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# BMJ Open

## Who leads and who supports? A cross-sectional mixed methods study of mothers' and fathers' support for child physical activity

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Manuscripts

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3 1 Who leads and who supports? A cross-sectional mixed methods study of mothers' and  
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5 2 fathers' support for child physical activity  
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3 28 **ABSTRACT**  
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5 29 **Objectives:** Examine the extent to which parent gender is associated with supporting  
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8 30 children's physical activity.  
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10 31 **Design:** Cross-sectional mixed-methods study.  
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13 32 **Setting:** 47 primary schools located in Bristol (UK).  
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16 33 **Participants:** 944 8-9-year-old children and one of their parents provided quantitative data;  
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18 34 51 parents were interviewed.  
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21 35 **Methods:** Children wore an accelerometer and mean minutes of moderate-to-vigorous-  
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23 36 intensity physical activity (MVPA) per day, counts per minute (CPM), and achievement of  
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25 37 national MVPA guidelines were derived. Parents reported who leads in supporting child  
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27 38 activity during the week and weekend. Linear and logistic regression examined the  
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29 39 association between gender of parent who leads child activity and child physical activity. For  
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31 40 the semi-structured telephone interviews, inductive and deductive content analysis were used  
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33 41 to explore the role of gender in how parents lead child activity.  
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37 42 **Results:** Parents appeared to have a stronger role in supporting boys to be more active, than  
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39 43 girls, and the strongest associations were when they reported that both parents had equal roles  
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41 44 in supporting their child. For example, compared with the reference of female/mother leading  
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43 45 support, equal contribution from both parents was associated with boys doing 5.9 (95% CI:  
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45 46 1.2 to 10.6) more minutes of MVPA per day during the week, and more CPM on both week  
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47 47 and weekend days (55.1 [14.3 to 95.9] and 52.8 [1.8 to 103.7], respectively). Associations in  
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49 48 girls were weaker and sometimes in the opposite direction but there was no strong statistical  
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51 49 evidence for gender interactions. Qualitatively, parents described a range of support  
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53 50 arrangements, commonly; proactively supporting physical activity equally, mothers leading  
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3 51 during the week, families getting together at weekends, families doing activities separately  
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5 52 due to preferences, and parents using activities to bond one-to-one with children.  
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8 53 **Conclusions:** Mothers primarily lead child activity during the week. Children, possibly more  
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10 54 so boys, are more active if both parents share the supporting role.  
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15 56 **Key words:** Physical activity, children, parents, gender, mixed-methods  
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3 71 **ARTICLE SUMMARY**  
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5 72 **Strengths and limitations of this study**  
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8 73 **Strengths**  
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11 74 • Mixed-methods study.  
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13 75 • Accelerometer data from a large sample of 8-9-year-old children.  
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15 76 • Semi-structured interviews with 51 parents, including 20 fathers.  
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21 78 **Limitations**  
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- 24 79 • Cross-sectional study design from a single UK region.  
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26 80 • The measurement of parental leadership of child physical activity would be  
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28 81 strengthened by collecting data from both parents and information on the quality and  
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30 82 quantity of leadership.  
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## 92 INTRODUCTION

93 Children who are physically active are at a lower risk of obesity, high blood pressure,  
94 metabolic syndrome, and depression.[1 2] The UK Government recommends that children  
95 and young people aged 5 to 18 years should engage in at least 60 minutes of moderate-to-  
96 vigorous-intensity physical activity (MVPA) every day.[3] However, data from the nationally  
97 representative Millennium cohort showed that only 51% of 7-8 year olds met the  
98 recommendation.[4] Physical activity declines throughout childhood and adolescence, with  
99 boys being more active than girls at all ages.[4-9] Thus, in order to develop effective means  
100 of increasing child physical activity, there is a need to understand the factors that influence  
101 behaviour.

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103 Parents act as gatekeepers to children's activity,[10] and can play an important role in  
104 increasing their child's physical activity.[11-13] For instance, parents can influence their  
105 child's activity by being active with their child, role-modelling active behaviour, and/or by  
106 facilitating physical activity for their child (logistic support).[13-16] Studies examining links  
107 between parent and child physical activity have yielded mixed results.[14 17-20] A growing  
108 body of work has shown that providing logistic support is associated with increased physical  
109 activity,[21-23] and therefore, may be the most important source of parental influence on  
110 children's activity.

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112 The gender of the parent who takes the lead in supporting child activity could be an important  
113 influence on children's activity levels. Several studies suggest that mothers play a larger role  
114 in the logistical planning of children's physical activity, while fathers are more likely to  
115 model physical activity.[24 25] However, most studies in this area have focused on the

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3 116 mother-child relationship, and relatively little attention has been paid to the role of  
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5 117 fathers.[26] From qualitative interviews with parents of 5-6-year-old children in the B-  
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7 118 Proact1v study, we found evidence that fathers play a key role in promoting children's  
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9 119 physical activity, influencing their choices and behaviours,[27] a finding replicated in other  
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11 120 studies.[28 29] The Healthy Dads, Healthy Kids intervention demonstrated that engaging  
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13 121 fathers in physical activity with their children can promote increases in children's physical  
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15 122 activity.[30 31] Data from the B-Proact1v interviews suggest that fathers may take more  
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17 123 responsibility for their son's physical activity (e.g., taking their son to sports clubs), and  
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19 124 mothers with their daughter's activity.[27] To date, there is inconsistent evidence regarding  
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21 125 whether gender-specific parental influence (i.e., mothers with daughters and fathers with  
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23 126 sons) is stronger than cross-gender parental influence (i.e., mothers with sons and fathers with  
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25 127 daughters) on children's physical activity.[24 32-35] Therefore, a greater understanding is  
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27 128 needed about the role gender plays in how parents support their child to be active, and if this  
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29 129 varies by child gender.  
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37 131 The aim of this mixed-methods study was to examine parent gender, in terms of which parent  
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39 132 takes the lead in supporting their child to be active, and its association with child physical  
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41 133 activity. A secondary aim was to discover if these associations varied by child gender.  
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## 45 46 135 **METHODS**

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49 136 Data are from the longitudinal B-Proact1v study, which aimed to examine factors associated  
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51 137 with children's and parents' physical activity and screen-viewing behaviours. The study has  
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53 138 been described in detail elsewhere.[9 17 36] Briefly, in 2012 and 2013, data were collected  
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55 139 from 1299 Year 1 children (5-6 years old) from 57 primary schools across Bristol, UK.  
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3 140 Between March 2015 and July 2016, 47 of the original schools were re-recruited and data  
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5 141 were collected from 1223 Year 4 children (8-9 years old). One of the children's parents were  
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7 142 also recruited to the study. The current study used cross-sectional data from the Year 4  
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9 143 assessments, for the 944 children and parents who provided valid child accelerometer data  
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11 144 and complete parent questionnaire data for questions on child and parent demographics and  
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13 145 gender roles associated with supporting child activity (Figure 1). In addition, we drew on  
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15 146 qualitative data via semi-structured telephone interviews from a sub-sample of 51 parents  
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17 147 (details below; Figure 2). The study received ethical approval from the School for Policy  
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19 148 Studies Ethics Committee at the University of Bristol, and written parent consent was  
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22 149 received for all participants.  
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### 26 27 28 151 *Accelerometer data*

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30 152 Children wore a waist-worn ActiGraph wGT3X-BT accelerometer for five days including  
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32 153 two weekend days. Accelerometer data were processed using Kinesoft (v3.3.75; Kinesoft,  
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34 154 Saskatchewan, Canada), and were included in the primary analyses if children provided at  
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36 155 least three days of valid data (including at least one weekend day). A valid day was defined  
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38 156 as at least 500 minutes of data after excluding intervals of  $\geq 60$  minutes of zero counts,  
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40 157 allowing up to two minutes of interruptions. Minutes spent in MVPA were derived using  
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42 158 population-specific cut points for children.[37] Mean accelerometer counts per minute  
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44 159 (CPM), and a binary variable indicating whether the child's average daily MVPA was greater  
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46 160 than the 60 minutes per day recommended by the UK government,[3] were also derived.  
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### 52 53 162 *Parent leadership variables*

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3 163 To understand the gender roles associated with parents supporting their child's activity,  
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5 164 parents were asked three questions via a questionnaire: a) "In your family who takes the lead  
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7 165 role in supporting your Year 4 child to be active during the week?", b) "In your family who  
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9 166 takes the lead role in supporting your Year 4 child to be active at the weekend?" and c) "Who  
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11 167 do you think should take the lead role in supporting your Year 4 child to be active?". Each  
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13 168 question had three response options: "Mother/Female care-giver", "Father/Male care-giver"  
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15 169 or "About the same" for questions a) and b), and "Should be shared" for question c).  
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### 20 21 171 ***Demographic information***

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24 172 Parents provided demographic information via a questionnaire, including parent and child  
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26 173 gender and date of birth. Where children's date of birth was missing (21% of children) they  
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28 174 were assigned the median age of 9.0 years (as the children were all in the same school year  
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30 175 with a maximum age difference between the youngest and oldest of just under 12-months  
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32 176 legally possible). Indices of Multiple Deprivation (IMD) scores, based upon the English  
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34 177 Indices of Deprivation (<http://data.gov.uk/dataset/index-of-multiple-deprivation>), were  
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36 178 assigned to each child based on their reported home postcode.  
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### 41 42 43 180 ***Interview data***

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45 181 During consent procedures, parents were informed that they may be re-contacted to take part  
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47 182 in a telephone interview. Only families with complete data for all measures (child and parent  
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49 183 accelerometer data, child height, weight and blood pressure, and child and parent  
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51 184 questionnaire data) were included in the interview sample (N=625, of which 161 (25.8%) had  
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53 185 data from fathers). This sample was stratified according to the child's MVPA minutes per day  
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55 186 (dichotomised around the study median: 57.5 minutes), sedentary minutes per day  
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3 187 (dichotomised around the median: 434.6 minutes), and by child gender. This produced eight  
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5 188 sub-groups (1 = low MVPA, low sedentary time boys; and 8 = high MVPA, high sedentary  
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7 189 time girls; Table S1). The order in which parents were invited to participate in an interview  
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9 190 was randomised within each sub-group. Contact attempts were made with 188 parents in  
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11 191 total, of which 59 (31.4%) initially agreed to participate in an interview, and 51 (27.1%)  
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13 192 completed an interview (Figure 2). Interviews were audio-recorded and continued until  
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15 193 theoretical saturation was reached for the entire sample and the sub-groups. Parents were  
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17 194 invited to participate by telephone between July and October 2016, and interviews were  
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19 195 conducted at the interviewee's convenience (37 during weekday daytimes (72.5%), 13 during  
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21 196 weekday evenings (25.5%), and 1 on a weekend evening (2%)). Participants were sent a £10  
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23 197 high street shopping voucher as a thank you for their time.  
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30 199 An interview guide was developed and refined by the research team based on identifying  
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32 200 gaps in current knowledge and guided by the Year 1 B-Proact1v quantitative and qualitative  
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34 201 findings. This included questions relating to a variety of topics, including parents'  
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36 202 perceptions of their child's physical activity and screen-viewing behaviours, strategies for  
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38 203 managing these behaviours, understanding what has changed regarding these behaviours, and  
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40 204 parents' experiences from their own childhood. Questions were posed in a non-leading  
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42 205 manner to allow participants to shape the direction of the interview, and issues that emerged  
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44 206 were probed. Interviews were conducted by two female researchers (qualified to at least MSc  
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46 207 level) who were trained in conducting qualitative interviews.  
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53 209 ***Mixed-methods approach***  
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3 210 The current study uses a mixed-methods design, incorporating quantitative data from  
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5 211 questionnaires and accelerometry, with qualitative data from semi-structured interviews.  
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7 212 Combining quantitative and qualitative approaches can provide a better understanding of  
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9 213 research problems than either approach alone,[38] and the opportunity to present a greater  
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11 214 diversity of divergent views.[39] Mixed-methods research is not designed to replace either  
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13 215 qualitative or quantitative research, but rather to extract the strengths and diminish the  
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15 216 weaknesses in both approaches within a single study.[40] Although many designs exist, there  
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17 217 are three primary mixed-methods models: 1) convergent parallel mixed-methods, in which  
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19 218 quantitative and qualitative research are conducted at roughly the same time and then  
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21 219 integrated to provide a comprehensive analysis of the research problem; 2) explanatory  
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23 220 sequential mixed-methods – quantitative research is conducted and analysed and then  
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25 221 qualitative research is introduced to build on the results and explain them in more detail; and  
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27 222 3) exploratory sequential mixed-methods – qualitative research is initially conducted and  
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29 223 analysed to explore the views of participants, and this information is used to build into a  
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31 224 second, quantitative phase.[41] The current study incorporated a convergent parallel mixed-  
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33 225 methods design, although quantitative data were collected prior to qualitative data collection,  
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35 226 analyses and interpretation were conducted in parallel.  
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## 43 ***Data analysis***

### 44 *Quantitative data*

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46 229 Means, proportions and Chi Square statistics were used to examine the distributions of  
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48 230 exposures, outcomes and co-variates between participants included and excluded in this  
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50 231 study, and between child and parent gender. Nearly all parents reported that both parents  
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52 232 “*should take the lead*” in supporting their child’s activity (93.8%), therefore we could not  
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234 explore the association of parental attitudes towards who should lead in supporting child  
235 physical activity, as numbers were too small in the mother or father only categories. We used  
236 linear regression models to examine the associations of parent leading child activity during  
237 the week and weekend with the child's MVPA minutes per day and CPM, and logistic  
238 regression models to examine associations with achievement of the MVPA guideline. Models  
239 were adjusted for child age, gender of parent providing the information on lead support, and  
240 household IMD score. Robust standard errors were used to account for the clustering of  
241 children in schools for all models. Models were examined for all children, and separately for  
242 boys and girls. Combined Wald tests were used to test for evidence of interaction between  
243 child gender and the exposure of interest. All analyses were performed in Stata version 14.0  
244 (StataCorp, 2015).

#### 246 *Qualitative data*

247 Interviews were transcribed verbatim and anonymised before being entered into QSR NVivo  
248 10 (QSR International, Warrington UK) to facilitate analysis. Using the framework method,  
249 thematic content analysis was performed by two researchers, enabling themes to develop both  
250 inductively from the accounts (experiences and views) of participants and deductively from  
251 existing literature.[42,43] Analysis involved several phases: familiarisation, coding,  
252 developing a framework, applying the framework, charting data into the framework matrix,  
253 and interpretation. During familiarisation, transcripts were thoroughly read and re-read  
254 independently by two researchers to immerse themselves in the data. After discussion  
255 between the two researchers, an initial coding frame was developed and applied to the data  
256 based on pre-existing ideas, and was refined throughout the process to allow for the inductive  
257 emergence of additional themes. The two researchers met regularly to ensure accuracy and

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3 258 consistency. Hierarchies of categories were created and summarised, and brief summaries,  
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5 259 mind maps, and representative quotes for each category were abstracted for reporting  
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7 260 purposes. The final quotes were selected as they are illustrative of several responses given by  
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9 261 parents.

