performed in Stata version 14.0 (StataCorp, 2015).
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20 204 **RESULTS**

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22 205 The distributions of characteristics of the children in the observed data, multiple imputation
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24 206 datasets and subset with complete information are shown in Table 1. All characteristics
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26 207 showed similar distributions in each of the datasets and had only a small proportion of
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28 208 missing data (maximum 16.1% for accelerometer measures).
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Table 1 Characteristics of children who took part in the Year 4 phase of the B-Proact1v Study (observed and multiple imputation) N=1223

Child Characteristic		Observed data		Imputed data (N=1223)	Complete data (N=987)
		N available	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %
Sedentary time at Year 4 (mins/day)		1026	445.4 (115.4)	444.7 (120.1)	446.0 (116.9)
MVPA at Year 4 (mins/day)		1026	61.6 (21.9)	61.9 (22.5)	61.8 (21.8)
Met MVPA guidelines at Year 4	No	1163	53.2	52.6	53.4
	Yes		46.8	47.4	46.6
Gender	Boy	1223	45.5	45.5	44.5
	Girl		54.5	54.5	55.5
Age at Year 4 (years)		1223	9.03 (0.41)	9.03 (0.41)	9.03 (0.43)
BMI z score at Year 4		1208	0.35 (1.08)	0.36 (1.08)	0.31 (1.07)
IMD score at Year 4		1204	15.9 (14.1)	15.9 (14.2)	15.3 (13.6)
Frequency child attends sport/exercise club at school	Never	1215	27.8	27.9	28.2
	1-2 days per week		45.5	45.5	45.8
	3-4 days per week		16.1	16.1	16.6
	5 days per week		10.5	10.5	9.4
Frequency child attends sport/exercise club outside school	Never	1214	20.6	20.6	19.4
	1-2 days per week		50.2	50.2	51.0
	3-4 days per week		20.8	20.9	21.5
	5 days per week		8.3	8.3	8.2
Frequency child plays with friends/family outside near home	Never	1205	6.3	6.4	6.5
	1-2 days per week		33.7	33.7	34.3
	3-4 days per week		29.0	28.9	29.7
	5 days per week		31.0	30.9	29.5
Frequency child plays with friends/family in home or garden	Never	1199	9.6	9.7	8.8
	1-2 days per week		34.5	34.6	35.0
	3-4 days per week		26.8	26.7	27.8
	5 days per week		29.1	29.0	28.5
Activity frequency score		1193	5.88 (2.29)	5.86 (2.29)	5.84 (2.26)

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3 210 *Associations of child characteristics with activity participation*
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5 211 Table S1 shows child activity attendance by gender. Girls tended to report lower frequencies
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7 212 of participating in organised physical activity in the school or community outside school
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9 213 hours, and had a lower mean overall activity score. There was no gender difference in
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11 214 friends/family play either in or outside of the home. The associations of other child
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13 215 characteristics with activity participation are shown in Table S2. There was some evidence
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15 216 that children who more frequently attended a sport/exercise club outside of school had a
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17 217 higher mean age. Child BMI was not strongly associated with any particular activity, but
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19 218 there was weak evidence that the overall activity score decreased with increasing BMI Z-
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21 219 score. Children who reported attendance of “Never” or “5 days/week” generally had the
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23 220 highest IMD scores, suggesting a U-shaped association, and there was a negative correlation
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25 221 between the overall activity score and IMD.
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32 223 *Inter-relationships of activity participation frequencies*
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34 224 Participating in one type of activity more frequently was generally associated with a higher
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36 225 frequency of participation in each of the others, except that attendance at a sport/exercise club
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38 226 outside of school was not associated with playing outside near the home (Table S3).
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43 228 *Associations of activity participation with sedentary time and MVPA*
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45 229 There was a negative correlation of the overall activity score with sedentary time and a
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47 230 positive correlation between the overall activity score and MVPA (Figures S1 and S2).
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51
52 232 Table 2 shows the mean difference in sedentary time by activity participation and overall
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54 233 activity score in the multiple imputation datasets, and Figure 1 shows the predicted sedentary
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56 234 time by activity participation. Sedentary time decreased on average with increasing frequency
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3 235 of attending sport/exercise clubs either at school or outside of school and with increasing
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5 236 frequency of playing with friends/family outside near the home in regression models adjusted
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7 237 for gender and age (Model 1). The association between sport/exercise club attendance outside
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9 238 of school and sedentary time weakened slightly on additional adjustment for BMI Z-score
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11 239 and IMD (Model 2) but other associations remained. An increase in children's overall activity
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13 240 score was also strongly associated with a reduction in sedentary time in both models.
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16 241 However, there was no evidence of an association between playing with friends/family at
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18 242 home and sedentary time. Associations did not differ between boys and girls. Findings were
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21 243 similar when restricted to children who had complete data (Table S4).
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Table 2 Mean difference in the children's average sedentary minutes per day associated with different activities using multiple imputation (N=1223)*

Exposure	Sedentary time (minutes/day): mean difference (95% confidence interval)							P for gender interaction
	All (N=1223)		Boys (N=556)		Girls (N=667)			
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2		
Frequency child attends sport/exercise club at school	Never (ref)	0	0	0	0	0	0	0.69
	1-2 days/week	-4.2	-3.0	7.9	8.9	-13.0	-11.5	
	3-4 days/week	(-22.5, 14.0)	(-21.4, 15.4)	(-16.6, 32.3)	(-15.9, 33.7)	(-38.3, 12.4)	(-37.5, 14.4)	
		-31.1	-28.8	-18.7	-16.9	-40.1	-37.3	
		(-50.7, -11.5)	(-46.4, -11.3)	(-41.8, 4.4)	(-41.2, 7.3)	(-71.7, -8.5)	(-65.4, -9.2)	
5 days/week	-18.7	-18.8	-9.6	-7.3	-26.0	-33.3		
	(-42.9, 5.6)	(-42.1, 4.5)	(-37.7, 18.4)	(-34.9, 20.4)	(-66.8, 14.8)	(-82.0, 15.5)		
P for trend	0.02	0.01	0.17	0.23	0.05	0.04		
Frequency child attends sport/exercise club outside of school	Never (ref)	0	0	0	0	0	0	0.81
	1-2 days/week	14.8	18.0	21.5	25.9	11.0	13.6	
	3-4 days/week	(-9.1, 38.7)	(-8.9, 45.0)	(-7.4, 50.5)	(-4.5, 56.4)	(-19.9, 42.0)	(-20.5, 47.7)	
		-7.2	-1.5	-1.0	4.8	-10.5	-4.1	
		(-27.0, 12.6)	(-23.4, 20.4)	(-32.8, 30.8)	(-27.1, 36.6)	(-30.5, 9.5)	(-27.3, 19.0)	
5 days/week	-19.9	-15.5	-12.6	-7.7	-25.2	-20.6		
	(-41.1, 1.2)	(-37.7, 6.8)	(-42.4, 17.1)	(-36.5, 21.1)	(-55.0, 4.6)	(-52.1, 11.0)		
P for trend	0.02	0.07	0.12	0.16	0.07	0.23		
Frequency child plays with friends/family outside near home	Never (ref)	0	0	0	0	0	0	0.56
	1-2 days/week	0.77	2.3	19.2	21.2	-16.6	-15.6	
	3-4 days/week	(-28.5, 30.0)	(-28.0, 32.7)	(-16.5, 55.0)	(-14.4, 56.8)	(-63.1, 30.0)	(-65.0, 33.9)	
		-5.2	-2.8	7.6	10.6	-17.6	-16.1	
		(-29.9, 19.6)	(-29.4, 23.7)	(-28.4, 43.5)	(-25.5, 46.6)	(-65.8, 30.5)	(-67.4, 35.3)	
5 days/week	-23.4	-24.1	-11.0	-10.2	-35.4	-37.8		
	(-49.0, 2.1)	(-50.8, 2.7)	(-45.2, 23.2)	(-44.4, 24.0)	(-79.9, 9.0)	(-86.6, 10.9)		
P for trend	0.004	0.001	0.07	0.05	0.02	0.02		
Frequency child plays with friends/family in home/garden	Never (ref)	0	0	0	0	0	0	0.90
	1-2 days/week	16.2	17.9	19.2	20.6	13.1	14.9	
	3-4 days/week	(-13.8, 46.3)	(-12.5, 48.2)	(-22.9, 61.3)	(-21.5, 62.7)	(-25.8, 52.0)	(-24.3, 54.1)	
		-3.9	-0.7	3.9	6.5	-10.7	-6.4	
		(-28.8, 20.9)	(-26.7, 25.4)	(-30.5, 38.4)	(-28.7, 41.7)	(-46.6, 25.3)	(-42.9, 30.1)	
5 days/week	5.3	6.1	9.9	11.6	1.2	0.6		
	(-22.9, 33.5)	(-22.5, 34.7)	(-32.5, 52.3)	(-31.2, 54.4)	(-39.2, 41.5)	(-40.2, 41.5)		
P for trend	0.49	0.49	0.85	0.91	0.49	0.45		
Activity score (per unit)	-4.8	-4.6	-3.8	-3.4	-5.9	-5.9	0.41	
	(-7.3, -2.3)	(-7.0, -2.1)	(-7.7, 0.1)	(-7.2, 0.4)	(-10.0, -1.7)	(-10.2, -1.6)		

*Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score

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3 246 The mean difference in MVPA by each of the activity variables in the multiple imputation
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5 247 data is shown in Table 3, with predicted MVPA by activity participation presented in Figure
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7 248 2. A higher frequency of attending sport/exercise clubs either at school or outside of school
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9 249 and of play either outside or in the home/garden were all associated with greater MVPA on
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11 250 average in Models 1 and 2. Associations were similar in boys and girls. A higher overall
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13 251 activity score was also associated with greater MVPA, with some evidence that this
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15 252 association was stronger in boys than in girls. Associations were similar when restricted to
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17 253 children with complete data (Table S5).
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Table 3 Mean difference in the children's average MVPA minutes per day associated with different activities using multiple imputation (N=1223)*

Exposure	Moderate-to-vigorous physical activity (minutes/day): mean difference (95% confidence interval)							
	All (N=1223)		Boys (N=556)		Girls (N=667)		P for gender interaction	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2		
Frequency child attends sport/exercise club at school	Never (ref)	0	0	0	0	0	0	0.64
	1-2 days/week	3.7 (0.3, 7.2)	3.6 (0.1, 7.0)	4.4 (-2.1, 10.9)	4.1 (-2.3, 10.5)	3.2 (-0.3, 6.7)	3.1 (-0.3, 6.6)	
	3-4 days/week	7.8 (2.9, 12.6)	7.5 (2.7, 12.4)	10.1 (2.6, 17.7)	9.6 (2.0, 17.2)	5.9 (0.9, 10.8)	5.8 (0.9, 10.7)	
	5 days/week	5.9 (-0.1, 11.8)	5.7 (-0.3, 11.7)	7.5 (-0.4, 15.4)	7.0 (-1.1, 15.0)	3.8 (-3.7, 11.3)	3.6 (-4.1, 11.4)	
	P for trend	0.007	0.01	0.02	0.03	0.05	0.06	
Frequency child attends sport/exercise club outside of school	Never (ref)	0	0	0	0	0	0	0.80
	1-2 days/week	0.9 (-2.5, 4.3)	0.7 (-2.9, 4.4)	1.8 (-4.7, 8.3)	1.3 (-5.5, 8.2)	0.5 (-3.3, 4.4)	0.5 (-3.4, 4.5)	
	3-4 days/week	6.9 (2.4, 11.5)	6.5 (1.9, 11.2)	8.9 (1.0, 16.8)	8.1 (0.1, 16.0)	5.5 (0.9, 10.1)	5.6 (1.1, 10.2)	
	5 days/week	9.9 (3.8, 16.0)	9.6 (3.3, 15.9)	11.8 (3.4, 20.1)	11.2 (2.4, 19.9)	8.2 (0.7, 15.7)	8.2 (0.8, 15.7)	
	P for trend	<0.001	<0.001	0.001	0.002	0.007	0.006	
Frequency child plays with friends/family outside near home	Never (ref)	0	0	0	0	0	0	0.19
	1-2 days/week	0.7 (-4.6, 6.0)	0.4 (-4.9, 5.6)	0.0 (-9.3, 9.2)	-0.5 (-9.9, 8.9)	1.4 (-6.0, 8.8)	1.3 (-6.2, 8.7)	
	3-4 days/week	5.1 (-0.9, 11.1)	4.8 (-1.1, 10.7)	6.1 (-4.1, 16.3)	5.7 (-4.5, 15.9)	4.4 (-3.5, 12.3)	4.3 (-3.7, 12.2)	
	5 days/week	9.6 (4.0, 15.3)	9.5 (3.9, 15.2)	13.0 (3.3, 22.8)	12.9 (3.0, 22.7)	6.7 (-0.7, 14.0)	6.6 (-0.9, 14.0)	
	P for trend	<0.001	<0.001	<0.001	<0.001	0.005	0.006	
Frequency child plays with friends/family in home/garden	Never (ref)	0	0	0	0	0	0	0.38
	1-2 days/week	2.0 (-2.4, 6.4)	1.6 (-2.7, 6.0)	-0.1 (-8.4, 8.3)	-0.6 (-8.9, 7.7)	3.8 (-2.2, 9.8)	3.6 (-2.4, 9.7)	
	3-4 days/week	5.6 (0.9, 10.3)	5.3 (0.4, 10.2)	5.6 (-3.1, 14.3)	5.4 (-3.5, 14.4)	5.7 (-0.6, 11.9)	5.5 (-0.9, 12.0)	
	5 days/week	7.4 (3.0, 11.8)	7.1 (2.7, 11.6)	8.3 (0.1, 16.6)	7.7 (-0.7, 16.1)	6.6 (0.7, 12.5)	6.5 (0.6, 12.5)	
	P for trend	<0.001	<0.001	<0.001	<0.001	0.005	0.006	

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2	P for trend	<0.001	<0.001	0.004	0.006	0.02	0.02	255
3	Activity score (per unit)	2.1	2.0	2.6	2.5	1.6	1.6	0.06
4		(1.4, 2.7)	(1.4, 2.7)	(1.7, 3.4)	(1.6, 3.4)	(0.8, 2.3)	(0.8, 2.3)	256
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 7 *MVPA Moderate-to-vigorous physical activity; Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score

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3 258 The associations of activity variables with achievement of the hour per day government
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5 259 guideline in the multiple imputation data are shown in Table 4. A higher frequency of
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7 260 participation in any of the activities, or an increase in the overall activity score, was
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9 261 associated with increased odds of meeting the government guideline in both models.
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11 262 Associations were similar in girls and boys. A unit increase in the activity score was
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13 263 associated with around an 18% increase in the odds of achieving 60 minutes of MVPA per
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15 264 day. Findings were unchanged when restricting to those with complete data (Table S6).
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Table 4 Odds ratios for achieving 60 minutes of MVPA per day associated with different activities using multiple imputation (N=1223)*