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## 13 263 **RESULTS**

### 14 264 *Participant characteristics*

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19 265 The characteristics of the participants included and excluded from the quantitative dataset,  
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21 266 and from the subset of interview participants, are shown in Table 1. Of the 944 included  
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23 267 families, the majority (680 (72%)) had data from a mother/female care giver, with 264 (28%)  
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25 268 from fathers/male care givers. Children excluded due to missing data were more likely to be  
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27 269 deprived and did less minutes of MVPA per day, but were otherwise similar to the included  
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29 270 dataset. Of the interview participants (N=51), 31 were mothers and 20 were fathers, with an  
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31 271 average age of 41.2 (SD: 4.5) years, and 94.1% were White British. The interview  
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33 272 participants were generally comparable to the main dataset, but tended to be less deprived.  
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35 273 Interview participants were also more likely to be fathers and have less active children  
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37 274 compared to the main dataset. The average interview duration was 34.4 minutes (SD: 8.0  
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39 275 minutes, range: 18 to 55 minutes).  
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Characteristic	Included (N=944)		Excluded		p	Interview sample (N=51)	
	Mean (SD) or %	N	Mean (SD) or %			Mean (SD) or %	
Child MVPA (mins/day)	62.8 (22.8)	209	58.6 (21.4)		0.01	58.3 (17.4)	
Accelerometer counts per minute	620.4 (203.2)	209	609.0 (208.8)		0.46	573.2 (142.0)	
Met MVPA guidelines (≥60 mins/day)		209			0.06		
Child gender	No		59.3		0.73	58.8	
	Yes		40.7			41.2	
	Boy		46.4			49.0	
	Girl		53.6			51.0	
Age of child (years)	9.03 (0.46)	279	9.04 (0.49)		0.91	8.95 (0.37)	
Household IMD <sup>b</sup> score	15.1 (13.6)	248	18.8 (15.5)		<0.001	11.5 (9.7)	
Takes lead role in child activity during the week		39			0.92		
	Mother	48.8	48.7		0.35	43.1	
	Father	6.8	5.1			9.8	
	Both parents	44.4	46.2			47.1	
Takes lead role in child activity at the weekend		37			0.35		
	Mother	24.5	32.4		0.64	23.5	
	Father	17.7	21.6			23.5	
	Both parents	57.8	45.9			52.9	
Who should take lead role in child PA		38			0.64		
	Mother	5.2	2.6		0.24	3.9	
	Father	1.0	0.0			3.9	
	Both parents	93.8	97.4			92.2	
Parent gender		41			0.24		
	Male	28.0	19.5		0.24	39.2	
	Female	72.0	80.5			60.8	

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5 276 **Table 1 Descriptive characteristics of the main study sample (N=944) and subset of interview participants (N=51)**

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8 277 MVPA: Moderate-to-vigorous physical activity; IMD: Index of multiple deprivation; a higher value indicates greater deprivation

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For peer review only



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3 278 Supplementary Table 2 shows the gender of the parent who reportedly leads child physical  
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5 279 activity by parent and child gender. Mothers reported that typically they led in supporting  
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7 280 their child's physical activity during the week, whereas fathers generally reported that duties  
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9 281 were shared between parents. Most mothers and fathers reported that both parents shared the  
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11 282 role of supporting their child's activity at the weekend, however, 31% of mothers and 27% of  
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13 283 fathers, respectively, reported that they led child activity.  
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19 285 The interview data generally supported this, with several mothers stating that they took the  
20  
21 286 lead in supporting their child to be active during the week out of necessity because fathers  
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23 287 were working long hours or late into the evening. Some mothers also reported that they try to  
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25 288 get the whole family together to do activities at the weekend, although this isn't always the  
26  
27 289 norm.  
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33 291 *"On a weekday it's just, you know, every night we've got one or the other [children] have got*  
34  
35 292 *a club on so it's just finish school and then me taking the children to their various clubs and*  
36  
37 293 *then coming home and it's, erm, you know, pretty much get ready for bedtime ... Weekends,*  
38  
39 294 *yeah, we try to do stuff as a family."* [Int 14, Mother, Girl, 63 MVPA minutes/day, Mother  
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41 295 leads weekday PA, Both parents lead weekend PA]  
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47 297 *"We like to do things as a family when we can; it's just all being around. My husband works*  
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49 298 *quite late hours and things like that ... He's, he's home when they're going to bed usually ...*  
50  
51 299 *but like last Sunday, we all went swimming together as a family thing... but that isn't – to be*  
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53 300 *honest, that isn't like, isn't like we would do that every weekend or anything"* [Int 35,  
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3 301 Mother, Girl, 72 MVPA minutes/day, Mother leads weekday PA, Both parents lead weekend  
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10 304 Some parents indicated that they share the responsibility of leading child physical activity,  
11  
12 305 due to sharing an appreciation for the benefits of physical activity or because they value  
13  
14 306 physical activity and feel a moral responsibility to fit activity in to the realities of life.

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20 308 *“I’m active, my husband’s active. And so, you know, we cascade that if you like down to the*  
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22 309 *children so we, we don’t really sit around at all, we’re very active and on the go...”* [Int 3,

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24 310 Mother, Son, 59 MVPA minutes/day, Both parents lead weekday and weekend PA]

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28  
29 312 *“Actively we are trying to get the children involved in the various, activities like*  
30  
31 313 *where there’s after-school or a swimming lesson or they are going to join Scouts, which will*  
32  
33 314 *be helpful for them in the long run... So, so we, we are encouraging them to get involved in*  
34  
35 315 *outdoor activities as much as possible.”* [Int 1, Father, Son, 76 MVPA minutes/day, Both

36  
37 316 parents lead weekday and weekend PA]

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42 318 *“So wherever we can we’ll always try and do the right thing and, you know, sometimes if it’s*  
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44 319 *not taking the car and it’s walking distance we’ll try and walk, and things like that..”* [Int 18,

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46 320 Father, Son, 86 MVPA minutes/day, Father leads weekday and weekend PA]

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51 322 A few parents reported sharing the responsibility of leading child physical activity, but also  
52  
53 323 doing activities separately due to child preferences. Examples included fathers and sons using  
54  
55 324 physical activity time to bond over shared interests, while also giving mothers a break for

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3 325 some “me time”, or parents taking children to separate activities to appease child preferences,  
4  
5 326 avoid conflict, and/or facilitate parent-child one-on-one time irrespective of gender.  
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10 328 *“We like going about walking as a family. Well, I say me and my husband do and we drag the*  
11  
12 329 *kids along, but, you know, it’s just getting some fresh air, but the boys have their own*  
13  
14 330 *interests as well, such as the rugby or football which my husband takes the boys to. I have a*  
15  
16 331 *bit of ‘me time’ when they go off to do that so, you know, it’s a mix, I think.” [Int 32, Mother,*  
17  
18 332 *Girl, 86 MVPA minutes/day, Both parents lead weekday and weekend PA]*  
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21  
22 334 *“I would like to do a little bit more with them but because my son doesn’t like what [child]*  
23  
24 335 *likes and I would like to take them swimming together a little bit more so we can all go and*  
25  
26 336 *do swimming but because he doesn’t like it; we kind of end up two of us doing it and two of*  
27  
28 337 *us not doing it” [Int 29, Mother, Girl, 56 MVPA minutes/day, Both parents lead weekday and*  
29  
30 338 *weekend PA]*  
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34 340 *“I’ve said I might take him mountain biking this Sunday because I see that as exercise for*  
35  
36 341 *him but also one to one. So, he’s getting that, the benefit of obviously exercise, the sport that*  
37  
38 342 *he actually really loves and is getting one to one time with a parent where, you know, it’s*  
39  
40 343 *hard isn’t it, when there’s other siblings” [Int 3, Mother, Son, 59 MVPA minutes/day, Both*  
41  
42 344 *parents lead weekday and weekend PA]*  
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46 346 In the quantitative dataset, parents of girls tended to report that mothers take the lead in  
47  
48 347 supporting their daughter’s activity during the week, while parents of boys tended to report  
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50 348 that the role was shared between both parents. Parents of boys and girls generally reported  
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3 349 that they shared the responsibility of leading child activity at the weekend, although parents  
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5 350 of girls were more likely to report that mothers lead in supporting their daughter's weekend  
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7 351 activity.  
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11  
12 353 In contrast, the interview data revealed a mix of gender patterns associated with supporting  
13  
14 354 child physical activity, not just mothers supporting daughters and fathers supporting sons.  
15  
16 355 Some fathers reported they lead in supporting their daughter's physical activity through  
17  
18 356 chauffeuring them to sports clubs, and expressed that they do so not just for logistical  
19  
20 357 reasons, but also because they get real enjoyment from watching. A few mothers reported a  
21  
22 358 lack of confidence in their own physical activity, because they aren't "naturally sporty" and  
23  
24 359 so they tend to let fathers take the lead in supporting child physical activity.  
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29  
30 361 *"Yeah, she's, she's been - she's been playing football for err two and a half seasons now ... so*  
31  
32 362 *that's - and she's passionate about that. So I'm just a sort of chauffeur dad ... that stands on*  
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34 363 *the touchline in the cold windy rain. I, I enjoy that."* [Int 51, Father, Girl, 71 MVPA  
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36 364 minutes/day, Father leads weekday and weekend PA]  
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41 366 *"Not that confident cause, like I say, I'm not actually naturally sporty or active. So it would*  
42  
43 367 *be something that we would probably do as a family with their dad, and we could do it*  
44  
45 368 *together.....He's more confident, yeah, and he's more knowledgeable really with all that*  
46  
47 369 *kind of stuff. And he's a - and he's the kind of person that's very much into, 'Come on, let's*  
48  
49 370 *give it a go. Let's try and see. We might really enjoy it,' whereas I'm a bit more like, 'Oh no,*  
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51 371 *don't make me do this. I'm really nervous.' And so I would probably shy away from it."* [Int  
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3 372 24, Mother, Girl, 43 MVPA minutes/day, Mother leads weekday PA, Father leads weekend  
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5 373 PA]

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10 375 *Associations of who leads child activity with child physical activity variables*

11  
12 376 Table 2 shows the mean difference in child MVPA minutes per day by which parent/s take  
13  
14 377 the lead in supporting child activity during the week and weekend. Compared to reporting  
15  
16 378 that mothers lead child activity (reference group), reporting that parents share the role of  
17  
18 379 supporting child activity during the week was associated with children doing, on average, an  
19  
20 380 additional 3.5 minutes of MVPA per day. When examined separately by child gender, parents  
21  
22 381 sharing the role of leading child activity during the week was associated with, on average, an  
23  
24 382 additional 5.9 minutes of MVPA per day for boys, and 0.4 minutes per day for girls, with no  
25  
26 383 strong statistical evidence of a difference between boys and girls ( $P_{\text{interaction}} = 0.34$ ). Fathers  
27  
28 384 taking the lead in supporting child activity (compared to mothers) was more weakly  
29  
30 385 associated with child MVPA, with an inverse (rather than positive) association for girls, but  
31  
32 386 again with no strong statistical evidence for gender interaction. Associations for parent  
33  
34 387 leadership of child physical activity during the weekend showed very similar patterns to those  
35  
36 388 for weekday activity, but were somewhat weaker in magnitude. In general, the patterns of  
37  
38 389 association with achieving MVPA recommendations were similar to what was found for  
39  
40 390 MVPA as a continuous measure, including point estimates suggesting weaker or inverse  
41  
42 391 effects in girls but no evidence of gender interaction (Table 3). The one exception was that  
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44 392 fathers supporting activity at weekends had a similar magnitude of effect as both parents  
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46 393 being lead supporters.  
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3 395 The mean difference in children's CPM by parent/s who lead child activity during the week  
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5 396 also showed a similar pattern to that seen for time spent in MVPA (Table 2).  
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397 **Table 2 Mean difference in the children’s average MVPA minutes per day and accelerometer counts per minute associated with gender**

Exposure		Moderate-to-vigorous physical activity (minutes/day): mean difference (95% confidence interval)			P for gender interaction	
		All (N=944)	Boys (N=427)	Girls (N=517)		
<b>Takes leads role in child activity during week</b>	Mother (ref)	0	0	0	0.34	398 399 400 401 402 403
	Father	0.3 (-5.7, 6.3)	8.1 (-1.7, 17.9)	-3.7 (-10.4, 2.9)		404 405 406
	Both parents	3.5 (0.6, 6.5)	5.9 (1.2, 10.6)	0.4 (-3.0, 3.8)		407
<b>Takes lead role in child activity at the weekend</b>	Mother (ref)	0	0	0	0.22	408 409 410 411 (N=944)
	Father	1.7 (-2.8, 6.2)	5.7 (-1.5, 12.9)	-3.4 (-8.5, 1.7)		412
	Both parents	2.4 (-1.1, 5.9)	4.5 (-1.4, 10.3)	0.7 (-3.0, 4.4)		413
Exposure		Accelerometer counts per minute: mean difference (95% confidence interval)			P for gender interaction	
		All (N=944)	Boys (N=427)	Girls (N=517)		
<b>Takes leads role in child activity during week</b>	Mother (ref)	0	0	0	0.61	414 415 416
	Father	0.7 (-51.7, 53.2)	56.7 (-28.8, 142.1)	-22.8 (-86.7, 41.1)		417
	Both parents	28.0 (2.0, 54.0)	55.1 (14.3, 95.9)	2.8 (-29.9, 35.4)		418 419 420
<b>Takes lead role in child activity at the weekend</b>	Mother (ref)	0	0	0	0.33	
	Father	13.1 (-26.5, 52.6)	55.6 (-7.2, 118.3)	-26.2 (-75.9, 23.4)		
	Both parents	22.6 (-7.7, 52.9)	52.8 (1.8, 103.7)	4.7 (-31.3, 40.7)		

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13 429 MVPA: Moderate-to-vigorous physical activity; Models are adjusted for child age, parent gender and household IMD score

14 430 **Table 3 Odds ratio for children achieving 60 minutes of MVPA per day associated with gender of parent leading physical activity during**

Exposure	Meeting government guideline: odds ratio (95% confidence interval)			P for gender interaction		the week and weekend (N=944)
	All (N=944)	Boys (N=427)	Girls (N=517)			
<b>Takes leads role in child activity during week</b>	Mother (ref)	0	0	0.95	431	
	Father	0.96 (0.54, 1.72)	1.61 (0.62, 4.21)		432	
	Both parents	1.60 (1.20, 2.14)	2.23 (1.37, 3.62)		433	
<b>Takes lead role in child activity at the weekend</b>	Mother (ref)	0	0	0.30	434	
	Father	1.20 (0.78, 1.86)	2.10 (1.02, 4.32)		435	
	Both parents	1.20 (0.86, 1.68)	1.81 (1.01, 3.24)		436	

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MVPA: Moderate-to-vigorous physical activity; Models are adjusted for child age, parent gender and household IMD score

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3 447 **DISCUSSION**  
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5 448 The data presented in this paper show that while parents believe the responsibility of leading  
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7 449 child physical activity should be shared between both of them, quantitative data suggest that  
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9 450 families mostly share the role on the weekend, with mothers primarily leading child activity  
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11 451 during the week. This finding was mirrored in the interview data, where several mothers  
12  
13 452 reported that they led child activity during the week, because fathers worked long hours or  
14  
15 453 late into the evening. Traditional familial roles are shifting, and it is now more common for  
16  
17 454 both parents to work and for fathers to take on the role of primary care provider,[44 45] so it  
18  
19 455 may be expected that more fathers are taking an active role in their children's physical  
20  
21 456 activity. We found that the majority of parents reported they shared the leadership role for  
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23 457 supporting their child's activity both during the week and at the weekend (40-65% of mothers  
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25 458 and fathers responded this way for both time points; Table S2).  
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33 460 In quantitative analyses for all three outcomes (time spent in MVPA, meeting MVPA  
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35 461 recommendations and CPM) we saw similar patterns of, in general, higher child physical  
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37 462 activity where parents reportedly shared the role of supporting their child's physical activity  
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39 463 during both weekdays and weekends. The one exception was for meeting MVPA  
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41 464 recommendations at the weekend, where associations of fathers reportedly taking the lead  
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43 465 were similar to those when both parents shared the responsibility. There was some evidence  
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45 466 that positive associations were stronger for sons, and that some associations were inverse for  
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47 467 daughters. However, we found no strong statistical evidence that associations differed  
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49 468 between sons and daughters, and without further exploration in much larger numbers we  
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51 469 cannot assume that parental roles in supporting their child's activity differ by the child's  
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53 470 gender.  
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472 There was some suggestion that mothers were more likely to lead in supporting their daughter  
473 to be active, while fathers were more likely to support their son's activity, though caution is  
474 needed here given the disparity in which parents provide data, with 72% of families having  
475 data from mothers only and 28% from fathers only. Several studies have reported that fathers  
476 may be more involved in their son's physical activity,[15 27] or have found stronger links  
477 between father-son and mother-daughter dyads in terms of their physical activity  
478 behaviour.[32-34] In contrast, interview data from the current study revealed a myriad of  
479 gender patterns, including examples from fathers supporting girls' physical activity because  
480 they were more confident than mothers at leading physical activity or because they enjoy  
481 watching their daughter play football, and a mother taking her son mountain biking to engage  
482 in quality one-on-one time. There were also examples of fathers taking sons to traditionally  
483 male-orientated sports (e.g., rugby or football) to bond over shared interests and give mothers  
484 a break from parenting.