Exposure		Meeting government guideline: odds ratio (95% confidence interval)						P for gender interaction
		All (N=1223)		Boys (N=556)		Girls (N=667)		
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	
Frequency child attends sport/exercise club at school	Never (ref)	1	1	1	1	1	1	0.34
	1-2 days/week	1.33 (0.98, 1.81)	1.31 (0.97, 1.78)	1.10 (0.65, 1.86)	1.07 (0.63, 1.81)	1.54 (1.06, 2.23)	1.54 (1.07, 2.21)	
	3-4 days/week	1.87 (1.16, 3.01)	1.83 (1.14, 2.93)	2.22 (1.09, 4.53)	2.14 (1.04, 4.40)	1.63 (0.94, 2.85)	1.63 (0.94, 2.82)	
	5 days/week	1.69 (1.03, 2.78)	1.67 (1.02, 2.76)	1.61 (0.83, 3.09)	1.55 (0.79, 3.02)	1.76 (0.84, 3.69)	1.77 (0.84, 3.73)	
P for trend		0.01	0.01	0.03	0.05	0.05	0.05	
Frequency child attends sport/exercise club outside of school	Never (ref)	1	1	1	1	1	1	0.93
	1-2 days/week	1.14 (0.80, 1.64)	1.13 (0.77, 1.64)	1.21 (0.74, 1.98)	1.18 (0.70, 1.99)	1.11 (0.68, 1.80)	1.12 (0.69, 1.82)	
	3-4 days/week	1.82 (1.22, 2.72)	1.75 (1.16, 2.65)	2.07 (1.11, 3.87)	1.95 (1.03, 3.67)	1.66 (0.99, 2.78)	1.69 (1.01, 2.83)	
	5 days/week	2.70 (1.57, 4.62)	2.63 (1.51, 4.58)	3.24 (1.49, 7.07)	3.15 (1.41, 7.06)	2.30 (1.12, 4.72)	2.33 (1.14, 4.77)	
P for trend		<0.001	<0.001	<0.001	0.001	0.009	0.008	
Frequency child plays with friends/family outside near home	Never (ref)	1	1	1	1	1	1	0.74
	1-2 days/week	1.15 (0.70, 1.88)	1.12 (0.69, 1.82)	0.98 (0.46, 2.09)	0.94 (0.43, 2.06)	1.47 (0.62, 3.45)	1.47 (0.63, 3.43)	
	3-4 days/week	1.88 (1.12, 3.16)	1.84 (1.11, 3.06)	1.62 (0.73, 3.58)	1.59 (0.70, 3.58)	2.32 (0.91, 5.91)	2.32 (0.92, 5.88)	
	5 days/week	2.11 (1.26, 3.52)	2.10 (1.26, 3.49)	2.08 (0.92, 4.69)	2.07 (0.91, 4.74)	2.35 (0.93, 5.99)	2.36 (0.93, 6.02)	
P for trend		<0.001	<0.001	0.003	0.002	0.01	0.02	
Frequency child plays with friends/family in home/garden	Never (ref)	1	1	1	1	1	1	0.21
	1-2 days/week	1.27 (0.84, 1.91)	1.23 (0.81, 1.86)	0.94 (0.52, 1.72)	0.90 (0.49, 1.64)	1.75 (0.84, 3.64)	1.75 (0.84, 3.65)	
	3-4 days/week	1.51 (1.00, 2.28)	1.46 (0.96, 2.23)	1.29 (0.70, 2.40)	1.28 (0.68, 2.44)	1.80 (0.86, 3.80)	1.80 (0.86, 3.79)	
	5 days/week	1.71 (1.14, 2.56)	1.67 (1.11, 2.53)	1.71 (0.90, 3.25)	1.62 (0.83, 3.14)	1.80 (0.88, 3.69)	1.81 (0.88, 3.70)	

P for trend	0.005	0.006	0.01	0.02	0.21	0.21	266
Activity score (per unit)	1.18 (1.12, 1.25)	1.18 (1.11, 1.25)	1.21 (1.12, 1.30)	1.20 (1.11, 1.30)	1.16 (1.07, 1.25)	1.16 (1.07, 1.25)	0.52 267

* MVPA Moderate-to-vigorous physical activity; Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score

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3 269 *Sensitivity Analysis*
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5 270 When we changed the inclusion criteria for accelerometer measures from three to one valid
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7 271 day, findings were largely unchanged, except that boys showed a stronger association
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9 272 between sport/exercise club attendance at their school and MVPA than girls (p for interaction
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11 273 = 0.03 in multiple imputation data).
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16 275 **DISCUSSION**
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18 276 The findings demonstrate that increased participation in organised physical activity at school
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20 277 and in the community are associated with greater overall physical activity and reduced
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22 278 sedentary time among both boys and girls. Specifically, a child who attends a school-based
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24 279 club 3-4 days per week obtained 7.8 more minutes of MVPA per day than a child who did not
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26 280 attend at all, with attendance of five days a week at a sport/exercise club outside of school
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28 281 associated with 10.9 more minutes of MVPA than children who never attended clubs. There
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30 282 were comparable patterns for engagement in non-organised activity at home or in the
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32 283 neighbourhood, both were associated with increased MVPA, but only activity outside of the
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34 284 home was associated with reduced sedentary time. When the four different contexts of
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36 285 physical activity were combined, the analyses showed that each additional 1-2 activities
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38 286 participated in per week increased the odds of meeting the Chief Medical Officers'
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40 287 recommendation of 60 minutes of MVPA per day by 18%. Thus, encouraging children to
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42 288 attend after-school and community-based physical activity clubs, as well as to play at home
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44 289 and in the neighbourhood is critical for helping children to increase MVPA. Moreover, in
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46 290 light of the relative consistency in findings for each of the four forms of physical activity, the
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48 291 message to parents should be that physical activity can be accumulated in all four settings
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50 292 which allows them to find a balance that works for their family. For some families with
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52 293 working parents, after-school programmes may be the key activity to focus on, whereas for
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3 294 other families encouraging children to play in the neighbourhood is likely to be useful for
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5 295 maximising physical activity. Furthermore, as there was little evidence that play at home was
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7 296 associated with a reduction in sedentary time, it is also important to examine ways of
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10 297 encouraging non-sedentary activities within the home.

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14 299 The UK Childhood Obesity strategy recommends that all primary schools should provide at
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16 300 least 30 minutes per day of physical activity opportunities across the curriculum, break times
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18 301 and extra-curricular activities.[28] The data presented here show that in the imputed dataset
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20 302 72.2% of Year 4 children were attending school-based programmes at least once per week
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22 303 and 10.5% were attending five days per week. Previous research has shown that in the UK,
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24 304 after-school clubs for primary school children tend to be dominated by team sports, such as
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26 305 football and rugby, with limited provision for non-competitive physical activities.[29] Thus,
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28 306 increasing the number and variety of sessions that children attend and improving the quality
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30 307 of those sessions is likely to provide a cost effective means of increasing children's physical
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32 308 activity. This hypothesis is consistent with the recent Theory of Expanded, Extended and
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34 309 Enhanced Opportunities (TEO), which suggests that the most effective means of increasing
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36 310 children's physical activity will be provided by extending and expanding current
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38 311 provision.[19] Thus, schools and community groups should be encouraged to extend current
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40 312 after-school provision to more children, diversify the activities to interest more pupils
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42 313 (preferably involving pupils in deciding what activities to offer), and enhance the quality of
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44 314 provision to maximise the amount of activity obtained. These relatively simple changes could
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46 315 be made at each school and would provide scalable ways for increasing overall levels of
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48 316 physical activity and contributing to the UK government's goal of reducing the prevalence of
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50 317 childhood obesity.

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3 319 ***Strengths and limitations***
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5 320 The major strength of this study is the large sample size and provision of detailed information
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7 321 about participation in four different physical activity settings alongside accelerometer-
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9 322 assessed physical activity. In addition, the use of multiple imputation models to provide
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11 323 estimates for participants with missing data using a robust methodology has enabled us to
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13 324 maximise the sample for analysis. The study is limited by the cross-sectional design, which
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15 325 limits the ability to infer causation between frequency of participation in different settings
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17 326 and levels of physical activity. All questions were self-reported and it is possible that some
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19 327 were recalled more accurately than others. The report of play within the home is likely to
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21 328 include both sedentary and physically active forms of play, as the question included play
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23 329 indoors, which could be expected to be more sedentary, as well as outdoors in the garden,
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25 330 which is likely to be more active. We were unable to disentangle these. We also cannot rule
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27 331 out the possibility of residual confounding, but have adjusted for several key potential
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29 332 confounding variables in order to minimise this. The study is also drawn from the greater
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31 333 Bristol area in the UK and as such our ability to extend findings to other settings and
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33 334 countries is limited.
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41 336 **CONCLUSIONS**

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43 337 Participation in organised physical activity at school and in the community is associated with
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45 338 greater physical activity and reduced sedentary time among both boys and girls. In light of
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47 339 the challenges of promoting physical activity during school time, parents should encourage
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49 340 children to attend after school clubs, attend community activity groups and play in the
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51 341 neighbourhood to help their children to meet physical activity guidelines. The data show that
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53 342 all four types of activity contribute similarly to overall physical activity and there is therefore
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55 343 an opportunity for families to find the best mix of options for them.
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5 345 **ACKNOWLEDGEMENTS**

6
7 346 This work was supported by grants from the British Heart Foundation (ref PG/11/51/28986
8
9 347 and SP 14/4/31123). DAL works in a unit that receives funding from the University of Bristol
10
11 348 and UK Medical Research Council (MC_UU_1201/5); she is also a UK National Institute of
12
13 349 Health and Research Senior Investigator (NF-SI-0166-10196). The funders had no
14
15 350 involvement in data analysis, data interpretation or writing of the paper.

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19 351 We would like to thank all of the families and schools that have taken part in the B-
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21 352 PROACTIV project. We would also like to thank all current and previous members of the
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23 353 research team who are not authors on this paper.
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28 355 **COMPETING INTERESTS**

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30 356 All authors have completed the ICMJE uniform disclosure form at
31
32 357 www.icmje.org/coi_disclosure.pdf and declare: all authors had financial support from the
33
34 358 British Heart Foundation for the submitted work; no financial relationships with any
35
36 359 organisations that might have an interest in the submitted work in the previous three years; no
37
38 360 other relationships or activities that could appear to have influenced the submitted work.
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44 362 **CONTRIBUTORS**

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46 363 Conception / design: RJ, ESM, JLT, DAL and SJS.

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48 364 Data analysis / acquisition/ interpretation: RJ, CMW, ESM and DAL

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50 365 Drafting / revising critically for important content: All authors.

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52 366 Final approval: All authors.

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54 367 Accountability for study and manuscript: RJ.

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3 369 **DATA SHARING STATEMENT:** The datasets generated during the current study are not
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5 370 publicly available as the project is ongoing and data are not ready for archiving. We will
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7 371 consider reasonable requests for access to the data once the project is complete in 2019.
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467 **Figure 1 Predicted time spent in sedentary behaviour by type of activity using multiple**
468 **imputation (N=1223)***

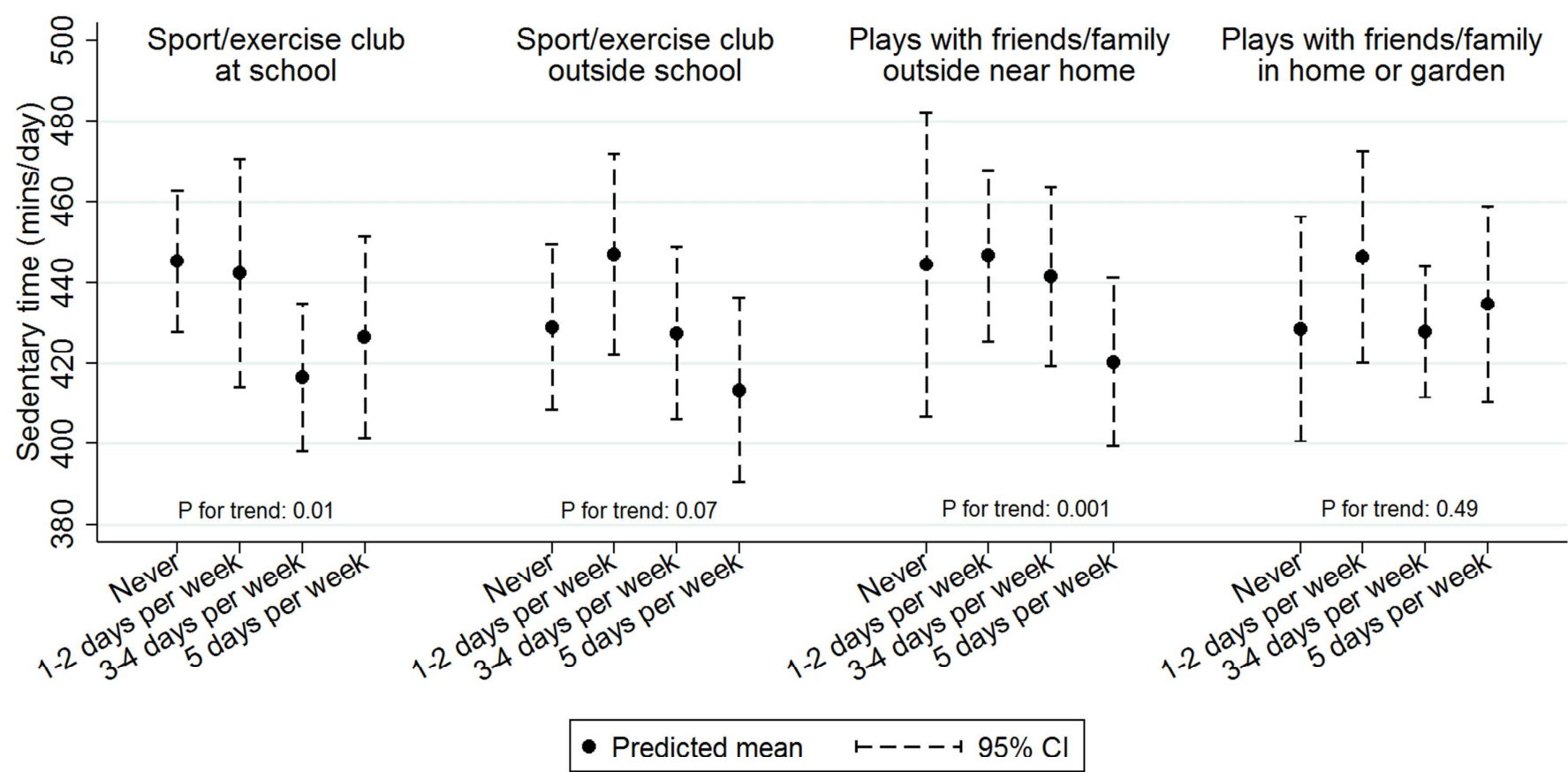
469 **Figure 2 Predicted time spent in moderate-to-vigorous physical activity by type of**
470 **activity using multiple imputation (N=1223)***

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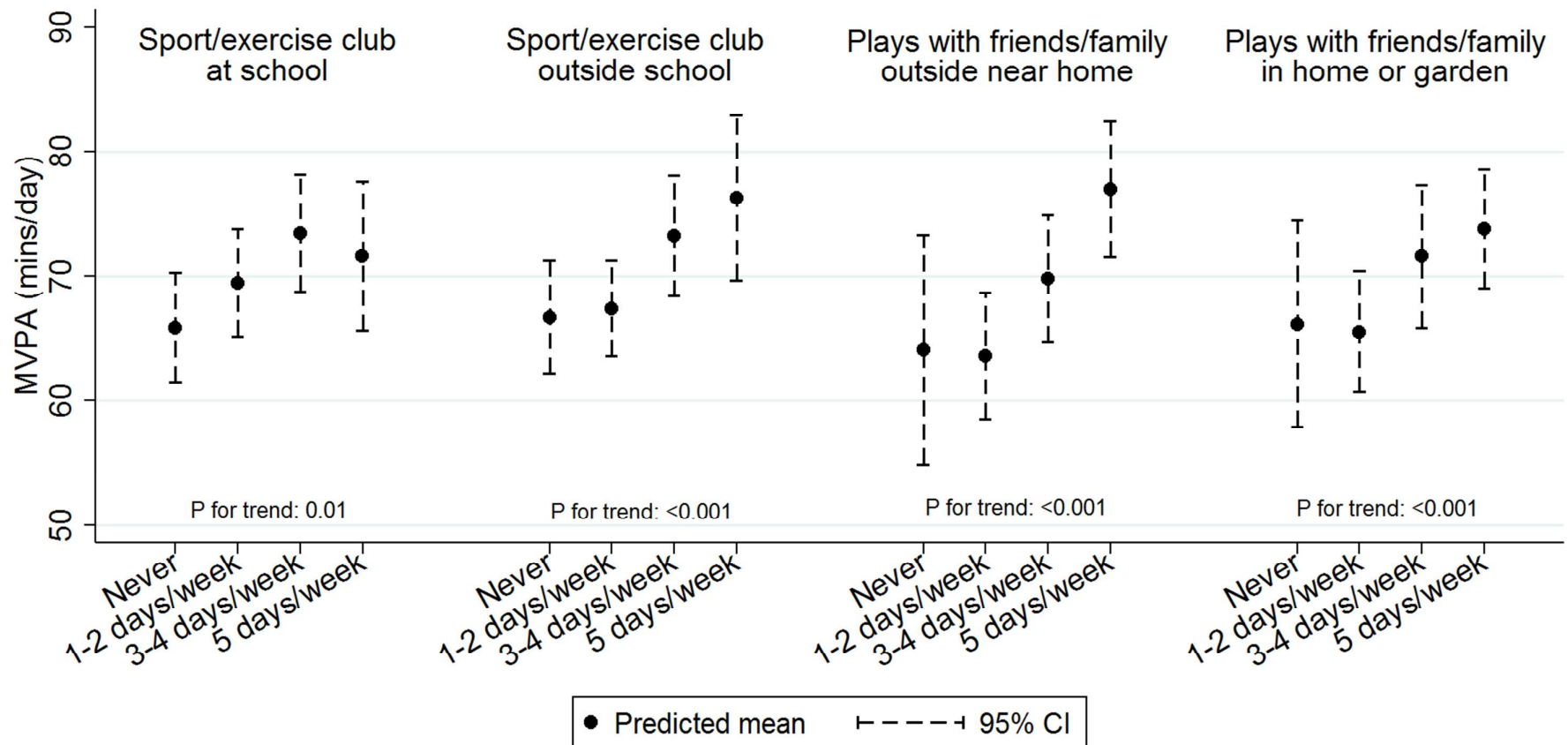
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Figure 1 Predicted time spent in sedentary behaviour by type of activity using multiple imputation (N=1223)*