485

486 The results from the current study suggest intervention studies should be developed to engage  
487 both parents, or specifically fathers, in taking the lead to support their children to be active,  
488 not necessarily focused on children and parents being active together, but rather on how  
489 parents can work together to schedule times for children to be active across the week in both  
490 structured and unstructured activities, and how parents can share the role between parenting  
491 partners. Table 4 summarises the key findings and implications for how parents can support  
492 child activity that have emerged from this study. These suggestions provide ways that  
493 researchers and policy makers can help parents to support their child's physical activity,  
494 through providing advice and encouragement to developing family physical activity plans.

495 **Table 4 Key findings and implications for how parents can support their child's physical activity**

Finding	Implication
Mothers primarily lead child physical activity during the week	Develop advice for mothers to help them facilitate their child's physical activity during busy weekdays (e.g., identifying times in the day for promoting activity, ideas for active games)
Engaging fathers to be involved in supporting child physical activity is important	Encourage fathers to see the important role they can play in supporting their child's activity
Children, possibly more so boys, are more active if both parents share the role of supporting child physical activity	Develop family physical activity plans (e.g., who can lead when) to encourage both parents to take an active role in supporting their child's physical activity
Parents can use physical activity time to bond over shared interests or engage in quality one-to-one time with children	Encourage parents to value physical activity time as a way to share interests and bond with children (e.g., promote physical activity as quality family time)
Some parents, possibly more so mothers, struggle for confidence when it comes to supporting child physical activity	Develop parental skills and confidence in supporting and facilitating child activity, and encourage parents to model the behaviours that they wish their child to adopt

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3 496 ***Strengths and limitations***  
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5 497 A main strength of the study is the mixed-methods approach, utilising both accelerometer-  
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7 498 assessed physical activity from a large sample of 8-9-year-old children and semi-structured  
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9  
10 499 interview data with parents. This approach provides rich data about the gender roles  
11  
12 500 associated with how parents support their child's activity. Another strength is that we  
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14 501 interviewed a relatively large sample of parents, including 20 fathers, a group that are known  
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16 502 to be difficult to engage in research.[46] Limitations of the study include its cross-sectional  
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18 503 nature so causality could not be examined. In the main dataset, parents were primarily  
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20 504 represented by mothers (72%), which is likely to have influenced how they responded to  
21  
22 505 questions about who leads in supporting their child's activity. We had very limited power to  
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24 506 explore gender interactions, thus whilst our results suggest that parent leadership to support  
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26 507 their child's physical activity might have a strong positive impact on sons compared with  
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28 508 daughters it would be wrong to conclude that from these data, and much larger independent  
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30 509 studies are required to explore that further. Parental responses to our exposure questions  
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32 510 provided no information on the type (quality or quantity) of their leadership role.  
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34 511 Additionally, 279 participants were excluded from the study due to missing data, which may  
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36 512 have resulted in sampling bias, because these participants differed from included participants  
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38 513 in terms of their MVPA and household IMD score. This study is also drawn from the greater  
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40 514 Bristol area (UK), and as such our ability to extend findings to other settings and countries is  
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42 515 limited.  
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49 518 **CONCLUSIONS**  
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53 519 We found some evidence that parents share the role of supporting their children to be active.  
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55 520 It is possible that mothers primarily lead child activity during the week, with the role shared  
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3 521 more equally on the weekend. Children are more active when parents share the responsibility  
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5 522 of supporting their child's activity, but further large independent studies are required to  
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7 523 replicate our findings and determine whether parental leadership has a stronger effect on sons  
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9 524 than daughters. Future studies should also seek to engage more fathers, verify reports of who  
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11 525 takes a leading role (for example through cross comparison of reports from each parent and  
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13 526 the child or direct observation), and to collect information on the nature of leadership roles  
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15 527 (quality and frequency).  
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38  
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## 539 **COMPETING INTERESTS**

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44  
45 540 All authors have completed the ICMJE uniform disclosure form at  
46  
47 541 [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) and declare: all authors had financial support from the  
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53 544 other relationships or activities that could appear to have influenced the submitted work.  
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4 546 **CONTRIBUTORS**

7 547 Conception / design: RJ, ESM, JLT, DAL and SJS.

9 548 Quantitative and Qualitative data collection: ESM.

11 549 Data analysis / acquisition/ interpretation: ESM, RJ, ZT and DAL.

13 550 Drafting / revising critically for important content: All authors.

15 551 Final approval: All authors.

17 552 Accountability for study and manuscript: ESM, RJ.

19 553

21 554 **DATA SHARING STATEMENT**

23 555 The datasets generated during the current study are not publicly available as the project is

25 556 ongoing and data are not ready for archiving. We will make quantitative data available to the

27 557 wider research community once the project is complete in August 2019. Because of possible

29 558 disclosure with qualitative data we will consider requests to use and further explore those

31 559 data on a per request basis with an appropriate balance between sharing data as fully as

33 560 possible whilst maintaining participant anonymity.

35 561

37 562 **REFERENCES**

39 563 1. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity  
41 564 and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act* 2010;**7**:40  
43 565 doi: 10.1186/1479-5868-7-40.

45 566 2. Strong WB, Malina RM, Blimkie CJ, et al. Evidence based physical activity for  
47 567 school-age youth. *J Pediatr* 2005;**146**(6):732-7

- 1  
2  
3 568 3. Department of Health, Physical Activity, Health Improvement and Protection. Start  
4  
5 569 Active, Stay Active: A report on physical activity from the four home countries'  
6  
7 570 Chief Medical Officers. London, 2011.
- 8  
9 571 4. Griffiths LJ, Cortina-Borja M, Sera F et al. How active are our children? Findings  
10  
11 572 from the Millennium Cohort Study. *BMJ Open* 2013;**3**(8):e002893 doi:  
12  
13 573 10.1136/bmjopen-2013-002893.
- 14  
15 574 5. Scholes S. Health Survey for England 2015: Physical activity in children. Health  
16  
17 575 and Social Care Information Centre. London, 2016.
- 18  
19 576 6. Cooper AR, Goodman A, Page AS, et al. Objectively measured physical activity  
20  
21 577 and sedentary time in youth: the International children's accelerometry database  
22  
23 578 (ICAD). *Int J Behav Nutr Phys Act* 2015;**12**:113 doi: 10.1186/s12966-015-0274-5.
- 24  
25 579 7. Nader PR, Bradley RH, Houts RM, McRitchie SL, O'Brien M. Moderate-to-  
26  
27 580 vigorous physical activity from ages 9 to 15 years. *JAMA* 2008;**300**(3):295-305.
- 28  
29 581 8. Farooq MA, Parkinson KN, Adamson AJ, et al. Timing of the decline in physical  
30  
31 582 activity in childhood and adolescence: Gateshead Millennium Cohort Study. *Br J*  
32  
33 583 *Sports Med* 2017:1-6 doi:10.1136/bjsports-2016-096933.
- 34  
35 584 9. Jago R, Solomon-Moore E, Macdonald-Wallis C, Sebire SJ, Thompson JL, Lawlor  
36  
37 585 DA. Change in children's physical activity and sedentary time between Year 1 and  
38  
39 586 Year 4 of primary school in the B-PROACTIV cohort. *Int J Behav Nutr Phys Act*  
40  
41 587 2017;**14**:33 doi: 10.1186/s12966-017-0492-0.
- 42  
43 588 10. Patrick H, Hennessy E, McSpadden K, Oh A. Parenting styles and practices in  
44  
45 589 children's obesogenic behaviors: scientific gaps and future research directions.  
46  
47 590 *Child Obes* 2013;**9**(S1):S73-86 doi: 10.1089/chi.2013.0039.
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2  
3 591 11. Davison KK, Masse LC, Timperio A, et al. Physical activity parenting measurement  
4  
5 592 and research: challenges, explanations, and solutions. *Child Obes*  
6  
7 593 2013;**9**(Suppl):S103-9 doi: 10.1089/chi.2013.0037.  
8  
9 594 12. Sleddens EF, Gerards SM, Thijs C, de Vries NK, Kremers SP. General parenting,  
10  
11 595 childhood overweight and obesity-inducing behaviors: a review. *Int J Pediatr Obes*  
12  
13 596 2011;**6**(2-2):e12-27 doi: 10.3109/17477166.2011.566339.  
14  
15  
16 597 13. O'Connor TM, Jago R, Baranowski T. Engaging parents to increase youth physical  
17  
18 598 activity: a systematic review. *Am J Prev Med* 2009;**37**(2):141-9 doi:  
19  
20 599 10.1016/j.amepre.2009.04.020.  
21  
22 600 14. Jago R, Fox KR, Page AS, Brockman R, Thompson JL. Parent and child physical  
23  
24 601 activity and sedentary time: do active parents foster active children? *BMC Public*  
25  
26 602 *Health* 2010;**10**(1):194 doi: 10.1186/1471-2458-10-194.  
27  
28  
29 603 15. Gustafson SL, Rhodes RE. Parental correlates of physical activity in children and  
30  
31 604 early adolescents. *Sports Med* 2006;**36**(1):79-97.  
32  
33 605 16. Edwardson CL, Gorely T. Parental influences on different types and intensities of  
34  
35 606 physical activity in youth: A systematic review. *Psychol Sport Exerc*  
36  
37 607 2010;**11**(6):522-35 doi: 10.1016/j.psychsport.2010.05.001.  
38  
39 608 17. Jago R, Sebire SJ, Wood L, et al. Associations between objectively assessed child  
40  
41 609 and parental physical activity: a cross-sectional study of families with 5-6 year old  
42  
43 610 children. *BMC Public Health* 2014;**14**:655 doi: 10.1186/1471-2458-14-655.  
44  
45  
46 611 18. Jago R, Solomon-Moore E, Macdonald-Wallis C, Thompson JL, Lawlor DA, Sebire  
47  
48 612 SJ. Association of parents' and children's physical activity and sedentary time in  
49  
50 613 Year 4 (8-9) and change between Year 1 (5-6) and Year 4: a longitudinal study. *Int*  
51  
52 614 *J Behav Nutr Phys Act* 2017;**14**:110 doi: 10.1186/s12966-017-0565-0.  
53  
54  
55  
56  
57  
58  
59

- 1  
2  
3 615 19. Fuemmeler BF, Anderson CB, Mâsse LC. Parent-child relationship of directly  
4  
5 616 measured physical activity. *Int J Behav Nutr Phys Act* 2011;**8**:17 doi:  
6  
7 617 10.1186/1479-5868-8-17.  
8  
9 618 20. Garriguet D, Colley R, Bushnik T. Parent-Child association in physical activity and  
10  
11 619 sedentary behaviour. *Health Reports* 2017;**28**(6):3-11.  
12  
13 620 21. Erkelenz N, Kobel S, Kettner S, et al. Parental activity as influence on children's  
14  
15 621 BMI percentiles and physical activity. *J Sports Sci Med* 2014;**13**:645-50.  
16  
17 622 22. Tate EB, Shah A, Jones M, et al. Toward a better understanding of the link between  
18  
19 623 parent and child physical activity levels: The moderating role of parental  
20  
21 624 encouragement. *J Phys Act Health* 2015;**12**:1238-44 doi: 10.1123/jpah.2014-0126.  
22  
23 625 23. Hennessy E, Hughes SO, Goldberg JP, et al. Parent-child interactions and  
24  
25 626 objectively-measured child physical activity: a cross-sectional study. *Int J Behav*  
26  
27 627 *Nutr Phys Act* 2010;**7**:71 doi: 10.1186/1479-5868-7-71.  
28  
29 628 24. Davison KK, Cutting TM, Birch LL. Parents' activity-related parenting practices  
30  
31 629 predict girls' physical activity. *Med Sci Sports Exerc* 2003;**35**:1589-95 doi:  
32  
33 630 10.1249/01.MSS.0000084524.19408.0C.  
34  
35 631 25. Lloyd AB, Lubans DR, Plotnikoff RC, Collins CE, Morgan PJ. Maternal and  
36  
37 632 paternal parenting practices and their influence on children's adiposity, screen-time,  
38  
39 633 diet and physical activity. *Appetite* 2014;**79**:149-57 doi:  
40  
41 634 10.1016/j.appet.2014.04.010.  
42  
43 635 26. Davison KK, Gicevic S, Aftosmes-Tobio A, et al. Fathers' representation in  
44  
45 636 observational studies on parenting and childhood obesity: a systematic review and  
46  
47 637 content analysis. *Am J Public Health* 2016;**106**(11):e14-e21 doi:  
48  
49 638 10.2105/AJPH.2016.303391.  
50  
51  
52  
53  
54  
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2  
3 639 27. Zahra J, Sebire SJ, Jago R. “He’s probably more Mr. sport than me” – a qualitative  
4  
5 640 exploration of mothers’ perceptions of fathers’ role in their children’s physical  
6  
7 641 activity. *BMC Pediatrics* 2015;15:101 doi: 10.1186/s12887-015-0421-9.  
8  
9 642 28. Vollmer RL, Adamsons K, Gorin A, Foster JS, Mobley AR. Investigating the  
10  
11 643 relationship of body mass index, diet quality, and physical activity level between  
12  
13 644 fathers and their preschool-aged children. *J Acad Nutr Diet* 2015;115:919-26 doi:  
14  
15 645 10.1016/j.jand.2014.12.003.  
16  
17 646 29. Schoeppe S, Liersch S, Röbl M, Krauth C, Walter U. Mothers and fathers both  
18  
19 647 matter: the positive influence of parental physical activity modelling on children’s  
20  
21 648 leisure-time physical activity. *Pediatr Exerc Sci* 2016;28:466-72 doi:  
22  
23 649 10.1123/pes.2015-0236.  
24  
25 650 30. Morgan PJ, Collins CE, Plotnikoff RC, et al. The ‘healthy dads, healthy kids’  
26  
27 651 community randomized controlled trial: a community-based healthy lifestyle  
28  
29 652 program for fathers and their children. *Prev Med* 2014;61:90-99 doi:  
30  
31 653 10.1016/j.ypmed.2013.12.019.  
32  
33 654 31. Morgan PJ, Lubans DR, Callister R, et al. The ‘healthy dads, healthy kids’  
34  
35 655 randomized controlled trial: efficacy of a healthy lifestyle program for overweight  
36  
37 656 fathers and their children. *Int J Obes* 2011;35(3):436-47 doi: 10.1038/ijo.2010.151.  
38  
39 657 32. Eriksson M, Nordqvist T, Rasmussen F. Associations between parents’ and 12-  
40  
41 658 year-old children’s sport and vigorous activity: the role of self-esteem and athletic  
42  
43 659 competence. *J Phys Act Health* 2008;5(3):359-73 doi: 10.1123/jpah.5.3.359.  
44  
45 660 33. O’Loughlin J, Paradis G, Kishchuk N, Barnett T, Renaud L. Prevalence and  
46  
47 661 correlates of physical activity behaviors among elementary schoolchildren in multi-  
48  
49 662 ethnic, low income, inner-city neighborhoods in Montreal, Canada. *Ann Epidemiol*  
50  
51 663 1999;9(7):397-407.  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 664 34. Trost SG, Pate RR, Saunders R, Ward DS, Dowda M, Felton G. A prospective  
4  
5 665 study of the determinants of physical activity in rural fifth-grade children. *Prev Med*  
6  
7 666 1997;**26**(2):257-63.  
8  
9 667 35. Trost SG, Pate RR, Ward DS, Saunders R, Riner W. Determinants of physical  
10  
11 668 activity in active and low-active, sixth grade African-American youth. *J Sch Health*  
12  
13 669 1999;**69**(1):29-34.  
14  
15  
16 670 36. Jago R, Thompson JL, Sebire SJ, et al. Cross-sectional associations between the  
17  
18 671 screen-time of parents and young children: differences by parent and child gender  
19  
20 672 and day of the week. *Int J Behav Nutr Phys Act* 2014;**11**:54 doi: 10.1186/1479-  
21  
22 673 5868-11-54.  
23  
24  
25 674 37. Evenson KR, Catellier DJ, Gill K, et al. Calibration of two objective measures of  
26  
27 675 physical activity for children. *J Sports Sci* 2008;**26**:1557-65 doi:  
28  
29 676 10.1080/02640410802334196.  
30  
31 677 38. Creswell J, Plano Clark V. *Designing and Conducting Mixed Methods Research*.  
32  
33 678 Thousand Oaks, CA: Sage, 2006.  
34  
35  
36 679 39. Tashakkori A, Teddlie C. *Handbook of Mixed Methods in Social & Behavioral*  
37  
38 680 *Research*. Thousand Oaks, CA: Sage, 2010.  
39  
40 681 40. Andrew S, Halcomb EJ. Mixed methods research is an effective method of enquiry  
41  
42 682 for community health research. *Contemp Nurse* 2006;**23**(2):145-153.  
43  
44 683 41. Creswell, J. *Research design: Qualitative, quantitative, and mixed methods*  
45  
46 684 *approaches*. Thousand Oaks, CA: Sage, 1997.  
47  
48 685 42. Elo S, Kyngäs H. The qualitative content analysis process. *J Adv Nurs* 2008;**62**(1):  
49  
50 686 107-15 doi: 10.1111/j.1365-2648.2007.04569.x.  
51  
52  
53  
54  
55  
56  
57  
58  
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- 1  
2  
3 687 43. Gale NK, Heath G, Cameron E, Rashid S, Redwood S. Using the framework  
4  
5 688 method for the analysis of qualitative data in multi-disciplinary health research.  
6  
7 689 BMC Med Res Methodol 2013;**13**:117 doi: 10.1186/1471-2288-13-117.  
8  
9 690 44. Anderson PM, Butcher KF. Childhood obesity trends and potential causes. Future  
10  
11 691 Child 2006;**16**:19-45 doi: 10.1353/foc.2006.0001.  
12  
13 692 45. Laughlin L. Who's minding the kids? Child care arrangements: spring 2011.  
14  
15 693 <https://www.census.gov/prod/2013pubs/p70-135.pdf>. Published April 2013.  
16  
17 694 46. Macfadyen A, Swallow V, Santacroce S, Lambert H. Involving fathers in research.  
18  
19 695 J Spec Pediatr Nurs 2011;**16**(3):216-9 doi: 10.1111/j.1744-6155.2011.00287.x  
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26 697 **Figure 1 Study flow of participants for the quantitative study**  
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31 699 **Figure 2 Study flow of participants for the qualitative study**  
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**Figure 1 Study flow of participants for the quantitative study**

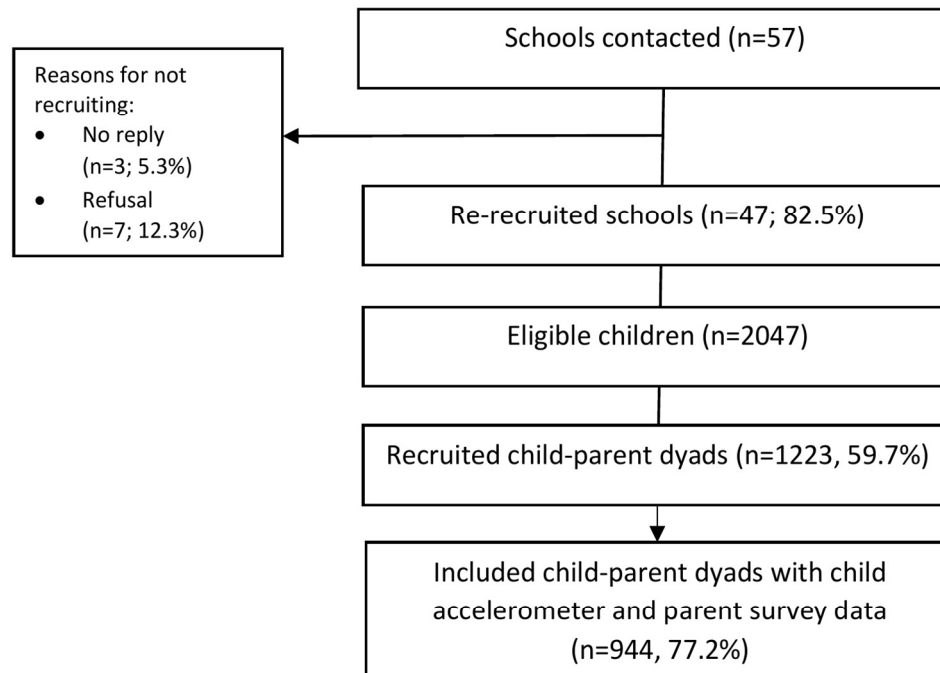


Figure 1 Study flow of participants for the quantitative study

132x104mm (300 x 300 DPI)

Figure 2 Study flow of participants for the qualitative study

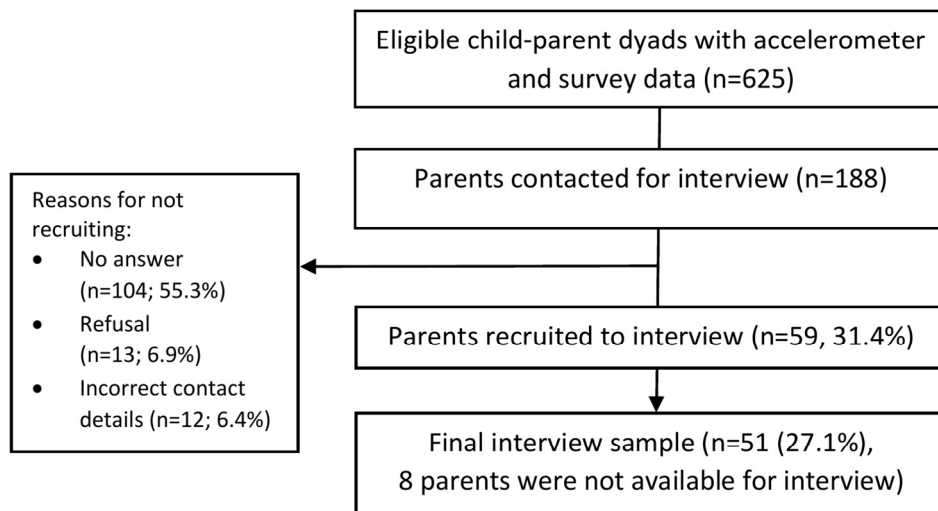


Figure 2 Study flow of participants for the qualitative study

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**Table S1 Number of mothers and fathers who were eligible for and recruited to the interview study**

No.	Sub-group description	N parents eligible in each sub-group			N parents recruited in each sub-group		
		Total	Mothers	Fathers	Total	Mothers	Fathers
1	Low MVPA, low SED boys	31	20	11	6	4	2
2	High MVPA, low SED boys	116	82	34	6	3	3
3	Low MVPA, high SED boys	67	51	16	7	5	2
4	High MVPA, high SED boys	63	48	15	6	3	3
5	Low MVPA, low SED girls	69	48	21	6	3	3
6	High MVPA, low SED girls	86	67	19	6	4	2
7	Low MVPA, high SED girls	138	111	27	7	4	3
8	High MVPA, high SED girls	55	37	18	7	5	2
	<b>Total</b>	<b>625</b>	<b>464</b>	<b>161</b>	<b>51</b>	<b>31</b>	<b>20</b>



Table S2 Frequency of reporting which parent leads child activity by parent and separately by child gender

		Parent gender		Chi-squared p-value for difference	Child gender		Chi-squared p-value for difference
		Males (N=264) %	Females (N=680) %		Boys (N=427) %	Girls (N=517) %	
<b>Takes lead role in child activity during the week</b>	Mother	26.9	57.4	<0.001	44.5	52.4	0.04
	Father	16.7	2.9		6.6	7.0	
	Both parents	56.4	39.7		48.9	40.6	
<b>Takes lead role in child activity at the weekend</b>	Mother	8.3	30.7	<0.001	21.1	27.3	0.02
	Father	26.9	14.1		20.8	15.1	
	Both parents	64.8	55.1		58.1	57.6	
<b>Who should take lead role in child activity</b>	Mother	1.1	6.9	0.001	4.2	6.0	0.07
	Father	1.5	0.7		1.6	0.4	
	Both parents	97.3	92.4		94.1	93.6	

## Who leads and who supports? A cross-sectional mixed methods study of mothers' and fathers' support for child physical activity

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

	Item No	Recommendation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract <b>Title Page</b>
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found – <b>Pages 2-3</b>
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported – <b>Pages 5-6</b>
Objectives	3	State specific objectives, including any prespecified hypotheses – <b>Page 6.</b>
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper <b>Pages 6-7.</b>
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection <b>Pages 6-7.</b>
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 <b>Page 7</b>
		(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 - <b>Pages 7-9</b>
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 <b>Pages 7-9</b>
Bias	9	Describe any efforts to address potential sources of bias – <b>Page 8</b>
Study size	10	Explain how the study size was arrived at - <b>Pages 7-8 (Figures 1 &amp; 2)</b>
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why - <b>Pages 10-11</b>
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding – <b>Pages 10-11</b>
		(b) Describe any methods used to examine subgroups and interactions – <b>Page 11</b>
		(c) Explain how missing data were addressed - <b>Pages 10-11</b>
		(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

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	addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy - <a href="#">Pages 10-11</a>
	(e) Describe any sensitivity analyses – <a href="#">Page 11</a>

Continued on next page

For peer review only

**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 <a href="#">Table 1 (Figure 1 &amp; 2)</a> (b) Give reasons for non-participation at each stage - <a href="#">Figure 1 &amp; 2</a> (c) Consider use of a flow diagram – <a href="#">Figure 1 &amp; 2</a>
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders – <a href="#">Table 1</a> (b) Indicate number of participants with missing data for each variable of interest - <a href="#">Table 1</a> (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 <a href="#">Table 1</a>
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 – <a href="#">Tables 2-3</a> (b) Report category boundaries when continuous variables were categorized - <a href="#">Tables 2-3</a> (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period Discussion – <a href="#">N/A</a>
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses – <a href="#">Supplementary tables</a>

**Discussion**

Key results	18	Summarise key results with reference to study objectives – <a href="#">Page 22</a>
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 - <a href="#">Page 25</a>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence – <a href="#">Page 25-26</a>
Generalisability	21	Discuss the generalisability (external validity) of the study results <a href="#">Page 25</a>

**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 – <a href="#">Page 26</a>
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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](http://www.strobe-statement.org).

## COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
<b>Domain 1: Research team and reflexivity</b>			
<i>Personal characteristics</i>			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	Page 27
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	Page 9
Occupation	3	What was their occupation at the time of the study?	Page 9
Gender	4	Was the researcher male or female?	Page 9
Experience and training	5	What experience or training did the researcher have?	Page 9
<i>Relationship with participants</i>			
Relationship established	6	Was a relationship established prior to study commencement?	Pages 8-9
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	N/A
Interviewer characteristics	8	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	N/A
<b>Domain 2: Study design</b>			
<i>Theoretical framework</i>			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Page 11
<i>Participant selection</i>			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Pages 8-9
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	Page 9
Sample size	12	How many participants were in the study?	Page 9
Non-participation	13	How many people refused to participate or dropped out? Reasons?	Page 9 (Fig 2)
<i>Setting</i>			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	Page 8
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	N/A
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	Pages 8-9, 12 (Fig 1)
<i>Data collection</i>			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 9
Repeat interviews	18	Were repeat interviews carried out? If yes, how many?	N/A
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	Page 9
Field notes	20	Were field notes made during and/or after the interview or focus group?	N/A
Duration	21	What was the duration of the interviews or focus group?	Page 12
Data saturation	22	Was data saturation discussed?	Page 9
Transcripts returned	23	Were transcripts returned to participants for comment and/or	N/A

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
<b>Domain 3: analysis and findings</b>			
<i>Data analysis</i>			
Number of data coders	24	How many data coders coded the data?	Page 11
Description of the coding tree	25	Did authors provide a description of the coding tree?	N/A
Derivation of themes	26	Were themes identified in advance or derived from the data?	Page 11
Software	27	What software, if applicable, was used to manage the data?	Page 11
Participant checking	28	Did participants provide feedback on the findings?	N/A
<i>Reporting</i>			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Pages 14-17
Data and findings consistent	30	Was there consistency between the data presented and the findings?	Pages 14-17
Clarity of major themes	31	Were major themes clearly presented in the findings?	Pages 14-17
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	Pages 14-17

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

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# BMJ Open

## The roles of mothers and fathers in supporting child physical activity: a cross-sectional mixed-methods study

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3 1 The roles of mothers and fathers in supporting child physical activity: a cross-sectional  
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5 2 mixed-methods study  
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59 27 **Word count: Manuscript** (excluding tables) = 4734 words **Abstract** = 300 words  
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3 28 **ABSTRACT**  
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5 29 **Objectives:** Examine the extent parent gender is associated with supporting children's  
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8 30 physical activity.  
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10 31 **Design:** Cross-sectional mixed-methods study.  
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13 32 **Setting:** 47 primary schools located in Bristol (UK).  
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16 33 **Participants:** 944 8-9-year-old children and one of their parents provided quantitative data;  
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18 34 51 parents (20 fathers) were interviewed.  
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21 35 **Methods:** Children wore an accelerometer and mean minutes of moderate-to-vigorous-  
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23 36 intensity physical activity (MVPA) per day, counts per minute (CPM), and achievement of  
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25 37 national MVPA guidelines were derived. Parents reported who leads in supporting child  
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27 38 activity during the week and weekend. Linear and logistic regression examined the  
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29 39 association between gender of parent who supports child activity and child physical activity.  
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31 40 For the semi-structured telephone interviews, inductive and deductive content analysis were  
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33 41 used to explore the role of gender in how parents support child activity.  
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37 42 **Results:** Parents appeared to have a stronger role in supporting boys to be more active, than  
38  
39 43 girls, and the strongest associations were when they reported that both parents had equal roles  
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41 44 in supporting their child. For example, compared with the reference of female/mother  
42  
43 45 support, equal contribution from both parents during the week was associated with boys  
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45 46 doing 5.9 (95% CI: 1.2 to 10.6) more minutes of MVPA per day, and more CPM when both  
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47 47 parents support on weekday and weekends (55.1 [14.3 to 95.9] and 52.8 [1.8 to 103.7],  
48  
49 48 respectively). Associations in girls were weaker and sometimes in the opposite direction but  
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51 49 there was no strong statistical evidence for gender interactions. Themes emerged from the  
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53 50 qualitative data, specifically; parents proactively supporting physical activity equally,  
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55 51 mothers supporting during the week, families getting together at weekends, families doing  
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3 52 activities separately due to preferences, and parents using activities to bond one-to-one with  
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5 53 children.

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8 54 **Conclusions:** Mothers primarily support child activity during the week. Children, possibly  
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10 55 more so boys, are more active if both parents share the supporting role.