* Predictions were obtained from fully adjusted regression models (Model 2) including all Year 4 children (boys and girls) and are for a 9-year old boy with a BMI z-score of 0 and IMD score of 16. Predicted sedentary time for girls was approximately 15-17 mins/day higher (same additive effect across all categories of the exposure variable) depending on the regression model

Figure 1 Predicted time spent in moderate-to-vigorous physical activity by type of activity using multiple imputation (N=1223)*



* Predictions were obtained from fully adjusted regression models (Model 2) including all Year 4 children (boys and girls) and are for a 9-year old boy with a BMI z-score of 0 and IMD score of 16. Predicted time spent in moderate-to-vigorous physical activity for girls was approximately 13 mins/day lower (same additive effect across all categories of the exposure variable)

Table S1 Frequencies of sport/exercise club attendance and play outside and inside the home and mean activity score by gender in the observed data

		Boys N (%)		Girls N (%)		Chi-squared p-value for association
Frequency child attends sport/exercise club at school	Never	144 (25.9)		194 (29.4)		<0.001
	1-2 days/week	235 (42.3)		318 (48.2)		
	3-4 days/week	90 (16.2)		106 (16.1)		
	5 days/week	86 (15.5)		42 (6.4)		
Frequency child attends sport/exercise club outside of school	Never	85 (15.3)		165 (25.0)		<0.001
	1-2 days/week	289 (52.1)		321 (48.7)		
	3-4 days/week	121 (21.8)		132 (20.0)		
	5 days/week	60 (10.8)		41 (6.2)		
Frequency child plays with friends/family outside near home	Never	36 (6.6)		40 (6.1)		0.14
	1-2 days/week	187 (34.1)		219 (33.4)		
	3-4 days/week	142 (25.9)		207 (31.6)		
	5 days/week	184 (33.5)		190 (29.0)		
Frequency child plays with friends/family in home/garden	Never	53 (9.7)		62 (9.5)		0.76
	1-2 days/week	184 (33.7)		230 (35.2)		
	3-4 days/week	142 (26.0)		179 (27.4)		
	5 days/week	167 (30.6)		182 (27.9)		
		Boys		Girls		T-test p-value for gender difference
		N	Mean (SD)	N	Mean (SD)	
Activity frequency score		542	6.15 (2.42)	651	5.65 (2.16)	<0.001

		Age (years)		BMI z score		IMD score	
		Mean (SD)	N	Mean (SD)	N	Mean (SD)	N
Frequency child attends sport/exercise club at school	Never	9.03 (0.38)	1215	0.43 (1.14)	1202	17.30 (15.04)	1197
	1-2 days/week	9.05 (0.43)		0.35 (1.05)			
	3-4 days/week	9.00 (0.45)		0.29 (1.02)			
	5 days/week	8.99 (0.39)		0.27 (1.13)			
P-value for difference between categories*		0.31		0.36		0.07	
Frequency child attends sport/exercise club outside of school	Never	9.01 (0.40)	1214	0.47 (1.07)	1201	20.03 (16.06)	1196
	1-2 days/week	9.01 (0.43)		0.37 (1.09)			
	3-4 days/week	9.05 (0.41)		0.23 (1.07)			
	5 days/week	9.12 (0.39)		0.30 (1.06)			
P-value for difference between categories*		0.05		0.09		<0.001	
Frequency child plays with friends/family outside near home	Never	8.96 (0.47)	1205	0.48 (1.24)	1192	17.60 (16.02)	1187
	1-2 days/week	9.01 (0.42)		0.31 (1.06)			
	3-4 days/week	9.05 (0.41)		0.39 (1.07)			
	5 days/week	9.05 (0.40)		0.33 (1.08)			
P-value for difference between categories*		0.23		0.58		0.01	
Frequency child plays with friends/family in home/garden	Never	8.97 (0.38)	1199	0.50 (1.11)	1186	18.54 (15.94)	1181
	1-2 days/week	9.02 (0.45)		0.29 (1.09)			
	3-4 days/week	9.06 (0.41)		0.40 (1.07)			
	5 days/week	9.03 (0.39)		0.32 (1.07)			
P-value for difference between categories*		0.31		0.23		0.02	
		Correlation	P-value	Correlation	P-value	Correlation	P-value
Activity frequency score		0.04	0.13	-0.05	0.07	-0.07	0.02

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Table S2 Child characteristics by frequencies of sport/exercise club attendance and play outside and inside the home and activity score in the observed data

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Table S3 Pairwise comparisons of children's activity attendance frequencies in the multiple imputation data (N=1223)*

		Frequency child attends sport/exercise club at school (%)		Frequency child attends sport/exercise club outside of school (%)		Frequency child plays with friends/family outside near home (%)		Frequency child plays with friends/family in home/garden (%)	
		Up to 2 days/week	3 or more days/week	Up to 2 days/week	3 or more days/week	Up to 2 days/week	3 or more days/week	Up to 2 days/week	3 or more days/week
Frequency child attends sport/exercise club at school	Up to 2 days/week			76.3	23.7	42.7	57.3	47.3	52.7
	3 or more days/week			55.8	44.2	33.2	66.8	36.0	64.0
P for association				<0.001		0.003		0.001	
Frequency child attends sport/exercise club outside of school	Up to 2 days/week	79.0	21.0			40.2	59.8	46.8	53.2
	3 or more days/week	59.7	40.3			40.0	60.0	38.2	61.8
P for association		<0.001				0.94		0.006	
Frequency child plays with friends/family outside near home	Up to 2 days/week	78.0	22.0	71.0	29.0			65.1	34.9
	3 or more days/week	70.3	29.7	70.8	29.2			30.3	69.7
P for association		0.003		0.94				<0.001	
Frequency child plays with friends/family in home/garden	Up to 2 days/week	78.3	21.7	74.9	25.1	59.0	41.0		
	3 or more days/week	69.4	30.6	67.6	32.4	25.2	74.8		
P for association		0.001		0.006		<0.001			
Total		73.4	26.6	70.8	29.2	40.2	59.8	44.3	55.7

* Percentages presented are the proportions of children in each row that belong to each of the categories of child activity variables listed along the top of the table.

Table S4 Mean difference in the children's average sedentary minutes per day associated with different activities for those with complete data (N=987)*

Exposure		Sedentary time (minutes/day): mean difference (95% confidence interval)						P for gender interaction
		All (N=987)		Boys (N=439)		Girls (N=548)		
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	
Frequency child attends sport/exercise club at school	Never (ref)	0	0	0	0	0	0	0.45
	1-2 days/week	-0.29	0.0	14.7	15.9	-11.4	-11.9	
	3-4 days/week	(-21.3, 20.7)	(-21.2, 21.3)	(-10.1, 39.5)	(-9.2, 41.0)	(-39.7, 16.8)	(-41.1, 17.3)	
	5 days/week	-26.3	-24.1	-13.8	-9.9	-36.0	-35.4	
		(-40.8, -11.8)	(-37.8, -10.4)	(-31.5, 4.0)	(-29.3, 9.4)	(-59.5, -12.4)	(-59.0, -11.7)	
		-16.0	-16.1	-7.1	-3.1	-22.0	-29.8	
		(-35.3, 3.3)	(-34.4, 2.3)	(-29.7, 15.4)	(-26.9, 20.6)	(-54.6, 10.7)	(-69.2, 9.66)	
P for trend		0.01	0.009	0.19	0.40	0.02	0.02	
Frequency child attends sport/exercise club outside of school	Never (ref)	0	0	0	0	0	0	0.73
	1-2 days/week	16.1	20.0	24.6	31.2	10.8	12.9	
	3-4 days/week	(-7.5, 39.7)	(-7.0, 47.0)	(-3.4, 52.7)	(0.6, 61.8)	(-19.3, 41.0)	(-20.0, 45.9)	
	5 days/week	-6.6	0.1	-3.2	5.6	-7.6	-2.0	
		(-23.2, 10.1)	(-19.6, 19.8)	(-28.8, 22.3)	(-17.7, 28.8)	(-26.3, 11.1)	(-26.7, 22.6)	
		-18.4	-13.8	-13.0	-5.9	-20.8	-18.2	
		(-36.5, -0.2)	(-33.8, 6.2)	(-36.3, 10.4)	(-28.8, 16.9)	(-46.0, 4.3)	(-46.4, 10.0)	
P for trend		0.009	0.05	0.02	0.03	0.08	0.28	
Frequency child plays with friends/family outside near home	Never (ref)	0	0	0	0	0	0	0.68
	1-2 days/week	4.5	6.0	16.3	20.2	-5.7	-7.1	
	3-4 days/week	(-26.7, 35.7)	(-27.5, 39.5)	(-13.4, 45.9)	(-10.1, 50.4)	(-55.7, 44.3)	(-59.0, 44.9)	
	5 days/week	-2.5	-0.6	8.3	13.0	-11.9	-13.2	
		(-30.1, 25.0)	(-31.6, 30.3)	(-23.1, 39.7)	(-19.4, 45.4)	(-68.1, 44.3)	(-71.3, 44.9)	
		-21.6	-21.9	-9.4	-6.4	-32.3	-36.4	
		(-49.0, 5.7)	(-50.4, 6.6)	(-35.4, 16.6)	(-32.8, 20.0)	(-78.9, 14.2)	(-86.0, 13.1)	
P for trend		<0.001	<0.001	0.08	0.08	0.009	0.01	
Frequency child plays with friends/family in home/garden	Never (ref)	0	0	0	0	0	0	0.86
	1-2 days/week	18.2	18.8	19.2	19.5	17.2	17.6	
	3-4 days/week	(-12.4, 48.8)	(-12.4, 50.0)	(-13.8, 52.2)	(-13.7, 52.8)	(-25.4, 59.9)	(-25.4, 60.6)	
	5 days/week	-4.5	-1.9	2.8	4.6	-10.1	-7.5	
		(-27.3, 18.2)	(-26.7, 22.9)	(-16.3, 21.9)	(-15.7, 25.0)	(-47.3, 27.0)	(-47.1, 32.1)	
		3.8	3.6	10.8	11.6	-2.2	-3.5	
		(-24.6, 32.2)	(-24.6, 31.8)	(-27.1, 48.8)	(-27.0, 50.2)	(-43.0, 38.6)	(-45.3, 38.3)	
P for trend		0.24	0.22	0.85	0.89	0.25	0.24	
Activity score (per unit)		-4.9	-4.7	-3.5	-2.9	-6.3	-6.6	0.28
		(-7.2, -2.7)	(-6.9, -2.4)	(-6.6, -0.4)	(-6.0, 0.2)	(-10.7, -2.0)	(-11.2, -1.9)	

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2 * Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score
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Table S5 Mean difference in the children's average MVPA minutes per day associated with different activities for those with complete data (N=987)*

Exposure	Moderate-to-vigorous physical activity (minutes/day): mean difference (95% confidence interval)							P for gender interaction
	All (N=987)		Boys (N=439)		Girls (N=548)			
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2		
Frequency child attends sport/exercise club at school	Never (ref)	0	0	0	0	0	0	0.64
	1-2 days/week	3.2	3.1	3.3	2.7	3.1	3.1	
		(-0.4, 6.8)	(-0.5, 6.6)	(-3.3, 9.8)	(-3.7, 9.2)	(-0.5, 6.8)	(-0.6, 6.8)	
	3-4 days/week	6.7	6.4	8.0	7.3	5.7	5.6	
		(1.7, 11.8)	(1.4, 11.4)	(1.0, 15.1)	(0.1, 14.4)	(0.6, 10.7)	(0.5, 10.7)	
	5 days/week	5.3	5.1	6.6	5.8	3.2	3.1	
		(-1.3, 11.9)	(-1.5, 11.8)	(-1.4, 14.6)	(-2.2, 13.8)	(-5.0, 11.5)	(-5.5, 11.6)	
P for trend		0.02	0.03	0.02	0.05	0.08	0.10	
Frequency child attends sport/exercise club outside of school	Never (ref)	0	0	0	0	0	0	0.53
	1-2 days/week	1.8	1.5	4.3	3.6	0.4	0.4	
		(-1.9, 5.5)	(-2.4, 5.4)	(-3.2, 11.9)	(-4.4, 11.7)	(-3.5, 4.3)	(-3.5, 4.4)	
	3-4 days/week	7.3	6.7	10.5	9.0	5.3	5.5	
		(3.0, 11.5)	(2.4, 11.0)	(2.8, 18.2)	(1.4, 16.6)	(0.6, 10.0)	(0.9, 10.0)	
	5 days/week	10.5	10.1	14.3	13.4	7.3	7.3	
		(4.6, 16.5)	(3.9, 16.2)	(6.3, 22.3)	(4.8, 22.0)	(-0.8, 15.3)	(-0.6, 15.2)	
P for trend		<0.001	<0.001	<0.001	<0.001	0.01	0.008	
Frequency child plays with friends/family outside near home	Never (ref)	0	0	0	0	0	0	0.32
	1-2 days/week	0.7	0.4	1.2	0.5	0.4	0.3	
		(-4.1, 5.5)	(-4.3, 5.0)	(-7.4, 9.7)	(-8.1, 9.1)	(-6.0, 6.9)	(-6.3, 6.9)	
	3-4 days/week	5.2	4.9	6.7	6.0	4.0	3.9	
		(-0.8, 11.2)	(-1.0, 10.7)	(-3.5, 16.9)	(-4.0, 15.9)	(-3.6, 11.7)	(-3.8, 11.7)	
	5 days/week	9.9	9.7	13.8	13.3	6.5	6.4	
		(4.4, 15.4)	(4.2, 15.1)	(4.6, 23.0)	(4.0, 22.5)	(-0.5, 13.5)	(-0.7, 13.6)	
P for trend		<0.001	<0.001	<0.001	<0.001	0.004	0.005	
Frequency child plays with friends/family in home/garden	Never (ref)	0	0	0	0	0	0	0.40
	1-2 days/week	2.5	2.2	0.6	0.4	4.1	4.0	
		(-0.9, 6.0)	(-1.4, 5.8)	(-7.0, 8.2)	(-7.4, 8.2)	(-0.9, 9.2)	(-1.1, 9.1)	
	3-4 days/week	6.6	6.3	6.7	6.9	6.5	6.4	
		(2.4, 10.7)	(1.8, 10.8)	(-1.8, 15.3)	(-1.9, 15.7)	(0.4, 12.6)	(0.1, 12.7)	
	5 days/week	8.6	8.4	9.3	9.1	7.9	7.8	
		(4.6, 12.5)	(4.3, 12.6)	(1.6, 16.9)	(1.0, 17.2)	(2.5, 13.3)	(2.4, 13.3)	
P for trend		<0.001	<0.001	0.001	0.001	0.003	0.003	
Activity score (per unit)		2.13	2.09	2.58	2.49	1.67	1.66	0.07
		(1.44, 2.82)	(1.37, 2.81)	(1.73, 3.43)	(1.55, 3.42)	(0.86, 2.47)	(0.85, 2.48)	

Exposure	Meeting government guideline: odds ratio (95% confidence interval)							P for gender interaction
	All (N=987)		Boys (N=439)		Girls (N=548)			
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2		
Frequency child attends sport/exercise club at school	Never (ref)	1	1	1	1	1	1	0.25
	1-2 days/week	1.27 (0.94, 1.71)	1.25 (0.93, 1.69)	0.97 (0.58, 1.63)	0.93 (0.55, 1.55)	1.57 (1.09, 2.25)	1.57 (1.09, 2.26)	
	3-4 days/week	1.77 (1.05, 2.97)	1.72 (1.03, 2.87)	1.97 (0.93, 4.18)	1.86 (0.88, 3.95)	1.65 (0.93, 2.91)	1.66 (0.94, 2.92)	
	5 days/week	1.63 (0.96, 2.77)	1.61 (0.95, 2.74)	1.49 (0.75, 2.96)	1.40 (0.70, 2.77)	1.73 (0.78, 3.85)	1.76 (0.78, 3.96)	
	P for trend	0.03	0.03	0.06	0.10	0.07	0.07	
Frequency child attends sport/exercise club outside of school	Never (ref)	1	1	1	1	1	1	0.66
	1-2 days/week	1.32 (0.91, 1.91)	1.29 (0.88, 1.88)	1.53 (0.89, 2.62)	1.46 (0.83, 2.57)	1.19 (0.72, 1.97)	1.21 (0.74, 1.99)	
	3-4 days/week	2.06 (1.38, 3.07)	1.97 (1.32, 2.95)	2.56 (1.32, 4.98)	2.28 (1.18, 4.40)	1.77 (1.05, 2.98)	1.81 (1.09, 3.03)	
	5 days/week	2.89 (1.76, 4.73)	2.80 (1.69, 4.63)	4.13 (1.97, 8.68)	3.92 (1.82, 8.44)	2.09 (1.06, 4.12)	2.14 (1.10, 4.18)	
	P for trend	<0.001	<0.001	<0.001	<0.001	0.006	0.004	
Frequency child plays with friends/family	Never (ref)	1	1	1	1	1	1	0.89
	1-2 days/week	1.16 (0.70, 1.92)	1.13 (0.70, 1.85)	1.03 (0.46, 2.29)	0.98 (0.43, 2.22)	1.40 (0.59, 3.30)	1.41 (0.60, 3.29)	

* MVPA Moderate-to-vigorous physical activity; Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score

Table S6 Odds ratios for achieving 60 minutes of MVPA per day associated with different activities for those with complete data (N=987)*

outside near home	3-4 days/week	1.94 (1.12, 3.35)	1.89 (1.12, 3.21)	1.59 (0.68, 3.75)	1.53 (0.65, 3.62)	2.43 (0.92, 6.45)	2.46 (0.94, 6.42)	
	5 days/week	2.14 (1.26, 3.65)	2.12 (1.26, 3.57)	2.01 (0.88, 4.63)	1.97 (0.85, 4.54)	2.45 (0.95, 6.36)	2.49 (0.97, 6.40)	
P for trend		<0.001	<0.001	0.007	0.005	0.007	0.006	
Frequency child plays with friends/family in home/garden	Never (ref)	1	1	1	1	1	1	0.30
	1-2 days/week	1.33 (0.88, 2.00)	1.30 (0.86, 1.97)	0.96 (0.51, 1.78)	0.94 (0.50, 1.77)	1.92 (0.90, 4.11)	1.94 (0.91, 4.12)	
	3-4 days/week	1.67 (1.10, 2.54)	1.64 (1.07, 2.52)	1.33 (0.66, 2.69)	1.36 (0.66, 2.82)	2.15 (0.96, 4.79)	2.16 (0.97, 4.80)	
	5 days/week	1.86 (1.21, 2.86)	1.85 (1.20, 2.86)	1.68 (0.86, 3.25)	1.67 (0.84, 3.32)	2.18 (1.04, 4.60)	2.20 (1.04, 4.62)	
P for trend		0.002	0.002	0.008	0.008	0.06	0.06	
Activity score (per unit)		1.19 (1.12, 1.26)	1.19 (1.12, 1.26)	1.20 (1.11, 1.30)	1.19 (1.10, 1.30)	1.18 (1.09, 1.28)	1.18 (1.09, 1.28)	0.79

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2 * MVPA Moderate-to-vigorous physical activity; Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score
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Figure S1 Scatter plot of sedentary time by activity score in the observed data (N=1003)

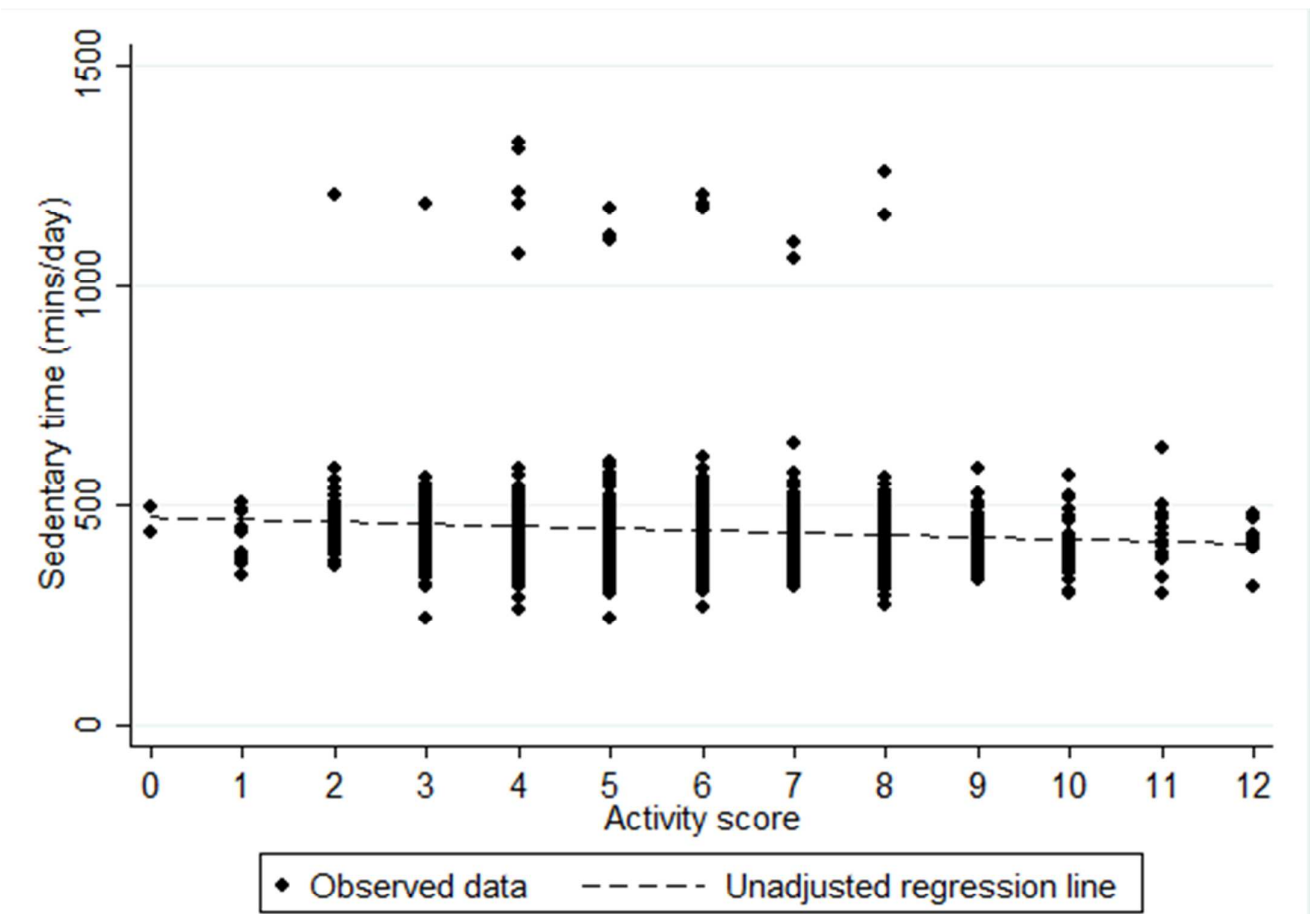
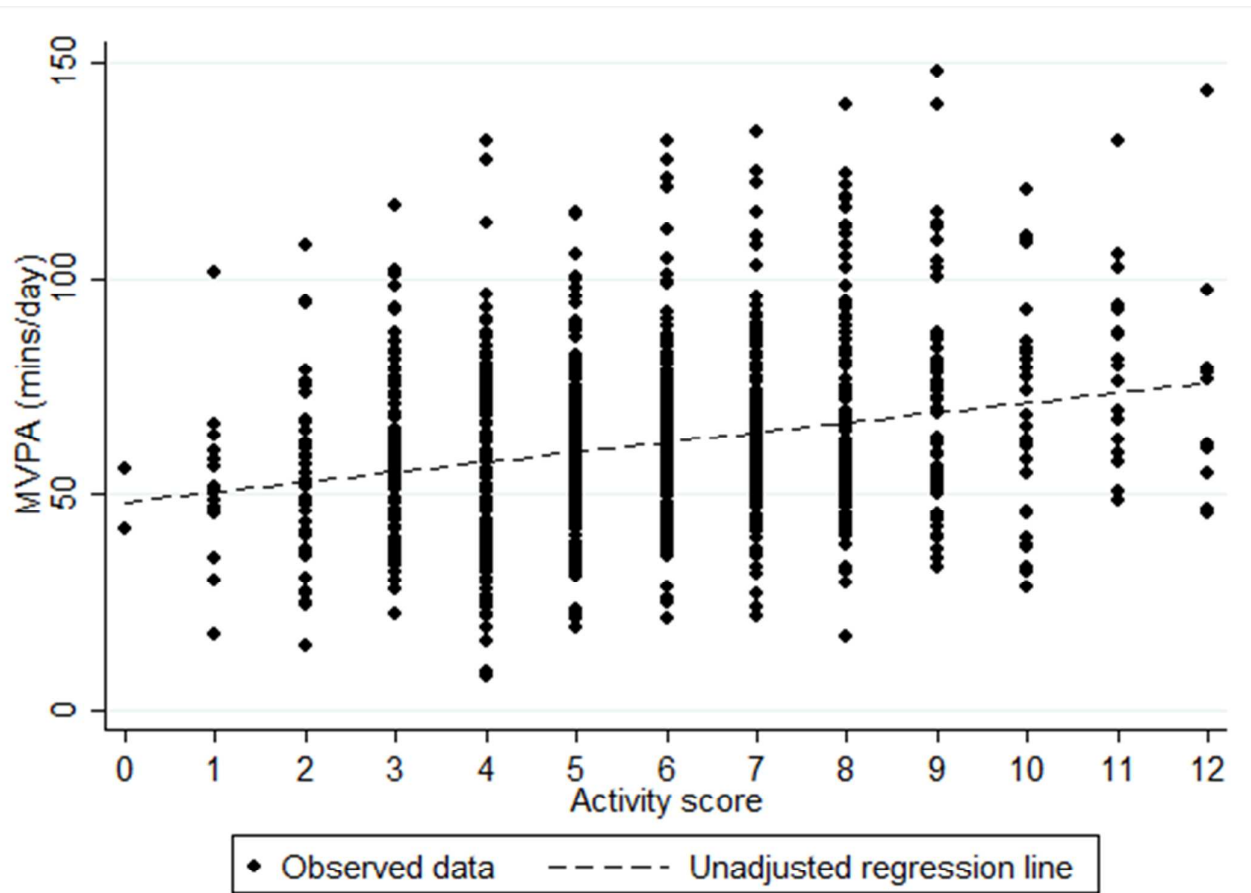


Figure S2 Scatter plot of time spent in moderate-to-vigorous physical activity by activity score in the observed data (N=1003)



Organised physical activity, neighbourhood play and child physical activity

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract Title Page
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found – Pages 2-3
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported – Pages 5-6
Objectives	3	State specific objectives, including any prespecified hypotheses – Page 6.
Methods		
Study design	4	Present key elements of study design early in the paper Pages 6-7.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Page 6.
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants Page 7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable - Page 7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Page 7-8
Bias	9	Describe any efforts to address potential sources of bias – Page 8
Study size	10	Explain how the study size was arrived at - Page 8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why - Pages 8-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding – Pages 8-9
		(b) Describe any methods used to examine subgroups and interactions – Pages 8-9
		(c) Explain how missing data were addressed - Pages 8-9
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of

		sampling strategy - Page 9
		(e) Describe any sensitivity analyses – Page 10

Continued on next page

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Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Table 1 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram - NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders – Table 1 (b) Indicate number of participants with missing data for each variable of interest - Table 1 (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures Table 1
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included – Tables 2-4 (b) Report category boundaries when continuous variables were categorized - Tables 2-4 (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period Discussion – Page 18
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses – Supplementary tables

Discussion

Key results	18	Summarise key results with reference to study objectives – Page 21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias - Page 23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence – Page 22
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 22

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based – Page 24
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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Associations between participation in organised physical activity in the school or community outside school hours, and neighbourhood play with child physical activity and sedentary time: a cross-sectional analysis of primary school-aged children from the UK

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-017588.R1
Article Type:	Research
Date Submitted by the Author:	26-Jun-2017
Complete List of Authors:	Jago, Russell; Univ Bristol, Centre for Exercise, Nutrition & Health Sciences, School for Policy Studies Macdonald-Wallis, Corrie; University of Bristol, Centre for Exercise, Nutrition & Health Sciences, School for Policy Studies, University of Bristol Solomon-Moore, Emma; Univ Bristol, Centre for Exercise, Nutrition & Health Sciences, School for Policy Studies Thompson, Janice; The University of Birmingham, School of Sport, Exercise and Rehabilitation Sciences Lawlor, Debbie; University of Bristol School of Social and Community Medicine, MRC Integrative Epidemiology Unit at the University of Bristol Sebire, Simon; University of Bristol, Centre for Exercise, Nutrition & Health Sciences, School for Policy Studies
Primary Subject Heading:	Public health
Secondary Subject Heading:	Paediatrics
Keywords:	Physical activity, children, accelerometer, extra-curricular, play

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Manuscripts

1 Associations between participation in organised physical activity in the school or community
2 outside school hours, and neighbourhood play with child physical activity and sedentary
3 time: a cross-sectional analysis of primary school-aged children from the UK

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27 **Word count:** Manuscript (excluding tables) = 3270 words Abstract = 298 words

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2
3 29 **ABSTRACT**
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6 30 **Objectives:** Assess the extent to which participation in organised physical activity in the
7
8 31 school or community outside school hours, and neighbourhood play, were associated with
9
10 32 children's physical activity and sedentary time.
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12 33 **Design:** Cross-sectional study.
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14 34 **Setting:** Children were recruited from 47 state funded primary schools in Southwest England.
15
16

17 35 **Participants:** 1223 8-9 year old children.
18

19 36 **Outcome measures:** Accelerometer-assessed moderate-to-vigorous-intensity physical
20
21 37 activity (MVPA) and sedentary time.
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26 39 **Methods:** Children wore an accelerometer and mean minutes of MVPA and sedentary time
27
28 40 per day were derived. Children reported their attendance at organised physical activity in the
29
30 41 school or community outside school hours, and neighbourhood play, using a piloted
31
32 42 questionnaire. Cross-sectional linear and logistic regression were used to examine if
33
34 43 attendance frequency at each setting (and all settings combined) was associated with
35
36 44 moderate-to-vigorous-intensity physical activity (MVPA) and sedentary time. Multiple
37
38 45 imputation methods were used to account for missing data and increase sample size.
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43 46
44 47 **Results:** Children who attended clubs at school 3-4 days per week obtained an average of
45
46 48 7.58 (95% CI: 2.7 to 12.4) more minutes of MVPA per day than children who never attended.
47
48 49 Report of participation in the three other non-school-based activities were similarly
49
50 50 associated with MVPA. Evidence for associations with sedentary time was generally weaker.
51
52 51 Associations were similar in girls and boys. When the four different contexts were combined,
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54 52 each additional 1-2 activities participated in per week increased participants' odds (OR: 1.18,
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3 53 95% CI: 1.12 to 1.26) of meeting the Government recommendations for 60 minutes of
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5 54 MVPA per day.
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9
10 56 **Conclusion:** Participating in organised physical activity at school and in the community is
11
12 57 associated with greater physical activity and reduced sedentary time among both boys and
13
14 58 girls. All four types of activity contribute to overall physical activity, which provides parents
15
16 59 with a range of settings in which to help their child be active.
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19 60
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21
22 61 **Key words:** Physical activity, children, accelerometer, clubs, extra-curricular, play
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3 62 **ARTICLE SUMMARY**
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6 63 **Strengths and limitations of this study**
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8
9 64 **Strengths**

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11 • Accelerometer data from a large sample of Year 4 children.
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13 • Detailed information on organised physical activity in the school or community
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15 outside school hours, and neighbourhood play.
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18 • Multiple imputation models to provide estimates for participants with missing data.
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24 70 **Limitations**
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27 • Cross-sectional study design.
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29 • Data are from a single UK region.
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73 INTRODUCTION

74 Physical activity is associated with improved mental well-being, reduced risk of obesity and
75 lower blood pressure among children.[1] Sedentary time may also be a risk factor for non-
76 communicable diseases but it is not clear if this effect is independent of physical activity.[2-
77 4] The UK Chief Medical Officers recommend that all children and young people should
78 engage in at least an hour per day of moderate-to-vigorous-intensity physical activity
79 (MVPA) and limit sedentary time,[5] however considerable proportions of children do not
80 meet these guidelines.[6] For example, data from the nationally-representative Millennium
81 cohort showed that only 51% of 7-8 year olds met the recommendation.[7] The amount of
82 time children spend engaged in MVPA gradually declines with age, while sedentary time
83 increases.[6 8-11] Strategies to increase children's physical activity are needed.

84
85 The majority of interventions to increase children's physical activity have been delivered
86 during school time.[12 13] These interventions have included strategies such as changes to
87 the physical education provision and new educational programmes based on information
88 sharing and personal goal setting.[12-14] Overall, these programmes have tended to report no
89 effect, weak effects or moderate effects in sub-groups.[12-16] Potential reasons for this are
90 the difficulty faced in adding interventions to already full school-curricula and the lack of
91 skills and training that teachers have for delivering a range of activities to engage the
92 majority of children.[17] As such, there is a need to understand the potential of organised
93 physical activity outside school hours to increase MVPA.