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15 57 **Key words:** Physical activity, children, parents, gender, mixed-methods  
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3 72 **ARTICLE SUMMARY**  
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5 73 **Strengths and limitations of this study**  
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8 74 **Strengths**  
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11 75 • Mixed-methods study.  
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13 76 • Accelerometer data from a large sample of 8-9-year-old children.  
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15 77 • Semi-structured telephone interviews with 51 parents, including 20 fathers.  
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21 79 **Limitations**  
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24 80 • Cross-sectional study design from a single UK region.  
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26 81 • The measurement of parental support of child physical activity would be strengthened  
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28 82 by collecting data from both parents and information on the quality and quantity of  
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30 83 support.  
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## 93 INTRODUCTION

94 Children who are physically active are at a lower risk of obesity, high blood pressure,  
95 metabolic syndrome, and depression.[1 2] The UK Government recommends that children  
96 and young people aged 5 to 18 years should engage in at least 60 minutes of moderate-to-  
97 vigorous-intensity physical activity (MVPA) every day.[3] However, data from the nationally  
98 representative Millennium cohort showed that only 51% of 7-8 year olds met the  
99 recommendation.[4] Physical activity declines throughout childhood and adolescence, with  
100 boys being more active than girls at all ages.[4-9] Thus, in order to develop effective means  
101 of increasing child physical activity, there is a need to understand the factors that influence  
102 behaviour.

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104 Parents act as gatekeepers to children's activity,[10] and can play an important role in  
105 increasing their child's physical activity.[11-13] For instance, parents can influence their  
106 child's activity by being active with their child, role-modelling active behaviour, and/or by  
107 facilitating physical activity for their child (logistic support).[13-16] Studies examining  
108 associations between parent and child physical activity behaviour have yielded mixed  
109 results.[14 17-20] A growing body of research has shown that providing logistic support is  
110 associated with increased physical activity,[21-23] and therefore, may be the most important  
111 source of parental influence on children's activity.

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113 The gender of the parent who takes the lead in supporting child activity could be an important  
114 influence on children's activity levels. Traditional gender roles comprised of the public  
115 sphere (employment, education, politics) being dominated by men and the private sphere  
116 (home, family) being exclusively the realm of women.[24] However, these traditional roles

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3 117 have been shifting, as explained by the gender revolution framework,[25] whereby men's  
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5 118 attitudes have become much more accepting of gender equality in the family,[26] particularly  
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7 119 in caring for children.[27] It is not clear what the current role gender plays in parental  
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9 120 physical activity support. Several studies suggest that mothers play a larger role in the  
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11 121 logistical planning of children's physical activity, while fathers are more likely to model  
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13 122 physical activity.[28 29] However, most studies in this area have focused on the mother-child  
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15 123 relationship, and relatively little attention has been paid to the role of fathers.[30] From  
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17 124 qualitative interviews with parents of 5-6-year-old children in the B-Proact1v study, we  
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19 125 found evidence that fathers play a key role in promoting children's physical activity,  
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21 126 influencing their choices and behaviours,[31] a finding replicated in other studies.[32 33] The  
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23 127 Healthy Dads, Healthy Kids intervention demonstrated that engaging fathers in physical  
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25 128 activity with their children can promote increased physical activity among children.[34 35]  
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27 129 Data from the B-Proact1v interviews suggest that fathers may take more responsibility for  
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29 130 their son's physical activity (e.g., taking their son to sports clubs), and mothers with their  
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31 131 daughter's activity.[31] To date, there is inconsistent evidence regarding whether gender-  
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33 132 specific parental influence (i.e., mothers with daughters and fathers with sons) is stronger  
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35 133 than cross-gender parental influence (i.e., mothers with sons and fathers with daughters) on  
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37 134 children's physical activity.[28 36-39] Therefore, a greater understanding is needed about the  
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39 135 role gender plays in how parents support their child to be active, and if this varies by child  
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41 136 gender.  
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49 138 The aim of this mixed-methods study was to examine parent gender, in terms of which parent  
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51 139 supports their child to be active, and its association with child physical activity. A secondary  
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53 140 aim was to discover if these associations varied by child gender.  
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6 142 **METHODS**

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8 143 Data are from the longitudinal B-Proact1v study, which aimed to examine factors associated  
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10 144 with children's and parents' physical activity, sedentary time and screen-viewing behaviours.  
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12 145 The study has been described in detail elsewhere.[9 17 40] Briefly, in 2012 and 2013, data  
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14 146 were collected from 1299 Year 1 children (5-6 years old) from 57 primary schools across  
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16 147 Bristol, UK. Between March 2015 and July 2016, 47 of the original schools were re-recruited  
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18 148 and data were collected from 1223 Year 4 children (8-9 years old). One of the children's  
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20 149 parents were also recruited to the study. The current study used a mixed-methods design,  
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22 150 incorporating cross-sectional data from the Year 4 assessments, for the 944 children and  
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24 151 parents who provided valid child accelerometer data and complete parent questionnaire data  
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26 152 for questions on child and parent demographics and gender roles associated with supporting  
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28 153 child activity (Figure 1), with qualitative data via semi-structured telephone interviews from a  
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30 154 sub-sample of 51 parents (details below; Figure 2). The current study incorporated a  
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32 155 convergent parallel mixed-methods design. Quantitative data were collected prior to  
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34 156 qualitative data collection, but the analyses and interpretation were conducted in parallel.[41]  
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36 157 The study received ethical approval from the School for Policy Studies Ethics Committee at  
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38 158 the University of Bristol, and written parent consent was received for all participants.[42]  
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46 160 *Accelerometer data*

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49 161 Children wore a waist-worn ActiGraph wGT3X-BT accelerometer for five days including  
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51 162 two weekend days. Waist-worn accelerometers have been demonstrated to be valid for  
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53 163 measuring physical activity in children.[43 44] Accelerometer data were processed using  
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55 164 Kinesoft (v3.3.75; Kinesoft, Saskatchewan, Canada), and were included in the primary  
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3 165 analyses if children provided at least three days of valid data (including at least one weekend  
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5 166 day). A valid day was defined as at least 500 minutes of data after excluding intervals of  $\geq 60$   
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7 167 minutes of zero counts, allowing up to two minutes of interruptions. Minutes spent in MVPA  
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9 168 were derived using population-specific cut points for children.[45] In a comparative study  
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11 169 with other widely-used accelerometer cut points, the Evenson thresholds,[45] (in which stair  
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13 170 climbing and brisk walking corresponded to moderate-intensity physical activity) were shown  
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15 171 to provide the most accurate assessments of children's energy expenditure.[46] Mean  
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17 172 accelerometer counts per minute (CPM), and a binary variable indicating whether the child's  
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19 173 average daily MVPA was greater than the 60 minutes per day recommended by the UK  
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21 174 government,[3] were also derived.  
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### 28 176 ***Parent support variables***

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31 177 To understand the gender roles associated with parents supporting their child's activity,  
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33 178 parents were asked three questions via a questionnaire: a) "In your family who takes the lead  
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35 179 role in supporting your Year 4 child to be active during the week?", b) "In your family who  
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37 180 takes the lead role in supporting your Year 4 child to be active at the weekend?" and c) "Who  
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39 181 do you think should take the lead role in supporting your Year 4 child to be active?". Each  
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41 182 question had three response options: "Mother/Female care-giver", "Father/Male care-giver"  
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43 183 or "About the same" for questions a) and b), and "Should be shared" for question c).  
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### 49 185 ***Demographic information***

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52 186 Parents provided demographic information via a questionnaire, including parent and child  
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54 187 gender, date of birth, and ethnic origin. Where children's date of birth was missing (21% of  
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56 188 children) they were assigned the median age of 9.0 years (as the children were all in the same  
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3 189 school year with a maximum age difference between the youngest and oldest of just under  
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5 190 12-months legally possible). As an indicator of socio-economic status, Indices of Multiple  
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7 191 Deprivation (IMD) scores, based upon the English Indices of Deprivation,[47] were assigned  
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9 192 to each child based on their reported home postcode, where higher scores indicate greater  
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11 193 levels of deprivation. IMD scores provide a set of relative measures of deprivation for lower-  
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13 194 layer super output areas across England, based on seven different domains of deprivation:  
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15 195 income deprivation; employment deprivation; education, skills and training deprivation;  
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17 196 health deprivation and disability; crime; barriers to housing and services; and living  
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19 197 environment deprivation. Child height, weight and blood pressure were also measured.  
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#### 25 199 ***Interview data***

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28 200 During consent procedures, parents were informed that they may be re-contacted to take part  
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30 201 in a telephone interview. Only families with complete data for all measures (accelerometer  
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32 202 and questionnaire data, child height, weight and blood pressure) were included in the  
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34 203 interview sample (N=625, of which 161 (25.8%) had data from fathers). This sample was  
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36 204 stratified according to the child's MVPA minutes per day (dichotomised around the study  
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38 205 median: 57.5 minutes), sedentary minutes per day (dichotomised around the median: 434.6  
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40 206 minutes), and by child gender. This produced eight sub-groups (1 = low MVPA, low  
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42 207 sedentary time boys; and 8 = high MVPA, high sedentary time girls; Table S1). The order in  
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44 208 which parents were invited to participate in an interview was randomised within each sub-  
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46 209 group. Contact attempts were made with 188 parents in total, of which 59 (31.4%) initially  
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48 210 agreed to participate in an interview, and 51 (27.1%) completed an interview (Figure 2).  
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50 211 Interviews were audio-recorded and continued until theoretical saturation was reached for the  
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52 212 entire sample and the sub-groups. Parents were invited to participate by telephone between  
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3 213 July and October 2016, and interviews were conducted at the interviewee's convenience (37  
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5 214 during weekday daytimes (72.5%), 13 during weekday evenings (25.5%), and 1 on a  
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7 215 weekend evening (2%). Participants were sent a £10 high street shopping voucher as a thank  
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9 216 you for their time.  
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15 218 An interview guide was developed and refined by the research team based on identifying  
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17 219 gaps in current knowledge and guided by the Year 1 B-Proact1v quantitative and qualitative  
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19 220 findings. This included questions relating to a variety of topics, including parents'  
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21 221 perceptions of their child's physical activity and screen-viewing behaviours,[48] strategies  
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23 222 for managing these behaviours,[49 50] understanding what has changed regarding these  
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25 223 behaviours,[17 40] and understanding how family dynamics influence children's physical  
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27 224 activity.[51] The need to engage more fathers in research was also identified as a priority.[31  
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29 225 51] Questions were posed in a non-leading manner to allow participants to shape the direction  
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31 226 of the interview, and issues that emerged were probed. Interviews were conducted by two  
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33 227 female researchers (qualified to at least MSc level) who were trained in conducting  
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35 228 qualitative interviews.  
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## 42 230 ***Data analysis***

### 43 44 45 231 *Quantitative data*

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47 232 Means, proportions and Chi Square statistics were used to examine the distributions of  
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49 233 exposures, outcomes and co-variates between participants included and excluded in this  
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51 234 study, and between child and parent gender. Nearly all parents reported that both parents  
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53 235 "should take the lead" in supporting their child's activity (93.8%), therefore we could not  
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55 236 explore the association of parental attitudes towards who should support child physical  
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3 237 activity, as numbers were too small in the mother or father only categories. We used linear  
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5 238 regression models to examine the associations of parent support of child activity during the  
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7 239 week and weekend with the child's MVPA minutes per day and CPM, and logistic regression  
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9 240 models to examine associations with achievement of the MVPA guideline. Models were  
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11 241 adjusted for child age, gender of parent providing the information on support, and household  
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13 242 IMD score. Robust standard errors were used to account for the clustering of children in  
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15 243 schools for all models. Models were examined for all children, and separately for boys and  
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17 244 girls. Combined Wald tests were used to test for evidence of interaction between child gender  
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19 245 and the exposure of interest. All analyses were performed in Stata version 14.0 (StataCorp,  
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21 246 2015).

#### 247 248 *Qualitative data*

249 Interviews were transcribed verbatim and anonymised before being entered into QSR NVivo  
250 10 (QSR International, Warrington UK) to facilitate analysis. Using the framework method,  
251 thematic content analysis was performed by two researchers, enabling themes to develop both  
252 inductively from the accounts (experiences and views) of participants and deductively from  
253 existing literature.[52 53] Analysis involved several phases: familiarisation, coding,  
254 developing a framework, applying the framework, charting data into the framework matrix,  
255 and interpretation. During familiarisation, transcripts were thoroughly read and re-read  
256 independently by two researchers to immerse themselves in the data. After discussion  
257 between the two researchers, an initial coding frame was developed and applied to the data  
258 based on pre-existing ideas, and was refined throughout the process to allow for the inductive  
259 emergence of additional themes. The two researchers met regularly to ensure accuracy and  
260 consistency. Any disagreements that occurred during coding were discussed with additional

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3 261 members of the research team to ensure consensus, and no disagreements remained unsolved.  
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5 262 Hierarchies of categories were created and summarised, and brief summaries, mind maps,  
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7 263 and representative quotes for each category were abstracted for reporting purposes. The final  
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9 264 quotes were selected as they are illustrative of several responses given by parents.

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## 13 266 **RESULTS**

### 14 267 *Participant characteristics*

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19 268 The characteristics of the participants included and excluded from the quantitative dataset,  
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21 269 and from the subset of interview participants, are shown in Table 1. Of the 944 included  
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23 270 families, the majority (680 (72%)) had data from a mother/female care giver, with 264 (28%)  
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25 271 from fathers/male care givers. Children excluded due to missing data were more likely to be  
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27 272 deprived and did less minutes of MVPA per day, but were otherwise similar to the included  
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29 273 dataset. Of the interview participants (N=51), 31 were mothers and 20 were fathers, with an  
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31 274 average age of 41.2 (SD: 4.5) years, and 94.1% were White British. The interview  
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33 275 participants were generally comparable to the main dataset, but tended to be less deprived.  
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35 276 Interview participants were also more likely to be fathers and have less active children  
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37 277 compared to the main dataset. The average interview duration was 34.4 minutes (SD: 8.0  
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39 278 minutes, range: 18 to 55 minutes).  
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Characteristic	Included (N=944)	N	Excluded	p	Interview sample (N=51)
	Mean (SD) or %		Mean (SD) or %		Mean (SD) or %
Child MVPA (mins/day)	62.8 (22.8)	209	58.6 (21.4)	0.01	58.3 (17.4)
Accelerometer counts per minute	620.4 (203.2)	209	609.0 (208.8)	0.46	573.2 (142.0)
Met MVPA guidelines (≥60 mins/day)		209		0.06	
No	52.0		59.3		58.8
Yes	48.0		40.7		41.2
Child gender		279		0.73	
Boy	45.2		46.4		49.0
Girl	54.8		53.6		51.0
Age of child (years)	9.03 (0.46)	279	9.04 (0.49)	0.91	8.95 (0.37)
Household IMD <sup>b</sup> score	15.1 (13.6)	248	18.8 (15.5)	<0.001	11.5 (9.7)
Supports child activity during the week		39		0.92	
Mother	48.8		48.7		43.1
Father	6.8		5.1		9.8
Both parents	44.4		46.2		47.1
Supports child activity at the weekend		37		0.35	
Mother	24.5		32.4		23.5
Father	17.7		21.6		23.5
Both parents	57.8		45.9		52.9
Who should support child PA		38		0.64	
Mother	5.2		2.6		3.9
Father	1.0		0.0		3.9
Both parents	93.8		97.4		92.2
Parent gender		41		0.24	
Male	28.0		19.5		39.2
Female	72.0		80.5		60.8
Parent ethnic origin		53		0.52	
White British	89.2		91.3		94.1

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5 279 **Table 1 Descriptive characteristics of the main study sample (N=944) and subset of interview participants (N=51)**