94
95 After-school programmes have the potential to facilitate physical activity for children, as
96 schools have space in which children can be active, staff who can be trained, and many
97 parents welcome programmes that provide childcare.[16 18-21] Although a number of studies

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2
3 98 have examined the potential of delivering such sessions, it is not clear whether attendance at
4
5 99 the programmes currently provided by schools is associated with higher overall levels of
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7 100 MVPA.[18-21] There is also a lack of information about how attendance at community-based
8
9 101 physical activity clubs contributes to overall MVPA. Furthermore, as not all children attend
10
11 102 after-school programmes, it is not clear how other activities such as playing in the
12
13 103 neighbourhood or at home in the garden contribute to overall MVPA. A key question,
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15 104 therefore, is whether the frequency of participation in organised physical activity in the
16
17 105 school or community after school hours, neighbourhood play or home play is associated with
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19 106 the MVPA and sedentary time of children. Since some children will be active in all four
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21 107 settings, it would also be informative to examine collective participation across all settings.
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27 109 The aim of this study was to assess among children (8-9 years of age) the extent to which
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29 110 participation in organised physical activity in the school or community outside school hours,
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31 111 and playing with friends or family near the home or in the garden were associated with
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33 112 MVPA and sedentary time. A secondary aim was to examine if there was a cumulative
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35 113 association between participation in the four different types of activities with both MVPA
36
37 114 and sedentary time.
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43 116 **METHODS**

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45 117 The current analyses used data from the B-Proact1v study, which has been described in detail
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47 118 elsewhere.[11 22 23] Briefly, the study aimed to examine physical activity behaviours of
48
49 119 children and their parents over the course of primary school. Between 2012 and 2013, data
50
51 120 were collected from 1299 Year 1 children (5-6 years of age) from 57 schools in Bristol (UK).
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53 121 Between March 2015 and July 2016, all 57 schools were approached to re-join the study
54
55 122 when the children were in Year 4 (8-9 years of age), with 47 schools agreeing to take part
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3 123 (1223 children). The current analyses used data from the Year 4 assessments. The study
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5 124 received ethical approval from the School for Policy Studies Ethics Committee at the
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7 125 University of Bristol, and written parent consent was received for all participants.
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12 127 ***Data collection***

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14 128 Data were collected at schools, with children asked to complete a brief questionnaire. As
15
16 129 indicators of organised physical activity outside school hours in school and in the community
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18 130 respectively, we asked “How often do you attend... a) a sport or exercise club at school (NOT
19
20 131 including PE)? and b) a sport or exercise club at places other than your school (like a football
21
22 132 club or ballet)?” To indicate neighbourhood play outside and within the home we asked
23
24 133 “How much do you play with your friends and family... a) outside near your home? and b) in
25
26 134 your home or garden?”. These questions each had four response options: “Never”, “1-2 days
27
28 135 per week”, “3-4 days per week” or “5 days per week”. We assigned these 0, 1, 2 and 3 points
29
30 136 respectively and summed responses to derive an overall activity score ranging from 0 to 12,
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32 137 with a higher value indicating a higher frequency of activity participation.
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38 139 Child height was measured to the nearest 0.1cm using a SECA Leicester stadiometer (HAB
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40 140 International, Northampton). Weight was recorded to the nearest 0.1kg using a SECA 899
41
42 141 digital scale (HAB International, Northampton). Child Body Mass Index ($BMI = kg/m^2$) was
43
44 142 then calculated and converted to an age- and gender-specific standard deviation score.[24 25]
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46 143 Children wore a waist-worn ActiGraph wGT3X-BT accelerometer for five days including
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48 144 two weekend days. Parents provided demographic information via a questionnaire, including
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50 145 child gender and date of birth. Where children’s date of birth was missing (20.5% of
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52 146 children), they were assigned the median age of 9.0 years. Indices of Multiple Deprivation
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54 147 (IMD) scores, based upon the English Indices of Deprivation
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3 148 (<http://data.gov.uk/dataset/index-of-multiple-deprivation>), were assigned to each child based
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5 149 on their reported home postcode, where higher IMD scores indicate a greater level of
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7 150 deprivation.
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11 152 *Accelerometer data reduction*

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13
14 153 Accelerometer data were processed using Kinesoft (v3.3.75; Kinesoft, Saskatchewan,
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16 154 Canada). At least three valid days of data were required for accelerometer data to be
17
18 155 considered complete for a given child and included in analysis, where a valid day was defined
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20 156 as at least 500 minutes of data, after excluding intervals of ≥ 60 minutes of zero counts
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22 157 allowing up to two minutes of interruptions. We recognise that there is considerable variation
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24 158 in the number of minutes of accelerometer data that are required to be considered
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26 159 representative of a valid day.[26] These have ranged from 360 minutes per day which has
27
28 160 been used for 6 to 8 year old children,[27] to 800 minutes which has been used for older
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30 161 children.[28 29] Within the field there is no consensus on the minimum number of minutes
31
32 162 per day that are needed for a day to be considered valid. We, therefore, adopted a 500 minute
33
34 163 per day threshold to ensure that our data are comparable to the methods employed by the
35
36 164 International Children's Accelerometer Database,[6] which has pooled data from over 27,000
37
38 165 children across 20 large global cohorts. The child's average number of sedentary and MVPA
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40 166 minutes per day were derived using population-specific cut points for children.[30] We also
41
42 167 derived a binary variable indicating whether the child's average daily MVPA was greater
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44 168 than the 60 minutes per day recommended by the UK government.[5]
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50 170 *Analysis*

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3 171 The associations of child characteristics (gender, age, BMI z-score, and IMD) with activity
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5 172 participation were examined in the observed data using t-tests, Pearson's correlation
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7 173 coefficients, chi-squared tests and one-way analysis of variance as appropriate.
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13 175 Multiple imputation of missing data was used to create 20 imputed datasets for the 1223 Year
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15 176 4 children. We used 20 cycles of regression switching and combined regression coefficients
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17 177 across datasets using Rubin's rules.[31] We imputed separately for boys and girls to allow for
18
19 178 associations to differ by gender. All exposures (organised physical activity attendance and
20
21 179 neighbourhood play), outcomes (sedentary time and MVPA), potential confounders (gender,
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23 180 age, BMI z-score, and IMD) and child's school were included in multiple imputation models,
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25 181 and achievement of the MVPA guideline and overall activity score were imputed passively.
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27 182 Any children with less than three valid days of accelerometer data had their accelerometer
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29 183 measures imputed.
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36 185 We examined the pairwise associations of the activity participation variables by
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38 186 dichotomising, cross-tabulating and fitting unadjusted logistic regression models of one
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40 187 frequency variable on another.
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47 189 We used linear regression models to examine the associations of activity participation and the
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49 190 overall activity score with the child's average sedentary and MVPA minutes per day, and
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51 191 logistic regression models to examine associations with achievement of the MVPA guideline.
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53 192 In Model 1 we adjusted for gender and age, and in Model 2 we adjusted additionally for BMI
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55 193 z-score and IMD. To account for the clustering of children in schools and the associated
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57 194 potential to underestimate the standard errors which are used to compute the 95% confidence
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3 195 intervals and p-values, robust standard errors, which took account of the school level
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5 196 clustering, were used for all models. Combined Wald tests were used to test for evidence of
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7 197 interaction between the child's gender and the exposure of interest.
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13 199 We predicted the children's mean number of sedentary and MVPA minutes per day by
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15 200 frequency of participation in each activity based on linear combinations of the regression
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17 201 coefficients from fully-adjusted models (Model 2).
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23 203 Regression analyses were repeated restricting to the children who had complete data for all
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25 204 exposures, outcomes and co-variables and compared with the multiple imputation analysis.
26

27 205 We also produced scatter plots of sedentary time and MVPA by the overall activity score in
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29 206 the observed data.
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34 208 A sensitivity analysis was performed including accelerometer data for any children who had
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36 209 at least one valid day of measures to assess whether only including accelerometer data for
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38 210 children who recorded at least three valid days influenced our results. All analyses were
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40 211 performed in Stata version 14.0 (StataCorp, 2015).
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43 212

44 213 **RESULTS**

45
46 214 The distributions of characteristics of the children in the observed data, multiple imputation
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48 215 datasets and subset with complete information are shown in Table 1. All characteristics
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50 216 showed similar distributions in each of the datasets and had only a small proportion of
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52 217 missing data (maximum 16.1% for accelerometer measures).
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Table 1 Characteristics of children who took part in the Year 4 phase of the B-Proact1v Study (observed and multiple imputation) N=1223

Child Characteristic		Observed data		Imputed data (N=1223)	Complete data (N=987)
		N available	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %
Sedentary time at Year 4 (mins/day)		1026	445.4 (115.4)	444.7 (120.1)	446.0 (116.9)
MVPA at Year 4 (mins/day)		1026	61.6 (21.9)	61.9 (22.5)	61.8 (21.8)
Met MVPA guidelines at Year 4	No	1163	53.2	52.6	53.4
	Yes		46.8	47.4	46.6
Gender	Boy	1223	45.5	45.5	44.5
	Girl		54.5	54.5	55.5
Age at Year 4 (years)		1223	9.03 (0.41)	9.03 (0.41)	9.03 (0.43)
BMI z score at Year 4		1208	0.35 (1.08)	0.36 (1.08)	0.31 (1.07)
IMD score at Year 4		1204	15.9 (14.1)	15.9 (14.2)	15.3 (13.6)
Frequency child attends sport/exercise club at school	Never	1215	27.8	27.9	28.2
	1-2 days per week		45.5	45.5	45.8
	3-4 days per week		16.1	16.1	16.6
	5 days per week		10.5	10.5	9.4
Frequency child attends sport/exercise club outside school	Never	1214	20.6	20.6	19.4
	1-2 days per week		50.2	50.2	51.0
	3-4 days per week		20.8	20.9	21.5
	5 days per week		8.3	8.3	8.2
Frequency child plays with friends/family outside near home	Never	1205	6.3	6.4	6.5
	1-2 days per week		33.7	33.7	34.3
	3-4 days per week		29.0	28.9	29.7
	5 days per week		31.0	30.9	29.5
Frequency child plays with friends/family in home or garden	Never	1199	9.6	9.7	8.8
	1-2 days per week		34.5	34.6	35.0
	3-4 days per week		26.8	26.7	27.8
	5 days per week		29.1	29.0	28.5
Activity frequency score		1193	5.88 (2.29)	5.86 (2.29)	5.84 (2.26)

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3 219 *Associations of child characteristics with activity participation*
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5 220 Table S1 shows child activity attendance by gender. Girls tended to report lower frequencies
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7 221 of participating in organised physical activity in the school or community outside school
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9 222 hours, and had a lower mean overall activity score. There was no gender difference in
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11 223 friends/family play either in or outside of the home. The associations of other child
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13 224 characteristics with activity participation are shown in Table S2. There was some evidence
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15 225 that children who more frequently attended a sport/exercise club outside of school had a
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17 226 higher mean age. Child BMI was not strongly associated with any particular activity, but
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19 227 there was weak evidence that the overall activity score decreased with increasing BMI Z-
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21 228 score. Children who reported attendance of “Never” or “5 days/week” generally had the
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23 229 highest IMD scores, suggesting a U-shaped association, and there was a negative correlation
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25 230 between the overall activity score and IMD.
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32 232 *Inter-relationships of activity participation frequencies*
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34 233 Participating in one type of activity more frequently was generally associated with a higher
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36 234 frequency of participation in each of the others, except that attendance at a sport/exercise club
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38 235 outside of school was not associated with playing outside near the home (Table S3).
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43 237 *Associations of activity participation with sedentary time and MVPA*
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45 238 There was a negative correlation of the overall activity score with sedentary time and a
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47 239 positive correlation between the overall activity score and MVPA (Figures S1 and S2).
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51
52 241 Table 2 shows the mean difference in sedentary time by activity participation and overall

53 242 activity score in the multiple imputation datasets, and Figure 1 shows the predicted sedentary
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55 243 time by activity participation. Sedentary time decreased on average with increasing frequency
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3 244 of attending sport/exercise clubs either at school or outside of school and with increasing
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5 245 frequency of playing with friends/family outside near the home in regression models adjusted
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7 246 for gender and age (Model 1). The association between sport/exercise club attendance outside
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9 247 of school and sedentary time weakened slightly on additional adjustment for BMI Z-score
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11 248 and IMD (Model 2) but other associations remained. An increase in children's overall activity
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13 249 score was also strongly associated with a reduction in sedentary time in both models.
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16 250 However, there was no evidence of an association between playing with friends/family at
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18 251 home and sedentary time. Associations did not differ between boys and girls. Findings were
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21 252 similar when restricted to children who had complete data (Table S4).
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Table 2 Mean difference in the children's average sedentary minutes per day associated with different activities using multiple imputation (N=1223)*

Exposure	Sedentary time (minutes/day): mean difference (95% confidence interval)							P for gender interaction
	All (N=1223)		Boys (N=556)		Girls (N=667)			
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2		
Frequency child attends sport/exercise club at school	Never (ref)	0	0	0	0	0	0	0.69
	1-2 days/week	-4.2	-3.0	7.9	8.9	-13.0	-11.5	
	3-4 days/week	(-22.5, 14.0)	(-21.4, 15.4)	(-16.6, 32.3)	(-15.9, 33.7)	(-38.3, 12.4)	(-37.5, 14.4)	
		-31.1	-28.8	-18.7	-16.9	-40.1	-37.3	
		(-50.7, -11.5)	(-46.4, -11.3)	(-41.8, 4.4)	(-41.2, 7.3)	(-71.7, -8.5)	(-65.4, -9.2)	
5 days/week	-18.7	-18.8	-9.6	-7.3	-26.0	-33.3		
	(-42.9, 5.6)	(-42.1, 4.5)	(-37.7, 18.4)	(-34.9, 20.4)	(-66.8, 14.8)	(-82.0, 15.5)		
P for trend	0.02	0.01	0.17	0.23	0.05	0.04		
Frequency child attends sport/exercise club outside of school	Never (ref)	0	0	0	0	0	0	0.81
	1-2 days/week	14.8	18.0	21.5	25.9	11.0	13.6	
	3-4 days/week	(-9.1, 38.7)	(-8.9, 45.0)	(-7.4, 50.5)	(-4.5, 56.4)	(-19.9, 42.0)	(-20.5, 47.7)	
		-7.2	-1.5	-1.0	4.8	-10.5	-4.1	
		(-27.0, 12.6)	(-23.4, 20.4)	(-32.8, 30.8)	(-27.1, 36.6)	(-30.5, 9.5)	(-27.3, 19.0)	
5 days/week	-19.9	-15.5	-12.6	-7.7	-25.2	-20.6		
	(-41.1, 1.2)	(-37.7, 6.8)	(-42.4, 17.1)	(-36.5, 21.1)	(-55.0, 4.6)	(-52.1, 11.0)		
P for trend	0.02	0.07	0.12	0.16	0.07	0.23		
Frequency child plays with friends/family outside near home	Never (ref)	0	0	0	0	0	0	0.56
	1-2 days/week	0.77	2.3	19.2	21.2	-16.6	-15.6	
	3-4 days/week	(-28.5, 30.0)	(-28.0, 32.7)	(-16.5, 55.0)	(-14.4, 56.8)	(-63.1, 30.0)	(-65.0, 33.9)	
		-5.2	-2.8	7.6	10.6	-17.6	-16.1	
		(-29.9, 19.6)	(-29.4, 23.7)	(-28.4, 43.5)	(-25.5, 46.6)	(-65.8, 30.5)	(-67.4, 35.3)	
5 days/week	-23.4	-24.1	-11.0	-10.2	-35.4	-37.8		
	(-49.0, 2.1)	(-50.8, 2.7)	(-45.2, 23.2)	(-44.4, 24.0)	(-79.9, 9.0)	(-86.6, 10.9)		
P for trend	0.004	0.001	0.07	0.05	0.02	0.02		
Frequency child plays with friends/family in home/garden	Never (ref)	0	0	0	0	0	0	0.90
	1-2 days/week	16.2	17.9	19.2	20.6	13.1	14.9	
	3-4 days/week	(-13.8, 46.3)	(-12.5, 48.2)	(-22.9, 61.3)	(-21.5, 62.7)	(-25.8, 52.0)	(-24.3, 54.1)	
		-3.9	-0.7	3.9	6.5	-10.7	-6.4	
		(-28.8, 20.9)	(-26.7, 25.4)	(-30.5, 38.4)	(-28.7, 41.7)	(-46.6, 25.3)	(-42.9, 30.1)	
5 days/week	5.3	6.1	9.9	11.6	1.2	0.6		
	(-22.9, 33.5)	(-22.5, 34.7)	(-32.5, 52.3)	(-31.2, 54.4)	(-39.2, 41.5)	(-40.2, 41.5)		
P for trend	0.49	0.49	0.85	0.91	0.49	0.45		
Activity score (per unit)	-4.8	-4.6	-3.8	-3.4	-5.9	-5.9	0.41	
	(-7.3, -2.3)	(-7.0, -2.1)	(-7.7, 0.1)	(-7.2, 0.4)	(-10.0, -1.7)	(-10.2, -1.6)		

*Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score

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3 255 The mean difference in MVPA by each of the activity variables in the multiple imputation
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5 256 data is shown in Table 3, with predicted MVPA by activity participation presented in Figure
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7 257 2. A higher frequency of attending sport/exercise clubs either at school or outside of school
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9 258 and of play either outside or in the home/garden were all associated with greater MVPA on
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11 259 average in Models 1 and 2. Associations were similar in boys and girls. A higher overall
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13 260 activity score was also associated with greater MVPA, with some evidence that this
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15 261 association was stronger in boys than in girls. Associations were similar when restricted to
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17 262 children with complete data (Table S5).
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Table 3 Mean difference in the children's average MVPA minutes per day associated with different activities using multiple imputation (N=1223)*

Exposure		Moderate-to-vigorous physical activity (minutes/day): mean difference (95% confidence interval)						P for gender interaction
		All (N=1223)		Boys (N=556)		Girls (N=667)		
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	
Frequency child attends sport/exercise club at school	Never (ref)	0	0	0	0	0	0	0.64
	1-2 days/week	3.7 (0.3, 7.2)	3.6 (0.1, 7.0)	4.4 (-2.1, 10.9)	4.1 (-2.3, 10.5)	3.2 (-0.3, 6.7)	3.1 (-0.3, 6.6)	
	3-4 days/week	7.8 (2.9, 12.6)	7.5 (2.7, 12.4)	10.1 (2.6, 17.7)	9.6 (2.0, 17.2)	5.9 (0.9, 10.8)	5.8 (0.9, 10.7)	
	5 days/week	5.9 (-0.1, 11.8)	5.7 (-0.3, 11.7)	7.5 (-0.4, 15.4)	7.0 (-1.1, 15.0)	3.8 (-3.7, 11.3)	3.6 (-4.1, 11.4)	
P for trend		0.007	0.01	0.02	0.03	0.05	0.06	
Frequency child attends sport/exercise club outside of school	Never (ref)	0	0	0	0	0	0	0.80
	1-2 days/week	0.9 (-2.5, 4.3)	0.7 (-2.9, 4.4)	1.8 (-4.7, 8.3)	1.3 (-5.5, 8.2)	0.5 (-3.3, 4.4)	0.5 (-3.4, 4.5)	
	3-4 days/week	6.9 (2.4, 11.5)	6.5 (1.9, 11.2)	8.9 (1.0, 16.8)	8.1 (0.1, 16.0)	5.5 (0.9, 10.1)	5.6 (1.1, 10.2)	
	5 days/week	9.9 (3.8, 16.0)	9.6 (3.3, 15.9)	11.8 (3.4, 20.1)	11.2 (2.4, 19.9)	8.2 (0.7, 15.7)	8.2 (0.8, 15.7)	
P for trend		<0.001	<0.001	0.001	0.002	0.007	0.006	
Frequency child plays with friends/family outside near home	Never (ref)	0	0	0	0	0	0	0.19
	1-2 days/week	0.7 (-4.6, 6.0)	0.4 (-4.9, 5.6)	0.0 (-9.3, 9.2)	-0.5 (-9.9, 8.9)	1.4 (-6.0, 8.8)	1.3 (-6.2, 8.7)	
	3-4 days/week	5.1 (-0.9, 11.1)	4.8 (-1.1, 10.7)	6.1 (-4.1, 16.3)	5.7 (-4.5, 15.9)	4.4 (-3.5, 12.3)	4.3 (-3.7, 12.2)	
	5 days/week	9.6 (4.0, 15.3)	9.5 (3.9, 15.2)	13.0 (3.3, 22.8)	12.9 (3.0, 22.7)	6.7 (-0.7, 14.0)	6.6 (-0.9, 14.0)	
P for trend		<0.001	<0.001	<0.001	<0.001	0.005	0.006	
Frequency child plays with friends/family in home/garden	Never (ref)	0	0	0	0	0	0	0.38
	1-2 days/week	2.0 (-2.4, 6.4)	1.6 (-2.7, 6.0)	-0.1 (-8.4, 8.3)	-0.6 (-8.9, 7.7)	3.8 (-2.2, 9.8)	3.6 (-2.4, 9.7)	
	3-4 days/week	5.6 (0.9, 10.3)	5.3 (0.4, 10.2)	5.6 (-3.1, 14.3)	5.4 (-3.5, 14.4)	5.7 (-0.6, 11.9)	5.5 (-0.9, 12.0)	
	5 days/week	7.4 (3.0, 11.8)	7.1 (2.7, 11.6)	8.3 (0.1, 16.6)	7.7 (-0.7, 16.1)	6.6 (0.7, 12.5)	6.5 (0.6, 12.5)	

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P for trend	<0.001	<0.001	0.004	0.006	0.02	0.02	264
Activity score (per unit)	2.1 (1.4, 2.7)	2.0 (1.4, 2.7)	2.6 (1.7, 3.4)	2.5 (1.6, 3.4)	1.6 (0.8, 2.3)	1.6 (0.8, 2.3)	0.06 265

*MVPA Moderate-to-vigorous physical activity; Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score

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3 267 The associations of activity variables with achievement of the hour per day government
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5 268 guideline in the multiple imputation data are shown in Table 4. A higher frequency of
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7 269 participation in any of the activities, or an increase in the overall activity score, was
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10 270 associated with increased odds of meeting the government guideline in both models.
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12 271 Associations were similar in girls and boys. A unit increase in the activity score was
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14 272 associated with around an 18% increase in the odds of achieving 60 minutes of MVPA per
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16 273 day. Findings were unchanged when restricting to those with complete data (Table S6).
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Table 4 Odds ratios for achieving 60 minutes of MVPA per day associated with different activities using multiple imputation (N=1223)*

Exposure		Meeting government guideline: odds ratio (95% confidence interval)						P for gender interaction
		All (N=1223)		Boys (N=556)		Girls (N=667)		
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	
Frequency child attends sport/exercise club at school	Never (ref)	1	1	1	1	1	1	0.34
	1-2 days/week	1.33 (0.98, 1.81)	1.31 (0.97, 1.78)	1.10 (0.65, 1.86)	1.07 (0.63, 1.81)	1.54 (1.06, 2.23)	1.54 (1.07, 2.21)	
	3-4 days/week	1.87 (1.16, 3.01)	1.83 (1.14, 2.93)	2.22 (1.09, 4.53)	2.14 (1.04, 4.40)	1.63 (0.94, 2.85)	1.63 (0.94, 2.82)	
	5 days/week	1.69 (1.03, 2.78)	1.67 (1.02, 2.76)	1.61 (0.83, 3.09)	1.55 (0.79, 3.02)	1.76 (0.84, 3.69)	1.77 (0.84, 3.73)	
P for trend		0.01	0.01	0.03	0.05	0.05	0.05	
Frequency child attends sport/exercise club outside of school	Never (ref)	1	1	1	1	1	1	0.93
	1-2 days/week	1.14 (0.80, 1.64)	1.13 (0.77, 1.64)	1.21 (0.74, 1.98)	1.18 (0.70, 1.99)	1.11 (0.68, 1.80)	1.12 (0.69, 1.82)	
	3-4 days/week	1.82 (1.22, 2.72)	1.75 (1.16, 2.65)	2.07 (1.11, 3.87)	1.95 (1.03, 3.67)	1.66 (0.99, 2.78)	1.69 (1.01, 2.83)	
	5 days/week	2.70 (1.57, 4.62)	2.63 (1.51, 4.58)	3.24 (1.49, 7.07)	3.15 (1.41, 7.06)	2.30 (1.12, 4.72)	2.33 (1.14, 4.77)	
P for trend		<0.001	<0.001	<0.001	0.001	0.009	0.008	
Frequency child plays with friends/family outside near home	Never (ref)	1	1	1	1	1	1	0.74
	1-2 days/week	1.15 (0.70, 1.88)	1.12 (0.69, 1.82)	0.98 (0.46, 2.09)	0.94 (0.43, 2.06)	1.47 (0.62, 3.45)	1.47 (0.63, 3.43)	
	3-4 days/week	1.88 (1.12, 3.16)	1.84 (1.11, 3.06)	1.62 (0.73, 3.58)	1.59 (0.70, 3.58)	2.32 (0.91, 5.91)	2.32 (0.92, 5.88)	
	5 days/week	2.11 (1.26, 3.52)	2.10 (1.26, 3.49)	2.08 (0.92, 4.69)	2.07 (0.91, 4.74)	2.35 (0.93, 5.99)	2.36 (0.93, 6.02)	
P for trend		<0.001	<0.001	0.003	0.002	0.01	0.02	
Frequency child plays with friends/family in home/garden	Never (ref)	1	1	1	1	1	1	0.21
	1-2 days/week	1.27 (0.84, 1.91)	1.23 (0.81, 1.86)	0.94 (0.52, 1.72)	0.90 (0.49, 1.64)	1.75 (0.84, 3.64)	1.75 (0.84, 3.65)	
	3-4 days/week	1.51 (1.00, 2.28)	1.46 (0.96, 2.23)	1.29 (0.70, 2.40)	1.28 (0.68, 2.44)	1.80 (0.86, 3.80)	1.80 (0.86, 3.79)	
	5 days/week	1.71 (1.14, 2.56)	1.67 (1.11, 2.53)	1.71 (0.90, 3.25)	1.62 (0.83, 3.14)	1.80 (0.88, 3.69)	1.81 (0.88, 3.70)	

P for trend	0.005	0.006	0.01	0.02	0.21	0.21	275
Activity score (per unit)	1.18 (1.12, 1.25)	1.18 (1.11, 1.25)	1.21 (1.12, 1.30)	1.20 (1.11, 1.30)	1.16 (1.07, 1.25)	1.16 (1.07, 1.25)	0.52 276

* MVPA Moderate-to-vigorous physical activity; Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score

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3 278 *Sensitivity Analysis*
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5 279 When we changed the inclusion criteria for accelerometer measures from three to one valid
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7 280 day, findings were largely unchanged, except that boys showed a stronger association
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9 281 between sport/exercise club attendance at their school and MVPA than girls (p for interaction
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11 282 = 0.03 in multiple imputation data).
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16 284 **DISCUSSION**
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18 285 The findings demonstrate that increased participation in organised physical activity at school
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20 286 and in the community are associated with greater overall physical activity and reduced
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22 287 sedentary time among both boys and girls. Specifically, a child who attends a school-based
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24 288 club 3-4 days per week obtained 7.8 more minutes of MVPA per day than a child who did not
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26 289 attend at all, with attendance of five days a week at a sport/exercise club outside of school
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28 290 associated with 10.9 more minutes of MVPA than children who never attended clubs. There
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30 291 were comparable patterns for engagement in non-organised activity at home or in the
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32 292 neighbourhood, both were associated with increased MVPA, but only activity outside of the
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34 293 home was associated with reduced sedentary time. When the four different contexts of
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36 294 physical activity were combined, the analyses showed that each additional 1-2 activities
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38 295 participated in per week increased the odds of meeting the Chief Medical Officers'
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40 296 recommendation of 60 minutes of MVPA per day by 18%. Thus, encouraging children to
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42 297 attend after-school and community-based physical activity clubs, as well as to play at home
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44 298 and in the neighbourhood is critical for helping children to increase MVPA. Moreover, in
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46 299 light of the relative consistency in findings for each of the four forms of physical activity, the
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48 300 message to parents should be that physical activity can be accumulated in all four settings
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50 301 which allows them to find a balance that works for their family. For some families with
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52 302 working parents, after-school programmes may be the key activity to focus on, whereas for
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3 303 other families encouraging children to play in the neighbourhood is likely to be useful for
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5 304 maximising physical activity. Furthermore, as there was little evidence that play at home was
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7 305 associated with a reduction in sedentary time, it is also important to examine ways of
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10 306 encouraging non-sedentary activities within the home.

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14 308 The findings in this paper support previous research which has shown that introducing extra-
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16 309 curricular clubs into the school day can promote increased physical activity among primary
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18 310 school-aged children.[32] The study is in broad agreement with the body of work, which has
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20 311 shown that risky outdoor play and higher independent mobility are associated with higher
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22 312 levels of physical activity among children.[33-36] These findings complement these bodies of
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24 313 work by showing an additional effect of accumulating physical activity across different
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26 314 settings to maximise the overall amount of physical activity in which children engage.
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32 316 The UK Childhood Obesity strategy recommends that all primary schools should provide at
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34 317 least 30 minutes per day of physical activity opportunities across the curriculum, break times
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36 318 and extra-curricular activities.[37] The data presented here show that in the imputed dataset
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38 319 72.2% of Year 4 children were attending school-based programmes at least once per week
39
40 320 and 10.5% were attending five days per week. Previous research has shown that in the UK,
41
42 321 after-school clubs for primary school children tend to be dominated by team sports, such as
43
44 322 football and rugby, with limited provision for non-competitive physical activities.[38] Thus,
45
46 323 increasing the number and variety of sessions that children attend and improving the quality
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48 324 of those sessions is likely to provide a cost effective means of increasing children's physical
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50 325 activity. This hypothesis is consistent with the recent Theory of Expanded, Extended and
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52 326 Enhanced Opportunities (TEO), which suggests that the most effective means of increasing
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54 327 children's physical activity will be provided by extending and expanding current
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3 328 provision.[19] Thus, schools and community groups should be encouraged to extend current
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5 329 after-school provision to more children, diversify the activities to interest more pupils
6
7 330 (preferably involving pupils in deciding what activities to offer), and enhance the quality of
8
9 331 provision to maximise the amount of activity obtained. These relatively simple changes could
10
11 332 be made at each school and would provide scalable ways for increasing overall levels of
12
13 333 physical activity and contributing to the UK government's goal of reducing the prevalence of
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15 334 childhood obesity.
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335

336 *Strengths and limitations*

337 The major strength of this study is the large sample size and provision of detailed information
338 about participation in four different physical activity settings alongside accelerometer-
339 assessed physical activity. In addition, the use of multiple imputation models to provide
340 estimates for participants with missing data using a robust methodology has enabled us to
341 maximise the sample for analysis. The study is limited by the cross-sectional design, which
342 limits the ability to infer causation between frequency of participation in different settings
343 and levels of physical activity. All questions were self-reported and it is possible that some
344 were recalled more accurately than others. Moreover, as the questions used were developed
345 for this project we do not have information on the reliability and validity of the scale. The
346 report of play within the home is likely to include both sedentary and physically active forms
347 of play, as the question included play indoors, which could be expected to be more sedentary,
348 as well as outdoors in the garden, which is likely to be more active. Equally, as the question
349 focussed on play with friends or family we do not have any information about individual
350 play, and we were unable to disentangle these inter-related issues. We also cannot rule out the
351 possibility of residual confounding, but have adjusted for several key potential confounding

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3 352 variables in order to minimise this. The study is also drawn from the greater Bristol area in
4
5 353 the UK and as such our ability to extend findings to other settings and countries is limited.
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10 355 **CONCLUSIONS**

11 356 Participation in organised physical activity at school and in the community is associated with
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14 357 greater physical activity and reduced sedentary time among both boys and girls. In light of
15
16 358 the challenges of promoting physical activity during school time, parents should encourage
17
18 359 children to attend after school clubs, attend community activity groups and play in the
19
20 360 neighbourhood to help their children to meet physical activity guidelines. The data show that
21
22 361 all four types of activity contribute similarly to overall physical activity and there is therefore
23
24 362 an opportunity for families to find the best mix of options for them.
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28
29 364 **ACKNOWLEDGEMENTS**

30
31 365 This work was supported by grants from the British Heart Foundation (ref PG/11/51/28986
32
33 366 and SP 14/4/31123). DAL works in a unit that receives funding from the University of Bristol
34
35 367 and UK Medical Research Council (MC_UU_1201/5); she is also a UK National Institute of
36
37 368 Health and Research Senior Investigator (NF-SI-0166-10196). The funders had no
38
39 369 involvement in data analysis, data interpretation or writing of the paper.
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41
42

43 370 We would like to thank all of the families and schools that have taken part in the B-
44
45 371 PROACTIV project. We would also like to thank all current and previous members of the
46
47 372 research team who are not authors on this paper.
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52 374 **COMPETING INTERESTS**

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54 375 All authors have completed the ICMJE uniform disclosure form at
55
56 376 www.icmje.org/doi_disclosure.pdf and declare: all authors had financial support from the
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3 377 British Heart Foundation for the submitted work; no financial relationships with any
4
5 378 organisations that might have an interest in the submitted work in the previous three years; no
6
7 379 other relationships or activities that could appear to have influenced the submitted work.
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11
12 381 **CONTRIBUTORS**

13
14 382 Conception / design: RJ, ESM, JLT, DAL and SJS.