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8 280 MVPA: Moderate-to-vigorous physical activity; IMD: Index of multiple deprivation; a higher value indicates greater deprivation

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For peer review only

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3 281 Supplementary Table 2 shows the gender of the parent who reportedly supports child  
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5 282 physical activity by parent and child gender. Mothers reported that typically they led in  
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7 283 supporting their child's physical activity during the week, whereas fathers generally reported  
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9 284 that duties were shared between parents. Most mothers and fathers reported that both parents  
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11 285 shared the role of supporting their child's activity at the weekend, however, 31% of mothers  
12  
13 286 and 27% of fathers, respectively, reported that they led child activity.  
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19 288 The interview data generally supported this, with several mothers stating that they support  
20  
21 289 their child to be active during the week out of necessity because fathers were working long  
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23 290 hours or late into the evening. Some mothers also reported that they try to get the whole  
24  
25 291 family together to do activities at the weekend, although this isn't always the norm.  
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31 293 *"On a weekday it's just, you know, every night we've got one or the other [children] have got*  
32  
33 294 *a club on so it's just finish school and then me taking the children to their various clubs and*  
34  
35 295 *then coming home and it's, erm, you know, pretty much get ready for bedtime ... Weekends,*  
36  
37 296 *yeah, we try to do stuff as a family."* [Int 14, Mother, Girl, 63 MVPA minutes/day, Mother  
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39 297 supports weekday PA, Both parents support weekend PA]  
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45 299 *"We like to do things as a family when we can; it's just all being around. My husband works*  
46  
47 300 *quite late hours and things like that ... He's, he's home when they're going to bed usually ...*  
48  
49 301 *but like last Sunday, we all went swimming together as a family thing... but that isn't – to be*  
50  
51 302 *honest, that isn't like, isn't like we would do that every weekend or anything"* [Int 35,  
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53 303 Mother, Girl, 72 MVPA minutes/day, Mother supports weekday PA, Both parents support  
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55 304 weekend PA]  
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6 306 Some parents indicated that they share the responsibility of supporting child physical activity,  
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8 307 due to sharing an appreciation for the benefits of physical activity or because they value  
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10 308 physical activity and feel a moral responsibility to fit activity in to the realities of life.  
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15 310 *“I’m active, my husband’s active. And so, you know, we cascade that if you like down to the*  
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17 311 *children so we, we don’t really sit around at all, we’re very active and on the go...”* [Int 3,  
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19 312 Mother, Son, 59 MVPA minutes/day, Both parents support weekday and weekend PA]  
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25 314 *“Actively we are trying to get the children involved in the various, activities like*  
26  
27 315 *where there’s after-school or a swimming lesson or they are going to join Scouts, which will*  
28  
29 316 *be helpful for them in the long run... So, so we, we are encouraging them to get involved in*  
30  
31 317 *outdoor activities as much as possible.”* [Int 1, Father, Son, 76 MVPA minutes/day, Both  
32  
33 318 parents support weekday and weekend PA]  
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38 320 *“So wherever we can we’ll always try and do the right thing [physical activity] and, you*  
39  
40 321 *know, sometimes if it’s not taking the car and it’s walking distance we’ll try and walk, and*  
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42 322 *things like that..”* [Int 18, Father, Son, 86 MVPA minutes/day, Father supports weekday and  
43  
44 323 weekend PA]  
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49 325 A few parents reported sharing the responsibility of supporting child physical activity, but  
50  
51 326 also doing activities separately due to child preferences. Examples included fathers and sons  
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53 327 using physical activity time to bond over shared interests, while also giving mothers a respite  
54  
55 328 for some “me time”, or parents taking children to separate activities to appease child  
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3 329 preferences, avoid conflict, and/or facilitate parent-child one-on-one time irrespective of  
4  
5 330 gender.

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10 332 *“We like going about walking as a family. Well, I say me and my husband do and we drag the*  
11  
12 333 *kids along, but, you know, it’s just getting some fresh air, but the boys have their own*  
13  
14 334 *interests as well, such as the rugby or football which my husband takes the boys to. I have a*  
15  
16 335 *bit of ‘me time’ when they go off to do that so, you know, it’s a mix, I think.” [Int 32, Mother,*  
17  
18 336 *Girl, 86 MVPA minutes/day, Both parents support weekday and weekend PA]*

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24 338 *“I would like to do a little bit more with them but because my son doesn’t like what [child]*  
25  
26 339 *likes and I would like to take them swimming together a little bit more so we can all go and*  
27  
28 340 *do swimming but because he doesn’t like it; we kind of end up two of us doing it and two of*  
29  
30 341 *us not doing it” [Int 29, Mother, Girl, 56 MVPA minutes/day, Both parents support weekday*  
31  
32 342 *and weekend PA]*

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37 344 *“I’ve said I might take him mountain biking this Sunday because I see that as exercise for*  
38  
39 345 *him but also one to one. So, he’s getting that, the benefit of obviously exercise, the sport that*  
40  
41 346 *he actually really loves and is getting one to one time with a parent where, you know, it’s*  
42  
43 347 *hard isn’t it, when there’s other siblings” [Int 3, Mother, Son, 59 MVPA minutes/day, Both*  
44  
45 348 *parents support weekday and weekend PA]*

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50 350 In the quantitative dataset, parents of girls tended to report that mothers take the lead in  
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52 351 supporting their daughter’s activity during the week, while parents of boys tended to report  
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54 352 that the role was shared between both parents. Parents of boys and girls generally reported



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3 353 that they shared the responsibility of supporting child activity at the weekend, although  
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5 354 parents of girls were more likely to report that mothers supported their daughter's weekend  
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7 355 activity.  
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12 357 In contrast, the interview data revealed a mix of gender patterns associated with supporting  
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14 358 child physical activity, not just mothers supporting daughters and fathers supporting sons.  
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16 359 Some fathers reported that they supported their daughter's physical activity through  
17  
18 360 chauffeuring them to sports clubs, and expressed that they do so not just for logistical  
19  
20 361 reasons, but also because they get real enjoyment from watching. A few mothers reported a  
21  
22 362 lack of confidence in their own physical activity, because they aren't "naturally sporty" and  
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24 363 so they tend to let fathers take the lead in supporting child physical activity.  
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29  
30 365 *"Yeah, she's been playing football for two and a half seasons now ... and she's passionate*  
31  
32 366 *about that. So I'm just a sort of chauffeur dad ... that stands on the touchline in the cold*  
33  
34 367 *windy rain. I enjoy that."* [Int 51, Father, Girl, 71 MVPA minutes/day, Father supports  
35  
36 368 weekday and weekend PA]  
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41 370 *"Not that confident cause, like I say, I'm not actually naturally sporty or active. So it would*  
42  
43 371 *be something that we would probably do as a family with their dad, and we could do it*  
44  
45 372 *together.....He's more confident, yeah, and he's more knowledgeable really with all that*  
46  
47 373 *kind of stuff. And he's a – and he's the kind of person that's very much into, 'Come on, let's*  
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49 374 *give it a go. Let's try and see. We might really enjoy it,' whereas I'm a bit more like, 'Oh no,*  
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51 375 *don't make me do this. I'm really nervous.'* And so I would probably shy away from it." [Int  
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3 376 24, Mother, Girl, 43 MVPA minutes/day, Mother supports weekday PA, Father supports  
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5 377 weekend PA]

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10 379 *Associations of who supports child activity with child physical activity variables*

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12 380 Table 2 shows the mean difference in child MVPA minutes per day by which parent/s take  
13  
14 381 the lead in supporting child activity during the week and weekend. Compared to reporting  
15  
16 382 that mothers support child activity (reference group), reporting that parents share the role of  
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18 383 supporting child activity during the week was associated with children doing, on average, an  
19  
20 384 additional 3.5 minutes of MVPA per day. When examined separately by child gender, parents  
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22 385 sharing the role of supporting child activity during the week was associated with, on average,  
23  
24 386 an additional 5.9 minutes of MVPA per day for boys, and 0.4 minutes per day for girls, with  
25  
26 387 no strong statistical evidence of a difference between boys and girls ( $P_{\text{interaction}} = 0.34$ ).  
27  
28 388 Fathers taking the lead in supporting child activity (compared to mothers) was more weakly  
29  
30 389 associated with child MVPA, with an inverse (rather than positive) association for girls, but  
31  
32 390 again with no strong statistical evidence for gender interaction. Associations for parent  
33  
34 391 support of child physical activity during the weekend showed very similar patterns to those  
35  
36 392 for weekday activity, but were somewhat weaker in magnitude. In general, the patterns of  
37  
38 393 association with achieving MVPA recommendations were similar to what was found for  
39  
40 394 MVPA as a continuous measure, including point estimates suggesting weaker or inverse  
41  
42 395 effects in girls but no evidence of gender interaction (Table 3). The one exception was that  
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44 396 fathers supporting activity at weekends had a similar magnitude of effect as both parents  
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46 397 being supporters.

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3 399 The mean difference in children's CPM by parent/s who supports child activity during the  
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5 400 week also showed a similar pattern to that seen for time spent in MVPA (Table 2).  
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401 **Table 2 Mean difference in the children’s average MVPA minutes per day and accelerometer counts per minute associated with gender**

402 **of**  
403 **parent**  
404 **who**  
405 **support**  
406 **s**  
407 **physica**  
408 **l**  
409 **activity**  
410 **during**  
411 **the**  
412 **week**  
413 **and**  
414 **weeken**  
415 **d**  
416 **(N=944)**

Exposure		Moderate-to-vigorous physical activity (minutes/day): mean difference (95% confidence interval)			P for gender interaction
		All (N=944)	Boys (N=427)	Girls (N=517)	
<b>Supports child activity during week</b>	Mother (ref)	0	0	0	0.34
	Father	0.3 (-5.7, 6.3)	8.1 (-1.7, 17.9)	-3.7 (-10.4, 2.9)	
	Both parents	3.5 (0.6, 6.5)	5.9 (1.2, 10.6)	0.4 (-3.0, 3.8)	
<b>Supports child activity at the weekend</b>	Mother (ref)	0	0	0	0.22
	Father	1.7 (-2.8, 6.2)	5.7 (-1.5, 12.9)	-3.4 (-8.5, 1.7)	
	Both parents	2.4 (-1.1, 5.9)	4.5 (-1.4, 10.3)	0.7 (-3.0, 4.4)	
Exposure		Accelerometer counts per minute: mean difference (95% confidence interval)			P for gender interaction
		All (N=944)	Boys (N=427)	Girls (N=517)	
<b>Supports child activity during week</b>	Mother (ref)	0	0	0	0.61
	Father	0.7 (-51.7, 53.2)	56.7 (-28.8, 142.1)	-22.8 (-86.7, 41.1)	
	Both parents	28.0 (2.0, 54.0)	55.1 (14.3, 95.9)	2.8 (-29.9, 35.4)	
<b>Supports child activity at the weekend</b>	Mother (ref)	0	0	0	0.33
	Father	13.1 (-26.5, 52.6)	55.6 (-7.2, 118.3)	-26.2 (-75.9, 23.4)	
	Both parents	22.6 (-7.7, 52.9)	52.8 (1.8, 103.7)	4.7 (-31.3, 40.7)	

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MVPA: Moderate-to-vigorous physical activity; Models are adjusted for child age, parent gender and household IMD score

**Table 3 Odds ratio for children achieving 60 minutes of MVPA per day associated with gender of parent supporting child physical**

Exposure	Meeting government guideline: odds ratio (95% confidence interval)			P for gender interaction	436 activity during the week and weekend (N=944)
	All (N=944)	Boys (N=427)	Girls (N=517)		
<b>Supports child activity during week</b>	Mother (ref)	0	0	0.95	437
	Father	0.96 (0.54, 1.72)	1.61 (0.62, 4.21)		438
	Both parents	1.60 (1.20, 2.14)	2.23 (1.37, 3.62)		439
<b>Supports child activity at the weekend</b>	Mother (ref)	0	0	0.30	440
	Father	1.20 (0.78, 1.86)	2.10 (1.02, 4.32)		441
	Both parents	1.20 (0.86, 1.68)	1.81 (1.01, 3.24)		442

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453 MVPA: Moderate-to-vigorous physical activity; Models are adjusted for child age, parent gender and household IMD score

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3 454 **DISCUSSION**

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6 455 The data presented in this paper show that while the participants in this study believe the  
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8 456 responsibility of supporting child physical activity should be shared between both parents,  
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10 457 quantitative data suggest that families mostly share the role on the weekend, with mothers  
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12 458 primarily supporting child activity during the week. This finding was mirrored in the  
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14 459 interview data, where several mothers reported that they supported child activity during the  
15  
16 460 week, because fathers worked long hours or late into the evening. Despite families  
17  
18 461 traditionally functioning such that one parent (often the mother) takes on more childcare  
19  
20 462 responsibilities in general, it is interesting that parents still feel that supporting child activity  
21  
22 463 should be a shared responsibility. Indeed, traditional familial roles are shifting, and it is now  
23  
24 464 more common for both parents to work and for fathers to take on the role of primary care  
25  
26 465 provider,[54 55] so it may be expected that more fathers are taking an active role in their  
27  
28 466 children's physical activity. We found that the majority of parents reported they shared the  
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30 467 role of supporting their child's activity both during the week and at the weekend (40-65% of  
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32 468 mothers and fathers responded this way for both time points; Table S2).

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39 470 In quantitative analyses for all three outcomes (time spent in MVPA, meeting MVPA  
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41 471 recommendations and CPM) we saw similar patterns of, in general, higher child physical  
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43 472 activity where parents reportedly shared the role of supporting their child's physical activity  
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45 473 during both weekdays and weekends. For example, both parents supporting child activity  
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47 474 equally during the week was associated with boys doing an additional 40 minutes of MVPA  
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49 475 across the week, which could be the difference between a child achieving the recommended  
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51 476 guidelines or not. The one exception was for meeting MVPA recommendations at the  
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53 477 weekend, where associations of fathers reportedly leading the support were similar to those

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3 478 when both parents shared the responsibility. There was some evidence that positive  
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5 479 associations were stronger for sons, and that some associations were inverse for daughters.  
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7 480 However, we found no strong statistical evidence that associations differed between sons and  
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9 481 daughters, and without further exploration in much larger numbers we cannot assume that  
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11 482 parental roles in supporting their child's activity differ by the child's gender.  
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17 484 There was some suggestion that mothers were more likely to support their daughter to be  
18  
19 485 active, while fathers were more likely to support their son's activity, though caution is needed  
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21 486 here given the disparity in which parents provide data, with 72% of families having data from  
22  
23 487 mothers only and 28% from fathers only. Several studies have reported that fathers may be  
24  
25 488 more involved in their son's physical activity,[15 31] or have found stronger links between  
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27 489 father-son and mother-daughter dyads in terms of their physical activity behaviour.[36-38] In  
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29 490 contrast, interview data from the current study revealed a myriad of gender patterns,  
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31 491 including examples from fathers supporting girls' physical activity because they were more  
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33 492 confident than mothers in supporting physical activity or because they enjoy watching their  
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35 493 daughter play football, and a mother taking her son mountain biking to engage in quality one-  
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37 494 on-one time. There were also examples of fathers taking sons to traditionally male-orientated  
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39 495 sports (e.g., rugby or football) to bond over shared interests and give mothers a respite from  
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41 496 parenting.  
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48 498 The results from the current study suggest intervention studies should be developed to engage  
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50 499 both parents, or specifically fathers, in supporting their children to be active, not necessarily  
51  
52 500 focused on children and parents being active together, but rather on how parents can work  
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54 501 together to schedule times for children to be active across the week in both structured and  
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3 502 unstructured activities, and how parents can share the role between parenting partners. Table  
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5 503 4 summarises the key findings and implications for how parents can support child activity  
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7 504 that have emerged from this study. These suggestions provide ways that researchers and  
8  
9 505 policy makers can help parents to support their child's physical activity, through providing  
10  
11 506 advice and encouragement to developing family physical activity plans. Research needs to be  
12  
13 507 conducted into how best to operationalise these suggestions and understand the channels that  
14  
15 508 parents typically use for finding parenting advice and ideas for physical activities. Potential  
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17 509 avenues for disseminating advice include encouraging sharing of advice and positive  
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19 510 affirmations via parents' peer networks, delivering information through schools, or  
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21 511 communicating advice via social media and parenting forums.  
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512 **Table 4 Key findings and implications for how parents can support their child's physical activity**