15
16 383 Data analysis / acquisition/ interpretation: RJ, CMW, ESM and DAL

17
18 384 Drafting / revising critically for important content: All authors.

19
20 385 Final approval: All authors.

21
22 386 Accountability for study and manuscript: RJ.

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28 388 **DATA SHARING STATEMENT:** The datasets generated during the current study are not
29
30 389 publicly available as the project is ongoing and data are not ready for archiving. We will
31
32 390 consider reasonable requests for access to the data once the project is complete in 2019.
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37 392 **REFERENCES**

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33 **Figure 1 Predicted time spent in sedentary behaviour by type of activity using multiple**
34 **imputation (N=1223)***

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36 515 * Predictions were obtained from fully adjusted regression models (Model 2) including all
37 516 Year 4 children (boys and girls) and are for a 9-year old boy with a BMI z-score of 0 and
38 517 IMD score of 16. Predicted sedentary time for girls was approximately 15-17 mins/day higher
39 518 (same additive effect across all categories of the exposure variable) depending on the
40 519 regression model
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45 **Figure 2 Predicted time spent in moderate-to-vigorous physical activity by type of**
46 **activity using multiple imputation (N=1223)***

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48 523 * Predictions were obtained from fully adjusted regression models (Model 2) including all
49 524 Year 4 children (boys and girls) and are for a 9-year old boy with a BMI z-score of 0 and
50 525 IMD score of 16. Predicted time spent in moderate-to-vigorous physical activity for girls was
51 526 approximately 13 mins/day lower (same additive effect across all categories of the exposure
52 527 variable)
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For peer review only

Organised physical activity, neighbourhood play and child physical activity

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract Title Page
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found – Pages 2-3
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported – Pages 5-6
Objectives	3	State specific objectives, including any prespecified hypotheses – Page 6.
Methods		
Study design	4	Present key elements of study design early in the paper Pages 6-7.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Page 6.
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants Page 7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable - Page 7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Page 7-8
Bias	9	Describe any efforts to address potential sources of bias – Page 8
Study size	10	Explain how the study size was arrived at - Page 8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why - Pages 8-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding – Pages 8-9
		(b) Describe any methods used to examine subgroups and interactions – Pages 8-9
		(c) Explain how missing data were addressed - Pages 8-9
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of

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		sampling strategy - Page 9
		(e) Describe any sensitivity analyses – Page 10

Continued on next page

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Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Table 1 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram - NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders – Table 1 (b) Indicate number of participants with missing data for each variable of interest - Table 1 (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures Table 1
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included – Tables 2-4 (b) Report category boundaries when continuous variables were categorized - Tables 2-4 (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period Discussion – Page 18
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses – Supplementary tables

Discussion

Key results	18	Summarise key results with reference to study objectives – Page 21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias - Page 23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence – Page 22
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 22

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based – Page 24
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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

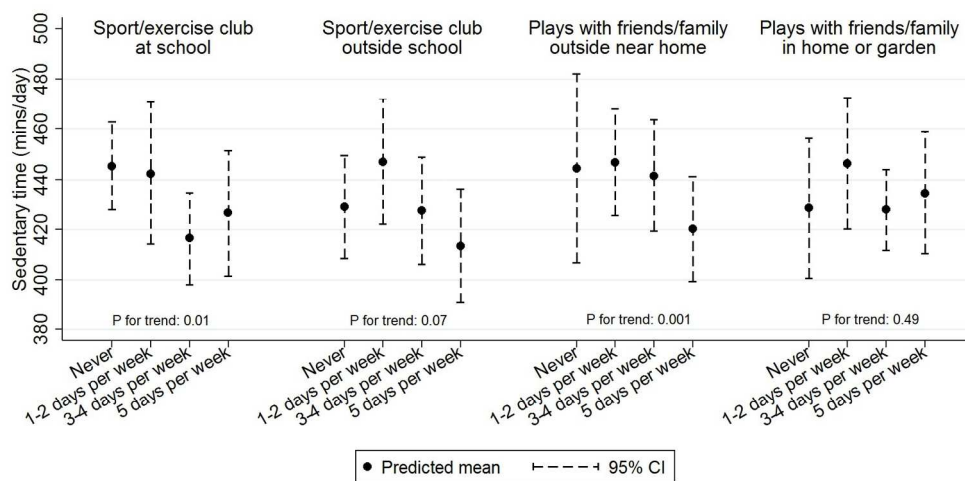


Figure 1 Predicted time spent in sedentary behaviour by type of activity using multiple imputation (N=1223)*

* Predictions were obtained from fully adjusted regression models (Model 2) including all Year 4 children (boys and girls) and are for a 9-year old boy with a BMI z-score of 0 and IMD score of 16. Predicted sedentary time for girls was approximately 15-17 mins/day higher (same additive effect across all categories of the exposure variable) depending on the regression model

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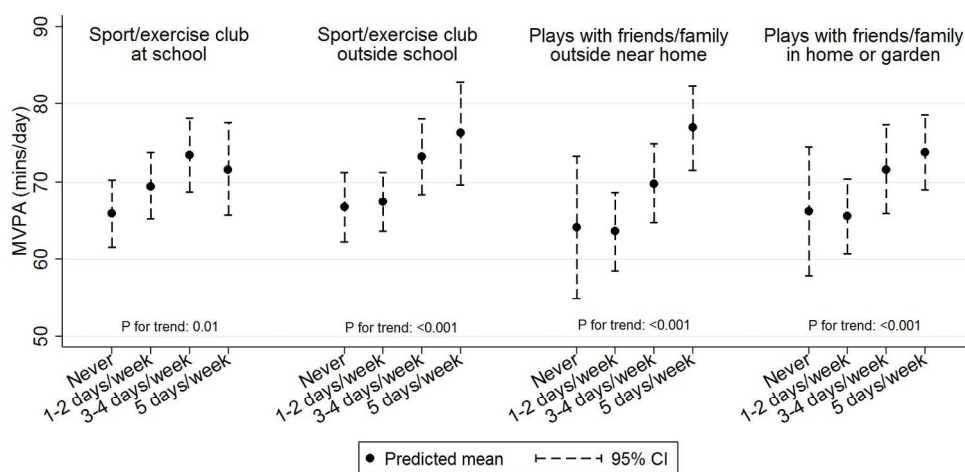


Figure 2 Predicted time spent in moderate-to-vigorous physical activity by type of activity using multiple imputation (N=1223)*

* Predictions were obtained from fully adjusted regression models (Model 2) including all Year 4 children (boys and girls) and are for a 9-year old boy with a BMI z-score of 0 and IMD score of 16. Predicted time spent in moderate-to-vigorous physical activity for girls was approximately 13 mins/day lower (same additive effect across all categories of the exposure variable)

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Figure S1 Scatter plot of sedentary time by activity score in the observed data (N=1003)

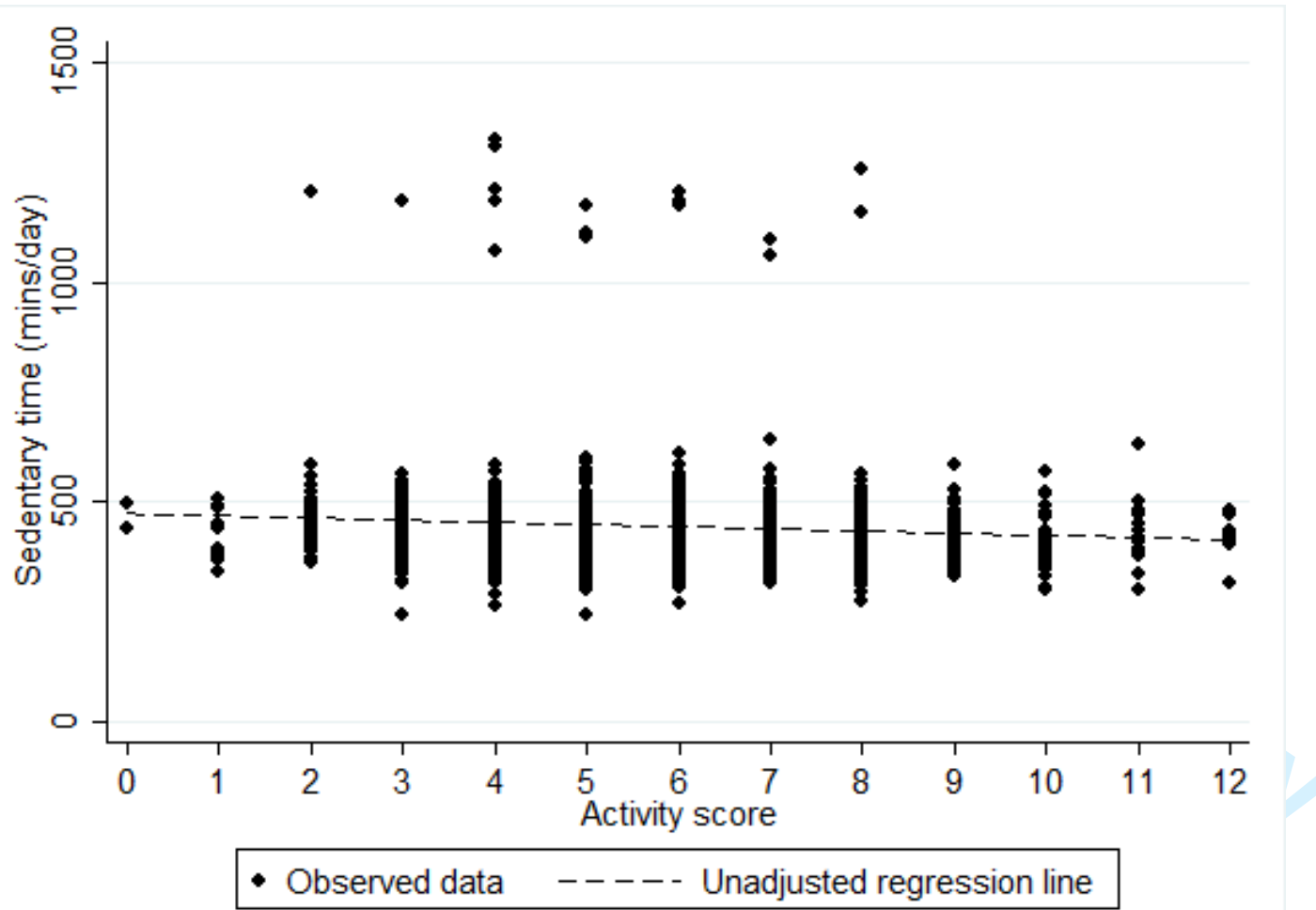


Figure S2 Scatter plot of time spent in moderate-to-vigorous physical activity by activity score in the observed data (N=1003)

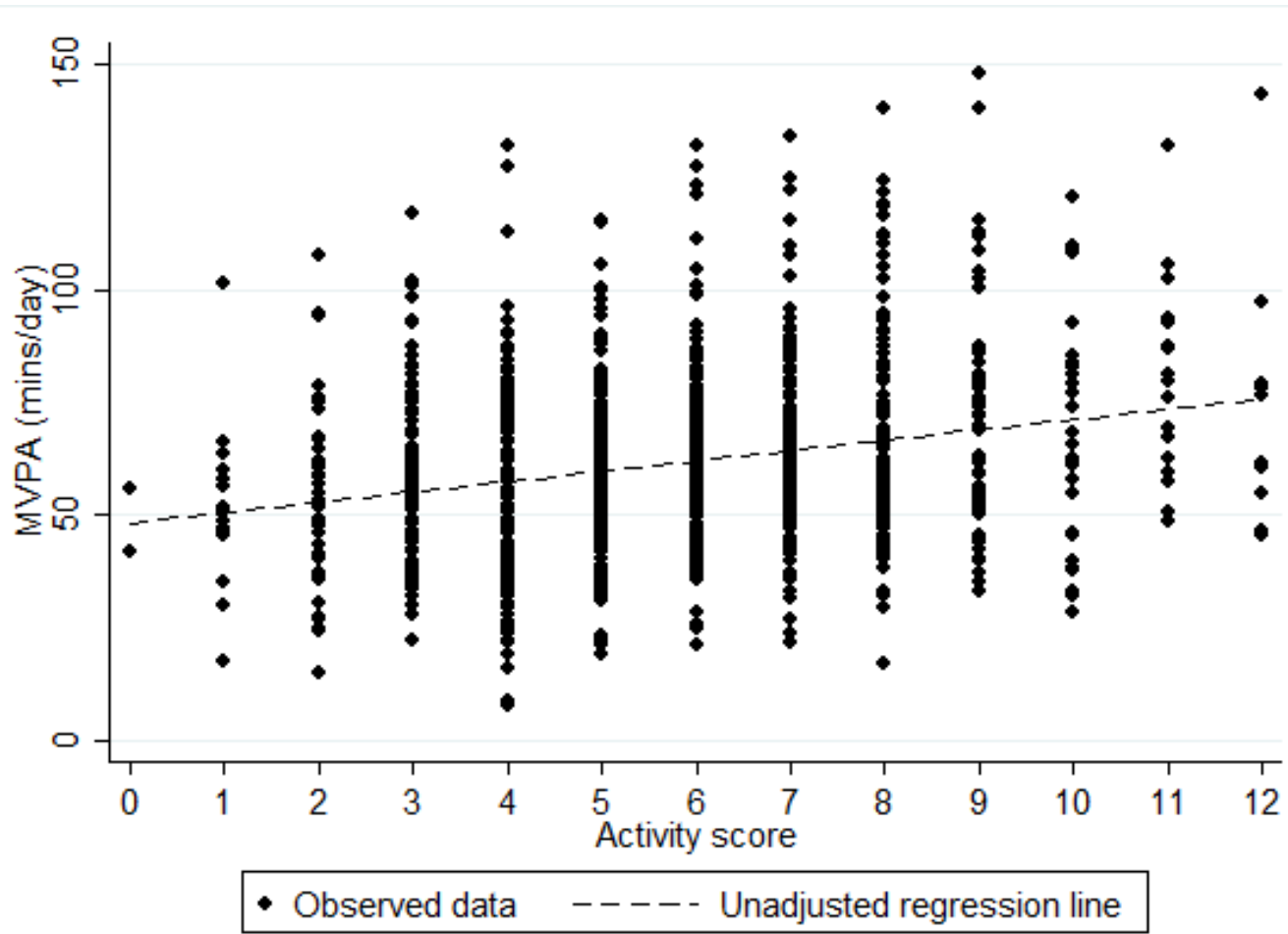


Table S1 Frequencies of sport/exercise club attendance and play outside and inside the home and mean activity score by gender in the observed data

		Boys N (%)		Girls N (%)		Chi-squared p-value for association
Frequency child attends sport/exercise club at school	Never	144 (25.9)		194 (29.4)		<0.001
	1-2 days/week	235 (42.3)		318 (48.2)		
	3-4 days/week	90 (16.2)		106 (16.1)		
	5 days/week	86 (15.5)		42 (6.4)		
Frequency child attends sport/exercise club outside of school	Never	85 (15.3)		165 (25.0)		<0.001
	1-2 days/week	289 (52.1)		321 (48.7)		
	3-4 days/week	121 (21.8)		132 (20.0)		
	5 days/week	60 (10.8)		41 (6.2)		
Frequency child plays with friends/family outside near home	Never	36 (6.6)		40 (6.1)		0.14
	1-2 days/week	187 (34.1)		219 (33.4)		
	3-4 days/week	142 (25.9)		207 (31.6)		
	5 days/week	184 (33.5)		190 (29.0)		
Frequency child plays with friends/family in home/garden	Never	53 (9.7)		62 (9.5)		0.76
	1-2 days/week	184 (33.7)		230 (35.2)		
	3-4 days/week	142 (26.0)		179 (27.4)		
	5 days/week	167 (30.6)		182 (27.9)		
		Boys		Girls		T-test p-value for gender difference
		N	Mean (SD)	N	Mean (SD)	
Activity frequency score		542	6.15 (2.42)	651	5.65 (2.16)	<0.001

Table S2 Child characteristics by frequencies of sport/exercise club attendance and play outside and inside the home and activity score in the observed data