Finding	Implication
Mothers primarily support child physical activity during the week	Develop advice for mothers to help them facilitate their child's physical activity during busy weekdays (e.g., identifying times in the day for promoting activity, ideas for active games)
Engaging fathers to be involved in supporting child physical activity is important	Encourage fathers to see the important role they can play in supporting their child's activity
Children, possibly more so boys, are more active if both parents share the role of supporting child physical activity	Develop family physical activity plans (e.g., who can support when) to encourage both parents to take an active role in supporting their child's physical activity
Parents can use physical activity time to bond over shared interests or engage in quality one-to-one time with children	Encourage parents to value physical activity time as a way to share interests and bond with children (e.g., promote physical activity as quality family time)
Some parents, possibly more so mothers, struggle for confidence when it comes to supporting child physical activity	Develop parental skills and confidence in supporting and facilitating child activity, and encourage parents to model the behaviours that they wish their child to adopt

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3 513 ***Strengths and limitations***  
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6 514 A main strength of the study is the mixed-methods approach, utilising both accelerometer-  
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8 515 assessed physical activity from a large sample of 8-9-year-old children and semi-structured  
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10 516 interview data with parents. This approach provides rich data about the gender roles  
11  
12 517 associated with how parents support their child's activity. Another strength is that we  
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14 518 interviewed a relatively large sample of parents, including 20 fathers, a group that are known  
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16 519 to be difficult to engage in research.[56] Limitations of the study include its cross-sectional  
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18 520 nature so causality could not be examined. In the main dataset, parents were primarily  
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20 521 represented by mothers (72%), which is likely to have biased how they responded to  
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23 522 questions about who supports their child's activity. In addition, because only one parent was  
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25 523 required to participate with their child, this study does not include information on whether  
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27 524 children were from same-sex families, single-parent families, or where primary caregivers are  
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29 525 grandparent or extended family. We had very limited power to explore gender interactions,  
30  
31 526 thus whilst our results suggest that parent support of their child's physical activity might have  
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33 527 a stronger positive impact on sons compared with daughters it would be wrong to conclude  
34  
35 528 that from these data, and much larger independent studies are required to explore that further.  
36  
37 529 Parental responses to our exposure questions provided no information on the type (quality or  
38  
39 530 quantity) of their supporting role, and thus it is not known whether both parents equally  
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41 531 supporting child activity is simply a proxy for greater support. Additionally, the variable  
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43 532 ascertaining which parent 'should take the lead in supporting child physical activity' did not  
44  
45 533 differentiate between weekdays and weekend days. 279 families were excluded from the  
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47 534 study due to missing data, which may have resulted in sampling bias, because these  
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49 535 participants differed from included participants in terms of their MVPA and household IMD  
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51 536 score. This study is also drawn from a single UK city area with a primarily White British  
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3 537 population, and as such our ability to extend findings to other settings countries, and  
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5 538 ethnicities is limited.

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9 540 **CONCLUSIONS**

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12 541 We found some evidence that parents share the role of supporting their children to be active.

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14 542 It is possible that mothers primarily support child activity during the week, with the role

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16 543 shared more equally on the weekend. Children are more active when parents share the

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18 544 responsibility of supporting their child's activity, but further large independent studies are

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20 545 required to replicate our findings and determine whether parental support has a stronger

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22 546 effect on sons than daughters. Future studies should also seek to engage more fathers, verify

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24 547 reports of who takes a supporting role (for example through cross comparison of reports from

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26 548 each parent and the child or direct observation), and to collect information on the nature of

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28 549 supporting roles (quality and frequency).

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50  
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52  
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3 561 **COMPETING INTERESTS**

4  
5 562 All authors have completed the ICMJE uniform disclosure form at  
6  
7 563 [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) and declare: all authors had financial support from the  
8  
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10  
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12  
13 566 other relationships or activities that could appear to have influenced the submitted work.  
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16 567

17  
18 568 **CONTRIBUTORS**

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21 569 Conception / design: RJ, ESM, JLT, DAL and SJS.  
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26  
27 572 Drafting / revising critically for important content: All authors.  
28  
29 573 Final approval: All authors.  
30  
31 574 Accountability for study and manuscript: ESM, RJ.  
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36 576 **DATA SHARING STATEMENT**

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38 577 The datasets generated during the current study are not publicly available as the project is  
39  
40 578 ongoing and data are not ready for archiving. We will make quantitative data available to the  
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42 579 wider research community once the project is complete in August 2019. Because of possible  
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44 580 disclosure with qualitative data we will consider requests to use and further explore those  
45  
46 581 data on a per request basis with an appropriate balance between sharing data as fully as  
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48 582 possible whilst maintaining participant anonymity.  
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53 584 **REFERENCES**  
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- 1  
2  
3 585 1. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity  
4  
5 586 and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act* 2010;**7**:40  
6  
7 587 doi: 10.1186/1479-5868-7-40.  
8
- 9 588 2. Strong WB, Malina RM, Blimkie CJ, et al. Evidence based physical activity for  
10  
11 589 school-age youth. *J Pediatr* 2005;**146**(6):732-7  
12
- 13 590 3. Department of Health, Physical Activity, Health Improvement and Protection. Start  
14  
15 591 Active, Stay Active: A report on physical activity from the four home countries?  
16  
17 592 Chief Medical Officers. London, 2011.  
18
- 19 593 4. Griffiths LJ, Cortina-Borja M, Sera F et al. How active are our children? Findings  
20  
21 594 from the Millennium Cohort Study. *BMJ Open* 2013;**3**(8):e002893 doi:  
22  
23 595 10.1136/bmjopen-2013-002893.  
24
- 25 596 5. Scholes S. Health Survey for England 2015: Physical activity in children. Health  
26  
27 597 and Social Care Information Centre. London, 2016.  
28
- 29 598 6. Cooper AR, Goodman A, Page AS, et al. Objectively measured physical activity  
30  
31 599 and sedentary time in youth: the International children's accelerometry database  
32  
33 600 (ICAD). *Int J Behav Nutr Phys Act* 2015;**12**:113 doi: 10.1186/s12966-015-0274-5.  
34  
35 601 7. Nader PR, Bradley RH, Houts RM, McRitchie SL, O'Brien M. Moderate-to-  
36  
37 602 vigorous physical activity from ages 9 to 15 years. *JAMA* 2008;**300**(3):295-305.  
38
- 39 603 8. Farooq MA, Parkinson KN, Adamson AJ, et al. Timing of the decline in physical  
40  
41 604 activity in childhood and adolescence: Gateshead Millennium Cohort Study. *Br J*  
42  
43 605 *Sports Med* 2017:1-6 doi:10.1136/bjsports-2016-096933.  
44
- 45 606 9. Jago R, Solomon-Moore E, Macdonald-Wallis C, Sebire SJ, Thompson JL, Lawlor  
46  
47 607 DA. Change in children's physical activity and sedentary time between Year 1 and  
48  
49 608 Year 4 of primary school in the B-PROACTIV cohort. *Int J Behav Nutr Phys Act*  
50  
51 609 2017;**14**:33 doi: 10.1186/s12966-017-0492-0.  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 610 10. Patrick H, Hennessy E, McSpadden K, Oh A. Parenting styles and practices in  
4  
5 611 children's obesogenic behaviors: scientific gaps and future research directions.  
6  
7 612 Child Obes 2013;**9**(S1):S73-86 doi: 10.1089/chi.2013.0039.  
8  
9 613 11. Davison KK, Masse LC, Timperio A, et al. Physical activity parenting measurement  
10  
11 614 and research: challenges, explanations, and solutions. Child Obes  
12  
13 615 2013;**9**(Suppl):S103-9 doi: 10.1089/chi.2013.0037.  
14  
15 616 12. Sleddens EF, Gerards SM, Thijs C, de Vries NK, Kremers SP. General parenting,  
16  
17 617 childhood overweight and obesity-inducing behaviors: a review. Int J Pediatr Obes  
18  
19 618 2011;**6**(2-2):e12-27 doi: 10.3109/17477166.2011.566339.  
20  
21 619 13. O'Connor TM, Jago R, Baranowski T. Engaging parents to increase youth physical  
22  
23 620 activity: a systematic review. Am J Prev Med 2009;**37**(2):141-9 doi:  
24  
25 621 10.1016/j.amepre.2009.04.020.  
26  
27 622 14. Jago R, Fox KR, Page AS, Brockman R, Thompson JL. Parent and child physical  
28  
29 623 activity and sedentary time: do active parents foster active children? BMC Public  
30  
31 624 Health 2010;**10**(1):194 doi: 10.1186/1471-2458-10-194.  
32  
33 625 15. Gustafson SL, Rhodes RE. Parental correlates of physical activity in children and  
34  
35 626 early adolescents. Sports Med 2006;**36**(1):79-97.  
36  
37 627 16. Edwardson CL, Gorely T. Parental influences on different types and intensities of  
38  
39 628 physical activity in youth: A systematic review. Psychol Sport Exerc  
40  
41 629 2010;**11**(6):522-35 doi: 10.1016/j.psychsport.2010.05.001.  
42  
43 630 17. Jago R, Sebire SJ, Wood L, et al. Associations between objectively assessed child  
44  
45 631 and parental physical activity: a cross-sectional study of families with 5-6 year old  
46  
47 632 children. BMC Public Health 2014;**14**:655 doi: 10.1186/1471-2458-14-655.  
48  
49 633 18. Jago R, Solomon-Moore E, Macdonald-Wallis C, Thompson JL, Lawlor DA, Sebire  
50  
51 634 SJ. Association of parents' and children's physical activity and sedentary time in  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 635 Year 4 (8-9) and change between Year 1 (5-6) and Year 4: a longitudinal study. *Int*  
4  
5 636 *J Behav Nutr Phys Act* 2017;**14**:110 doi: 10.1186/s12966-017-0565-0.  
6  
7 637 19. Fuemmeler BF, Anderson CB, Mâsse LC. Parent-child relationship of directly  
8  
9 638 measured physical activity. *Int J Behav Nutr Phys Act* 2011;**8**:17 doi:  
10  
11 639 10.1186/1479-5868-8-17.  
12  
13 640 20. Garriguet D, Colley R, Bushnik T. Parent-Child association in physical activity and  
14  
15 641 sedentary behaviour. *Health Reports* 2017;**28**(6):3-11.  
16  
17 642 21. Erkelenz N, Kobel S, Kettner S, et al. Parental activity as influence on children's  
18  
19 643 BMI percentiles and physical activity. *J Sports Sci Med* 2014;**13**:645-50.  
20  
21 644 22. Tate EB, Shah A, Jones M, et al. Toward a better understanding of the link between  
22  
23 645 parent and child physical activity levels: The moderating role of parental  
24  
25 646 encouragement. *J Phys Act Health* 2015;**12**:1238-44 doi: 10.1123/jpah.2014-0126.  
26  
27 647 23. Hennessy E, Hughes SO, Goldberg JP, et al. Parent-child interactions and  
28  
29 648 objectively-measured child physical activity: a cross-sectional study. *Int J Behav*  
30  
31 649 *Nutr Phys Act* 2010;**7**:71 doi: 10.1186/1479-5868-7-71.  
32  
33 650 24. Tilly L, Scott J. *Women, Work and Family*. New York: Holt, Reinhart and  
34  
35 651 Winston; 1978.  
36  
37 652 25. Goldscheider F, Bernhardt E, Lappegard T. *The Gender Revolution: A Framework*  
38  
39 653 *for Understanding Changing Family and Demographic Behavior*. *Popul Dev Rev*  
40  
41 654 2015;**41**(2):207-239.  
42  
43 655 26. Gerson K. *The Unfinished Revolution: Coming of Age in a New Era of Gender,*  
44  
45 656 *Work, and Family*. New York: Oxford University Press; 2010.  
46  
47 657 27. Hofferth S, Pleck J, Goldscheider F, Curtin S, Hrapezynski K. Changing family  
48  
49 658 structure and men's motivation for parenthood and parenting in the U.S. In:  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



- 1  
2  
3 659 Handbook of Father Involvement: Multidisciplinary Perspectives. 2<sup>nd</sup> ed. Cabrera  
4  
5 660 NJ, Tamis-LeMonda CS, editors. Taylor and Francis; 2012. p. 57-80.  
6  
7 661 28. Davison KK, Cutting TM, Birch LL. Parents' activity-related parenting practices  
8  
9 662 predict girls' physical activity. *Med Sci Sports Exerc* 2003;**35**:1589-95 doi:  
10  
11 663 10.1249/01.MSS.0000084524.19408.0C.  
12  
13 664 29. Lloyd AB, Lubans DR, Plotnikoff RC, Collins CE, Morgan PJ. Maternal and  
14  
15 665 paternal parenting practices and their influence on children's adiposity, screen-time,  
16  
17 666 diet and physical activity. *Appetite* 2014;**79**:149-57 doi:  
18  
19 667 10.1016/j.appet.2014.04.010.  
20  
21  
22 668 30. Davison KK, Gicevic S, Aftosmes-Tobio A, et al. Fathers' representation in  
23  
24 669 observational studies on parenting and childhood obesity: a systematic review and  
25  
26 670 content analysis. *Am J Public Health* 2016;**106**(11):e14-e21 doi:  
27  
28 671 10.2105/AJPH.2016.303391.  
29  
30  
31 672 31. Zahra J, Sebire SJ, Jago R. "He's probably more Mr. sport than me" – a qualitative  
32  
33 673 exploration of mothers' perceptions of fathers' role in their children's physical  
34  
35 674 activity. *BMC Pediatrics* 2015;**15**:101 doi: 10.1186/s12887-015-0421-9.  
36  
37 675 32. Vollmer RL, Adamsons K, Gorin A, Foster JS, Mobley AR. Investigating the  
38  
39 676 relationship of body mass index, diet quality, and physical activity level between  
40  
41 677 fathers and their preschool-aged children. *J Acad Nutr Diet* 2015;**115**:919-26 doi:  
42  
43 678 10.1016/j.jand.2014.12.003.  
44  
45  
46 679 33. Schoeppe S, Liersch S, Röbl M, Krauth C, Walter U. Mothers and fathers both  
47  
48 680 matter: the positive influence of parental physical activity modelling on children's  
49  
50 681 leisure-time physical activity. *Pediatr Exerc Sci* 2016;**28**:466-72 doi:  
51  
52 682 10.1123/pes.2015-0236.  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 683 34. Morgan PJ, Collins CE, Plotnikoff RC, et al. The ‘healthy dads, healthy kids’  
4  
5 684 community randomized controlled trial: a community-based healthy lifestyle  
6  
7 685 program for fathers and their children. *Prev Med* 2014;**61**:90-99 doi:  
8  
9 686 10.1016/j.ypmed.2013.12.019.
- 10  
11 687 35. Morgan PJ, Lubans DR, Callister R, et al. The ‘healthy dads, healthy kids’  
12  
13 688 randomized controlled trial: efficacy of a healthy lifestyle program for overweight  
14  
15 689 fathers and their children. *Int J Obes* 2011;**35**(3):436-47 doi: 10.1038/ijo.2010.151.
- 16  
17 690 36. Eriksson M, Nordqvist T, Rasmussen F. Associations between parents’ and 12-  
18  
19 691 year-old children’s sport and vigorous activity: the role of self-esteem and athletic  
20  
21 692 competence. *J Phys Act Health* 2008;**5**(3):359-73 doi: 10.1123/jpah.5.3.359.
- 22  
23 693 37. O’Loughlin J, Paradis G, Kishchuk N, Barnett T, Renaud L. Prevalence and  
24  
25 694 correlates of physical activity behaviors among elementary schoolchildren in multi-  
26  
27 695 ethnic, low income, inner-city neighborhoods in Montreal, Canada. *Ann Epidemiol*  
28  
29 696 1999;**9**(7):397-407.
- 30  
31 697 38. Trost SG, Pate RR, Saunders R, Ward DS, Dowda M, Felton G. A prospective  
32  
33 698 study of the determinants of physical activity in rural fifth-grade children. *Prev Med*  
34  
35 699 1997;**26**(2):257-63.
- 36  
37 700 39. Trost SG, Pate RR, Ward DS, Saunders R, Riner W. Determinants of physical  
38  
39 701 activity in active and low-active, sixth grade African-American youth. *J Sch Health*  
40  
41 702 1999;**69**(1):29-34.
- 42  
43 703 40. Jago R, Thompson JL, Sebire SJ, et al. Cross-sectional associations between the  
44  
45 704 screen-time of parents and young children: differences by parent and child gender  
46  
47 705 and day of the week. *Int J Behav Nutr Phys Act* 2014;**11**:54 doi: 10.1186/1479-  
48  
49 706 5868-11-54.