		Age (years)		BMI z score		IMD score	
		Mean (SD)	N	Mean (SD)	N	Mean (SD)	N
Frequency child attends sport/exercise club at school	Never	9.03 (0.38)	1215	0.43 (1.14)	1202	17.30 (15.04)	1197
	1-2 days/week	9.05 (0.43)		0.35 (1.05)		15.54 (14.02)	
	3-4 days/week	9.00 (0.45)		0.29 (1.02)		14.15 (11.07)	
	5 days/week	8.99 (0.39)		0.27 (1.13)		16.66 (15.10)	
	P-value for difference between categories*			0.31		0.36	
Frequency child attends sport/exercise club outside of school	Never	9.01 (0.40)	1214	0.47 (1.07)	1201	20.03 (16.06)	1196
	1-2 days/week	9.01 (0.43)		0.37 (1.09)		16.02 (14.12)	
	3-4 days/week	9.05 (0.41)		0.23 (1.07)		12.30 (10.25)	
	5 days/week	9.12 (0.39)		0.30 (1.06)		14.26 (13.64)	
	P-value for difference between categories*			0.05		0.09	
Frequency child plays with friends/family outside near home	Never	8.96 (0.47)	1205	0.48 (1.24)	1192	17.60 (16.02)	1187
	1-2 days/week	9.01 (0.42)		0.31 (1.06)		15.20 (13.83)	
	3-4 days/week	9.05 (0.41)		0.39 (1.07)		14.66 (12.48)	
	5 days/week	9.05 (0.40)		0.33 (1.08)		17.66 (15.08)	
	P-value for difference between categories*			0.23		0.58	
Frequency child plays with friends/family in home/garden	Never	8.97 (0.38)	1199	0.50 (1.11)	1186	18.54 (15.94)	1181
	1-2 days/week	9.02 (0.45)		0.29 (1.09)		15.85 (13.95)	
	3-4 days/week	9.06 (0.41)		0.40 (1.07)		14.24 (12.79)	
	5 days/week	9.03 (0.39)		0.32 (1.07)		16.85 (14.55)	
	P-value for difference between categories*			0.31		0.23	
		Correlation	P-value	Correlation	P-value	Correlation	P-value
Activity frequency score		0.04	0.13	-0.05	0.07	-0.07	0.02

Table S3 Pairwise comparisons of children's activity attendance frequencies in the multiple imputation data (N=1223)*

		Frequency child attends sport/exercise club at school (%)		Frequency child attends sport/exercise club outside of school (%)		Frequency child plays with friends/family outside near home (%)		Frequency child plays with friends/family in home/garden (%)	
		Up to 2 days/week	3 or more days/week	Up to 2 days/week	3 or more days/week	Up to 2 days/week	3 or more days/week	Up to 2 days/week	3 or more days/week
Frequency child attends sport/exercise club at school	Up to 2 days/week			76.3	23.7	42.7	57.3	47.3	52.7
	3 or more days/week			55.8	44.2	33.2	66.8	36.0	64.0
P for association				<0.001		0.003		0.001	
Frequency child attends sport/exercise club outside of school	Up to 2 days/week	79.0	21.0			40.2	59.8	46.8	53.2
	3 or more days/week	59.7	40.3			40.0	60.0	38.2	61.8
P for association		<0.001				0.94		0.006	
Frequency child plays with friends/family outside near home	Up to 2 days/week	78.0	22.0	71.0	29.0			65.1	34.9
	3 or more days/week	70.3	29.7	70.8	29.2			30.3	69.7
P for association		0.003		0.94				<0.001	
Frequency child plays with friends/family in home/garden	Up to 2 days/week	78.3	21.7	74.9	25.1	59.0	41.0		
	3 or more days/week	69.4	30.6	67.6	32.4	25.2	74.8		
P for association		0.001		0.006		<0.001			
Total		73.4	26.6	70.8	29.2	40.2	59.8	44.3	55.7

* Percentages presented are the proportions of children in each row that belong to each of the categories of child activity variables listed along the top of the table.

Table S4 Mean difference in the children's average sedentary minutes per day associated with different activities for those with complete data (N=987)*

Exposure	Sedentary time (minutes/day): mean difference (95% confidence interval)							P for gender interaction	
	All (N=987)		Boys (N=439)		Girls (N=548)				
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2			
Frequency child attends sport/exercise club at school	Never (ref)	0	0	0	0	0	0	0.45	
	1-2 days/week	-0.29	0.0	14.7	15.9	-11.4	-11.9		
	3-4 days/week		(-21.3, 20.7)	(-21.2, 21.3)	(-10.1, 39.5)	(-9.2, 41.0)	(-39.7, 16.8)		(-41.1, 17.3)
		5 days/week	-26.3	-24.1	-13.8	-9.9	-36.0		-35.4
			(-40.8, -11.8)	(-37.8, -10.4)	(-31.5, 4.0)	(-29.3, 9.4)	(-59.5, -12.4)		(-59.0, -11.7)
	-16.0	-16.1	-7.1	-3.1	-22.0	-29.8			
		(-35.3, 3.3)	(-34.4, 2.3)	(-29.7, 15.4)	(-26.9, 20.6)	(-54.6, 10.7)	(-69.2, 9.66)		
P for trend		0.01	0.009	0.19	0.40	0.02	0.02		
Frequency child attends sport/exercise club outside of school	Never (ref)	0	0	0	0	0	0	0.73	
	1-2 days/week	16.1	20.0	24.6	31.2	10.8	12.9		
	3-4 days/week		(-7.5, 39.7)	(-7.0, 47.0)	(-3.4, 52.7)	(0.6, 61.8)	(-19.3, 41.0)		(-20.0, 45.9)
		5 days/week	-6.6	0.1	-3.2	5.6	-7.6		-2.0
			(-23.2, 10.1)	(-19.6, 19.8)	(-28.8, 22.3)	(-17.7, 28.8)	(-26.3, 11.1)		(-26.7, 22.6)
	-18.4	-13.8	-13.0	-5.9	-20.8	-18.2			
		(-36.5, -0.2)	(-33.8, 6.2)	(-36.3, 10.4)	(-28.8, 16.9)	(-46.0, 4.3)	(-46.4, 10.0)		
P for trend		0.009	0.05	0.02	0.03	0.08	0.28		
Frequency child plays with friends/family outside near home	Never (ref)	0	0	0	0	0	0	0.68	
	1-2 days/week	4.5	6.0	16.3	20.2	-5.7	-7.1		
	3-4 days/week		(-26.7, 35.7)	(-27.5, 39.5)	(-13.4, 45.9)	(-10.1, 50.4)	(-55.7, 44.3)		(-59.0, 44.9)
		5 days/week	-2.5	-0.6	8.3	13.0	-11.9		-13.2
			(-30.1, 25.0)	(-31.6, 30.3)	(-23.1, 39.7)	(-19.4, 45.4)	(-68.1, 44.3)		(-71.3, 44.9)
	-21.6	-21.9	-9.4	-6.4	-32.3	-36.4			
		(-49.0, 5.7)	(-50.4, 6.6)	(-35.4, 16.6)	(-32.8, 20.0)	(-78.9, 14.2)	(-86.0, 13.1)		
P for trend		<0.001	<0.001	0.08	0.08	0.009	0.01		
Frequency child plays with friends/family in home/garden	Never (ref)	0	0	0	0	0	0	0.86	
	1-2 days/week	18.2	18.8	19.2	19.5	17.2	17.6		
	3-4 days/week		(-12.4, 48.8)	(-12.4, 50.0)	(-13.8, 52.2)	(-13.7, 52.8)	(-25.4, 59.9)		(-25.4, 60.6)
		5 days/week	-4.5	-1.9	2.8	4.6	-10.1		-7.5
			(-27.3, 18.2)	(-26.7, 22.9)	(-16.3, 21.9)	(-15.7, 25.0)	(-47.3, 27.0)		(-47.1, 32.1)
	3.8	3.6	10.8	11.6	-2.2	-3.5			
		(-24.6, 32.2)	(-24.6, 31.8)	(-27.1, 48.8)	(-27.0, 50.2)	(-43.0, 38.6)	(-45.3, 38.3)		
P for trend		0.24	0.22	0.85	0.89	0.25	0.24		
Activity score (per unit)		-4.9	-4.7	-3.5	-2.9	-6.3	-6.6	0.28	
		(-7.2, -2.7)	(-6.9, -2.4)	(-6.6, -0.4)	(-6.0, 0.2)	(-10.7, -2.0)	(-11.2, -1.9)		

* Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score

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Table S5 Mean difference in the children's average MVPA minutes per day associated with different activities for those with complete data (N=987)*

Exposure		Moderate-to-vigorous physical activity (minutes/day): mean difference (95% confidence interval)						P for gender interaction
		All (N=987)		Boys (N=439)		Girls (N=548)		
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	
Frequency child attends sport/exercise club at school	Never (ref)	0	0	0	0	0	0	0.64
	1-2 days/week	3.2 (-0.4, 6.8)	3.1 (-0.5, 6.6)	3.3 (-3.3, 9.8)	2.7 (-3.7, 9.2)	3.1 (-0.5, 6.8)	3.1 (-0.6, 6.8)	
	3-4 days/week	6.7 (1.7, 11.8)	6.4 (1.4, 11.4)	8.0 (1.0, 15.1)	7.3 (0.1, 14.4)	5.7 (0.6, 10.7)	5.6 (0.5, 10.7)	
	5 days/week	5.3 (-1.3, 11.9)	5.1 (-1.5, 11.8)	6.6 (-1.4, 14.6)	5.8 (-2.2, 13.8)	3.2 (-5.0, 11.5)	3.1 (-5.5, 11.6)	
	P for trend	0.02	0.03	0.02	0.05	0.08	0.10	
Frequency child attends sport/exercise club outside of school	Never (ref)	0	0	0	0	0	0	0.53
	1-2 days/week	1.8 (-1.9, 5.5)	1.5 (-2.4, 5.4)	4.3 (-3.2, 11.9)	3.6 (-4.4, 11.7)	0.4 (-3.5, 4.3)	0.4 (-3.5, 4.4)	
	3-4 days/week	7.3 (3.0, 11.5)	6.7 (2.4, 11.0)	10.5 (2.8, 18.2)	9.0 (1.4, 16.6)	5.3 (0.6, 10.0)	5.5 (0.9, 10.0)	
	5 days/week	10.5 (4.6, 16.5)	10.1 (3.9, 16.2)	14.3 (6.3, 22.3)	13.4 (4.8, 22.0)	7.3 (-0.8, 15.3)	7.3 (-0.6, 15.2)	
	P for trend	<0.001	<0.001	<0.001	<0.001	0.01	0.008	
Frequency child plays with friends/family outside near home	Never (ref)	0	0	0	0	0	0	0.32
	1-2 days/week	0.7 (-4.1, 5.5)	0.4 (-4.3, 5.0)	1.2 (-7.4, 9.7)	0.5 (-8.1, 9.1)	0.4 (-6.0, 6.9)	0.3 (-6.3, 6.9)	
	3-4 days/week	5.2 (-0.8, 11.2)	4.9 (-1.0, 10.7)	6.7 (-3.5, 16.9)	6.0 (-4.0, 15.9)	4.0 (-3.6, 11.7)	3.9 (-3.8, 11.7)	
	5 days/week	9.9 (4.4, 15.4)	9.7 (4.2, 15.1)	13.8 (4.6, 23.0)	13.3 (4.0, 22.5)	6.5 (-0.5, 13.5)	6.4 (-0.7, 13.6)	
	P for trend	<0.001	<0.001	<0.001	<0.001	0.004	0.005	
Frequency child plays with friends/family in home/garden	Never (ref)	0	0	0	0	0	0	0.40
	1-2 days/week	2.5 (-0.9, 6.0)	2.2 (-1.4, 5.8)	0.6 (-7.0, 8.2)	0.4 (-7.4, 8.2)	4.1 (-0.9, 9.2)	4.0 (-1.1, 9.1)	
	3-4 days/week	6.6 (2.4, 10.7)	6.3 (1.8, 10.8)	6.7 (-1.8, 15.3)	6.9 (-1.9, 15.7)	6.5 (0.4, 12.6)	6.4 (0.1, 12.7)	
	5 days/week	8.6 (4.6, 12.5)	8.4 (4.3, 12.6)	9.3 (1.6, 16.9)	9.1 (1.0, 17.2)	7.9 (2.5, 13.3)	7.8 (2.4, 13.3)	
	P for trend	<0.001	<0.001	0.001	0.001	0.003	0.003	
Activity score (per unit)		2.13 (1.44, 2.82)	2.09 (1.37, 2.81)	2.58 (1.73, 3.43)	2.49 (1.55, 3.42)	1.67 (0.86, 2.47)	1.66 (0.85, 2.48)	0.07

* MVPA Moderate-to-vigorous physical activity; Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score

Table S6 Odds ratios for achieving 60 minutes of MVPA per day associated with different activities for those with complete data (N=987)*

Exposure		Meeting government guideline: odds ratio (95% confidence interval)						P for gender interaction
		All (N=987)		Boys (N=439)		Girls (N=548)		
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	
Frequency child attends sport/exercise club at school	Never (ref)	1	1	1	1	1	1	0.25
	1-2 days/week	1.27 (0.94, 1.71)	1.25 (0.93, 1.69)	0.97 (0.58, 1.63)	0.93 (0.55, 1.55)	1.57 (1.09, 2.25)	1.57 (1.09, 2.26)	
	3-4 days/week	1.77 (1.05, 2.97)	1.72 (1.03, 2.87)	1.97 (0.93, 4.18)	1.86 (0.88, 3.95)	1.65 (0.93, 2.91)	1.66 (0.94, 2.92)	
	5 days/week	1.63 (0.96, 2.77)	1.61 (0.95, 2.74)	1.49 (0.75, 2.96)	1.40 (0.70, 2.77)	1.73 (0.78, 3.85)	1.76 (0.78, 3.96)	
P for trend		0.03	0.03	0.06	0.10	0.07	0.07	
Frequency child attends sport/exercise club outside of school	Never (ref)	1	1	1	1	1	1	0.66
	1-2 days/week	1.32 (0.91, 1.91)	1.29 (0.88, 1.88)	1.53 (0.89, 2.62)	1.46 (0.83, 2.57)	1.19 (0.72, 1.97)	1.21 (0.74, 1.99)	
	3-4 days/week	2.06 (1.38, 3.07)	1.97 (1.32, 2.95)	2.56 (1.32, 4.98)	2.28 (1.18, 4.40)	1.77 (1.05, 2.98)	1.81 (1.09, 3.03)	
	5 days/week	2.89 (1.76, 4.73)	2.80 (1.69, 4.63)	4.13 (1.97, 8.68)	3.92 (1.82, 8.44)	2.09 (1.06, 4.12)	2.14 (1.10, 4.18)	
P for trend		<0.001	<0.001	<0.001	<0.001	0.006	0.004	
Frequency child plays with friends/family outside near home	Never (ref)	1	1	1	1	1	1	0.89
	1-2 days/week	1.16 (0.70, 1.92)	1.13 (0.70, 1.85)	1.03 (0.46, 2.29)	0.98 (0.43, 2.22)	1.40 (0.59, 3.30)	1.41 (0.60, 3.29)	
	3-4 days/week	1.94 (1.12, 3.35)	1.89 (1.12, 3.21)	1.59 (0.68, 3.75)	1.53 (0.65, 3.62)	2.43 (0.92, 6.45)	2.46 (0.94, 6.42)	
	5 days/week	2.14 (1.26, 3.65)	2.12 (1.26, 3.57)	2.01 (0.88, 4.63)	1.97 (0.85, 4.54)	2.45 (0.95, 6.36)	2.49 (0.97, 6.40)	
P for trend		<0.001	<0.001	0.007	0.005	0.007	0.006	
Frequency child plays with friends/family in home/garden	Never (ref)	1	1	1	1	1	1	0.30
	1-2 days/week	1.33 (0.88, 2.00)	1.30 (0.86, 1.97)	0.96 (0.51, 1.78)	0.94 (0.50, 1.77)	1.92 (0.90, 4.11)	1.94 (0.91, 4.12)	
	3-4 days/week	1.67 (1.10, 2.54)	1.64 (1.07, 2.52)	1.33 (0.66, 2.69)	1.36 (0.66, 2.82)	2.15 (0.96, 4.79)	2.16 (0.97, 4.80)	
	5 days/week	1.86 (1.21, 2.86)	1.85 (1.20, 2.86)	1.68 (0.86, 3.25)	1.67 (0.84, 3.32)	2.18 (1.04, 4.60)	2.20 (1.04, 4.62)	
P for trend		0.002	0.002	0.008	0.008	0.06	0.06	
Activity score (per unit)		1.19 (1.12, 1.26)	1.19 (1.12, 1.26)	1.20 (1.11, 1.30)	1.19 (1.10, 1.30)	1.18 (1.09, 1.28)	1.18 (1.09, 1.28)	0.79

* MVPA Moderate-to-vigorous physical activity; Model 1 is adjusted for age and gender; Model 2 is additionally adjusted for BMI and IMD score