- 1  
2  
3 707 41. Creswell, J. Research design: Qualitative, quantitative, and mixed methods  
4  
5 708 approaches. Thousand Oaks, CA: Sage, 1997.  
6  
7 709 42. Jago R, Bailey R. Ethics and paediatric exercise science: Issues and making a  
8  
9 710 submission to a local ethics and research committee. *J Sports Sci* 2001;**19**(7):527-  
10  
11 711 535.  
12  
13 712 43. Payau MR, Adolph AL, Vohra FA, Butte NF. Validation and calibration of physical  
14  
15 713 activity monitors in children. *Obes Res* 2002;**10**(3):150-7. doi:  
16  
17 714 10.1038/oby.2002.24  
18  
19 715 44. Pate RR, Almeida MJ, McIver KL, Pfeiffer KA, Dowda M. Validation and  
20  
21 716 Calibration of an Accelerometer in Preschool Children. *Obes* 2006;**14**(11):2000-  
22  
23 717 2006. doi: 10.1038/oby.2006.234  
24  
25 718 45. Evenson KR, Catellier DJ, Gill K, et al. Calibration of two objective measures of  
26  
27 719 physical activity for children. *J Sport Sci* 2008;**26**:1557-65 doi:  
28  
29 720 10.1080/02640410802334196.  
30  
31 721 46. Trost SG, Loprinzi PD, Moore R, Pfeiffer KA. Comparison of accelerometer cut  
32  
33 722 points for predicting activity intensity in youth. *Med Sci Sports Exerc*  
34  
35 723 2011;**43**(7):1360-1368. doi: 10.1249/MSS.0b013e318206476e.  
36  
37 724 47. Department for Communities and Local Government. The English Indices of  
38  
39 725 Deprivation 2015 Statistical Release. Office for National Statistics 2015.  
40  
41 726 48. Kesten J, Jago R, Sebire SJ, et al. Understanding the accuracy of parental  
42  
43 727 perceptions of child physical activity: a mixed methods analysis. *J Phys Act Health*  
44  
45 728 2015;**12**(12):1529–35. doi: 10.1123/jpah.2014-0442.  
46  
47 729 49. Jago R, Zahra J, Edwards MJ, et al. Managing the screen-viewing behaviours of 5-6  
48  
49 730 year old children: a qualitative analysis of parental strategies. *BMJ Open* 2016;**6**(3):  
50  
51 731 e010355. doi: 10.1136/bmjopen-2015-010355.  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 732 50. Thompson JL, Sebire SJ, Kesten JM, et al. How parents perceive screen viewing in  
4  
5 733 their 5-6 year old child within the context of their own screen viewing time: a  
6  
7 734 mixed-methods study. *BMC Public Health* 2017;**17**:471. doi: 10.1186/s12889-017-  
8  
9 735 4394-5.  
10  
11 736 51. Sebire SJ, Jago R, Wood L, et al. Examining a conceptual model of parental  
12  
13 737 nurturance, parenting practices and physical activity among 5-6 year olds. *Soc Sci*  
14  
15 738 *Med* 2016;**148**:18-24. doi: 10.1016/j.socscimed.2015.11.022.  
16  
17  
18 739 52. Elo S, Kyngäs H. The qualitative content analysis process. *J Adv Nurs* 2008;**62**(1):  
19  
20 740 107-15 doi: 10.1111/j.1365-2648.2007.04569.x.  
21  
22 741 53. Gale NK, Heath G, Cameron E, Rashid S, Redwood S. Using the framework  
23  
24 742 method for the analysis of qualitative data in multi-disciplinary health research.  
25  
26 743 *BMC Med Res Methodol* 2013;**13**:117 doi: 10.1186/1471-2288-13-117.  
27  
28  
29 744 54. Anderson PM, Butcher KF. Childhood obesity trends and potential causes. *Future*  
30  
31 745 *Child* 2006;**16**:19-45 doi: 10.1353/foc.2006.0001.  
32  
33 746 55. Laughlin L. Who's minding the kids? Child care arrangements: spring 2011.  
34  
35 747 <https://www.census.gov/prod/2013pubs/p70-135.pdf>. Published April 2013.  
36  
37 748 56. Macfadyen A, Swallow V, Santacroce S, Lambert H. Involving fathers in research.  
38  
39 749 *J Spec Pediatr Nurs* 2011;**16**(3):216-9 doi: 10.1111/j.1744-6155.2011.00287.x  
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45 751 **Figure 1 Study flow of participants for the quantitative study**

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51 753 **Figure 2 Study flow of participants for the qualitative study**

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**Figure 1 Study flow of participants for the quantitative study**

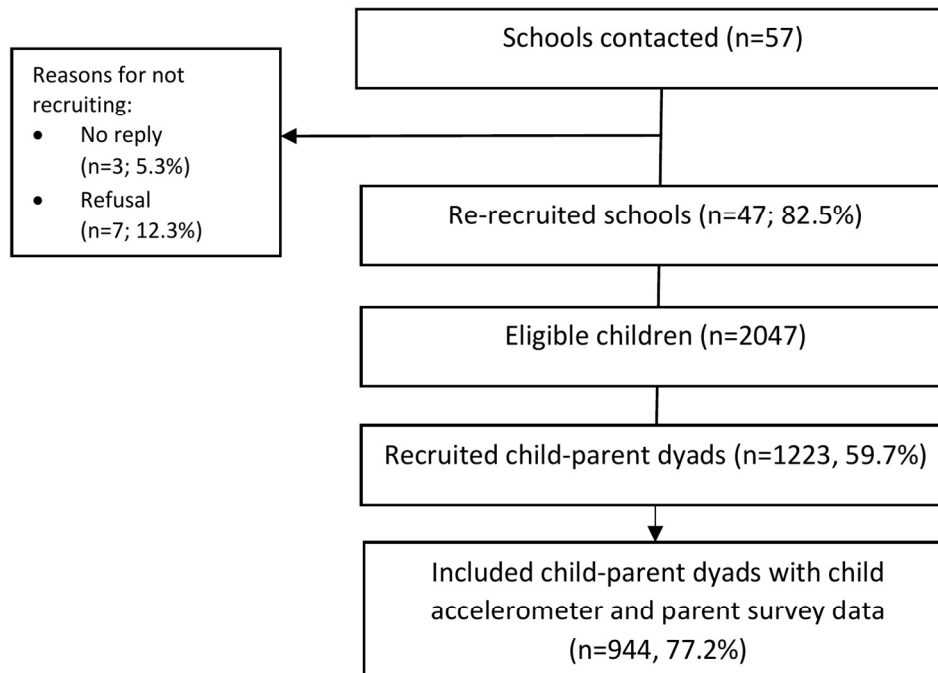


Figure 1 Study flow of participants for the quantitative study

132x104mm (300 x 300 DPI)

Figure 2 Study flow of participants for the qualitative study

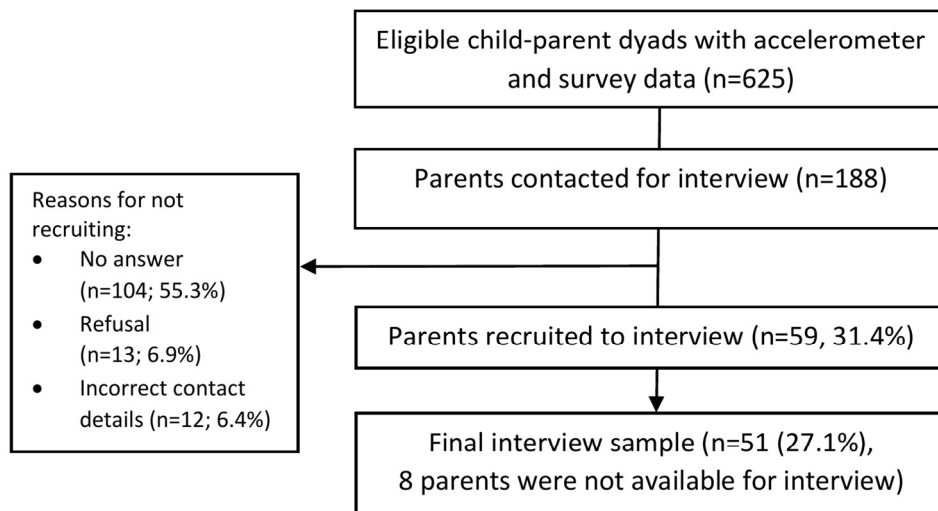


Figure 2 Study flow of participants for the qualitative study

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**Table S1 Number of mothers and fathers who were eligible for and recruited to the interview study**

No.	Sub-group description	N parents eligible in each sub-group			N parents recruited in each sub-group		
		Total	Mothers	Fathers	Total	Mothers	Fathers
1	Low MVPA, low SED boys	31	20	11	6	4	2
2	High MVPA, low SED boys	116	82	34	6	3	3
3	Low MVPA, high SED boys	67	51	16	7	5	2
4	High MVPA, high SED boys	63	48	15	6	3	3
5	Low MVPA, low SED girls	69	48	21	6	3	3
6	High MVPA, low SED girls	86	67	19	6	4	2
7	Low MVPA, high SED girls	138	111	27	7	4	3
8	High MVPA, high SED girls	55	37	18	7	5	2
	<b>Total</b>	<b>625</b>	<b>464</b>	<b>161</b>	<b>51</b>	<b>31</b>	<b>20</b>

Table S2 Frequency of reporting which parent supports child activity by parent and separately by child gender

		Parent gender		Chi-squared p-value for difference	Child gender		Chi-squared p-value for difference
		Males (N=264) %	Females (N=680) %		Boys (N=427) %	Girls (N=517) %	
<b>Supports child activity during the week</b>	Mother	26.9	57.4	<0.001	44.5	52.4	0.04
	Father	16.7	2.9		6.6	7.0	
	Both parents	56.4	39.7		48.9	40.6	
<b>Supports child activity at the weekend</b>	Mother	8.3	30.7	<0.001	21.1	27.3	0.02
	Father	26.9	14.1		20.8	15.1	
	Both parents	64.8	55.1		58.1	57.6	
<b>Who should support child activity</b>	Mother	1.1	6.9	0.001	4.2	6.0	0.07
	Father	1.5	0.7		1.6	0.4	
	Both parents	97.3	92.4		94.1	93.6	



## Who leads and who supports? A cross-sectional mixed methods study of mothers' and fathers' support for child physical activity

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

	Item No	Recommendation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract <b>Title Page</b>
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found – <b>Pages 2-3</b>
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported – <b>Pages 5-6</b>
Objectives	3	State specific objectives, including any prespecified hypotheses – <b>Page 6.</b>
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper <b>Pages 6-7.</b>
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection <b>Pages 6-7.</b>
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 <b>Page 7</b>
		(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 - <b>Pages 7-9</b>
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 <b>Pages 7-9</b>
Bias	9	Describe any efforts to address potential sources of bias – <b>Page 8</b>
Study size	10	Explain how the study size was arrived at - <b>Pages 7-8 (Figures 1 &amp; 2)</b>
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why - <b>Pages 10-11</b>
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding – <b>Pages 10-11</b>
		(b) Describe any methods used to examine subgroups and interactions – <b>Page 11</b>
		(c) Explain how missing data were addressed - <b>Pages 10-11</b>
		(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

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	addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy - <a href="#">Pages 10-11</a>
	<u>(e)</u> Describe any sensitivity analyses – <a href="#">Page 11</a>

Continued on next page

For peer review only

**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 <a href="#">Table 1 (Figure 1 &amp; 2)</a> (b) Give reasons for non-participation at each stage - <a href="#">Figure 1 &amp; 2</a> (c) Consider use of a flow diagram – <a href="#">Figure 1 &amp; 2</a>
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders – <a href="#">Table 1</a> (b) Indicate number of participants with missing data for each variable of interest - <a href="#">Table 1</a> (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 <a href="#">Table 1</a>
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 – <a href="#">Tables 2-3</a> (b) Report category boundaries when continuous variables were categorized - <a href="#">Tables 2-3</a> (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period Discussion – <a href="#">N/A</a>
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses – <a href="#">Supplementary tables</a>

**Discussion**

Key results	18	Summarise key results with reference to study objectives – <a href="#">Page 22</a>
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 - <a href="#">Page 25</a>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence – <a href="#">Page 25-26</a>
Generalisability	21	Discuss the generalisability (external validity) of the study results <a href="#">Page 25</a>

**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 – <a href="#">Page 26</a>
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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](http://www.strobe-statement.org).

## COREQ (CONsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
<b>Domain 1: Research team and reflexivity</b>			
<i>Personal characteristics</i>			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	Page 27
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	Page 9
Occupation	3	What was their occupation at the time of the study?	Page 9
Gender	4	Was the researcher male or female?	Page 9
Experience and training	5	What experience or training did the researcher have?	Page 9
<i>Relationship with participants</i>			
Relationship established	6	Was a relationship established prior to study commencement?	Pages 8-9
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	N/A
Interviewer characteristics	8	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	N/A
<b>Domain 2: Study design</b>			
<i>Theoretical framework</i>			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Page 11
<i>Participant selection</i>			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Pages 8-9
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	Page 9
Sample size	12	How many participants were in the study?	Page 9
Non-participation	13	How many people refused to participate or dropped out? Reasons?	Page 9 (Fig 2)
<i>Setting</i>			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	Page 8
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	N/A
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	Pages 8-9, 12 (Fig 1)
<i>Data collection</i>			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 9
Repeat interviews	18	Were repeat interviews carried out? If yes, how many?	N/A
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	Page 9
Field notes	20	Were field notes made during and/or after the interview or focus group?	N/A
Duration	21	What was the duration of the interviews or focus group?	Page 12
Data saturation	22	Was data saturation discussed?	Page 9
Transcripts returned	23	Were transcripts returned to participants for comment and/or	N/A

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
<b>Domain 3: analysis and findings</b>			
<i>Data analysis</i>			
Number of data coders	24	How many data coders coded the data?	Page 11
Description of the coding tree	25	Did authors provide a description of the coding tree?	N/A
Derivation of themes	26	Were themes identified in advance or derived from the data?	Page 11
Software	27	What software, if applicable, was used to manage the data?	Page 11
Participant checking	28	Did participants provide feedback on the findings?	N/A
<i>Reporting</i>			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Pages 14-17
Data and findings consistent	30	Was there consistency between the data presented and the findings?	Pages 14-17
Clarity of major themes	31	Were major themes clearly presented in the findings?	Pages 14-17
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	Pages 14-17

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

**Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.**