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

3

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28 **ABSTRACT**

29 **Objectives:** Examine the extent parent gender is associated with supporting children's
30 physical activity.

31 **Design:** Cross-sectional mixed-methods study.

32 **Setting:** 47 primary schools located in Bristol (UK).

33 **Participants:** 944 8-9-year-old children and one of their parents provided quantitative data;
34 51 parents (20 fathers) were interviewed.

35 **Methods:** Children wore an accelerometer and mean minutes of moderate-to-vigorous-
36 intensity physical activity (MVPA) per day, counts per minute (CPM), and achievement of
37 national MVPA guidelines were derived. Parents reported who leads in supporting child
38 activity during the week and weekend. Linear and logistic regression examined the
39 association between gender of parent who supports child activity and child physical activity.
40 For the semi-structured telephone interviews, inductive and deductive content analysis were
41 used to explore the role of gender in how parents support child activity.

42 **Results:** Parents appeared to have a stronger role in supporting boys to be more active, than
43 girls, and the strongest associations were when they reported that both parents had equal roles
44 in supporting their child. For example, compared with the reference of female/mother
45 support, equal contribution from both parents during the week was associated with boys
46 doing 5.9 (95% CI: 1.2 to 10.6) more minutes of MVPA per day, and more CPM when both
47 parents support on weekday and weekends (55.1 [14.3 to 95.9] and 52.8 [1.8 to 103.7],
48 respectively). Associations in girls were weaker and sometimes in the opposite direction but
49 there was no strong statistical evidence for gender interactions. Themes emerged from the
50 qualitative data, specifically; parents proactively supporting physical activity equally,
51 mothers supporting during the week, families getting together at weekends, families doing

52 activities separately due to preferences, and parents using activities to bond one-to-one with
53 children.

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

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57 **Key words:** Physical activity, children, parents, gender, mixed-methods

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72 **ARTICLE SUMMARY**

73 **Strengths and limitations of this study**

74 **Strengths**

- 75 • Mixed-methods study.
- 76 • Accelerometer data from a large sample of 8-9-year-old children.
- 77 • Semi-structured telephone interviews with 51 parents, including 20 fathers.

78

79 **Limitations**

- 80 • Cross-sectional study design from a single UK region.
- 81 • The measurement of parental support of child physical activity would be strengthened
- 82 by collecting data from both parents and information on the quality and quantity of
- 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.

103

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.

112

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

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

137

138 The aim of this mixed-methods study was to examine parent gender, in terms of which parent
139 supports their child to be active, and its association with child physical activity. A secondary
140 aim was to discover if these associations varied by child gender.

141

142 **METHODS**

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

159

160 *Accelerometer data*

161 Children wore a waist-worn ActiGraph wGT3X-BT accelerometer for five days including
162 two weekend days. Waist-worn accelerometers have been demonstrated to be valid for
163 measuring physical activity in children.[43 44] Accelerometer data were processed using
164 Kinesoft (v3.3.75; Kinesoft, Saskatchewan, Canada), and were included in the primary

165 analyses if children provided at least three days of valid data (including at least one weekend
166 day). A valid day was defined as at least 500 minutes of data after excluding intervals of ≥ 60
167 minutes of zero counts, allowing up to two minutes of interruptions. Minutes spent in MVPA
168 were derived using population-specific cut points for children.[45] In a comparative study
169 with other widely-used accelerometer cut points, the Evenson thresholds,[45] (in which stair
170 climbing and brisk walking corresponded to moderate-intensity physical activity) were shown
171 to provide the most accurate assessments of children's energy expenditure.[46] Mean
172 accelerometer counts per minute (CPM), and a binary variable indicating whether the child's
173 average daily MVPA was greater than the 60 minutes per day recommended by the UK
174 government,[3] were also derived.

175

176 *Parent support variables*

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

184

185 *Demographic information*

186 Parents provided demographic information via a questionnaire, including parent and child
187 gender, date of birth, and ethnic origin. Where children's date of birth was missing (21% of
188 children) they were assigned the median age of 9.0 years (as the children were all in the same

189 school year with a maximum age difference between the youngest and oldest of just under
190 12-months legally possible). As an indicator of socio-economic status, Indices of Multiple
191 Deprivation (IMD) scores, based upon the English Indices of Deprivation,[47] were assigned
192 to each child based on their reported home postcode, where higher scores indicate greater
193 levels of deprivation. IMD scores provide a set of relative measures of deprivation for lower-
194 layer super output areas across England, based on seven different domains of deprivation:
195 income deprivation; employment deprivation; education, skills and training deprivation;
196 health deprivation and disability; crime; barriers to housing and services; and living
197 environment deprivation. Child height, weight and blood pressure were also measured.

198

199 *Interview data*

200 During consent procedures, parents were informed that they may be re-contacted to take part
201 in a telephone interview. Only families with complete data for all measures (accelerometer
202 and questionnaire data, child height, weight and blood pressure) were included in the
203 interview sample (N=625, of which 161 (25.8%) had data from fathers). This sample was
204 stratified according to the child's MVPA minutes per day (dichotomised around the study
205 median: 57.5 minutes), sedentary minutes per day (dichotomised around the median: 434.6
206 minutes), and by child gender. This produced eight sub-groups (1 = low MVPA, low
207 sedentary time boys; and 8 = high MVPA, high sedentary time girls; Table S1). The order in
208 which parents were invited to participate in an interview was randomised within each sub-
209 group. Contact attempts were made with 188 parents in total, of which 59 (31.4%) initially
210 agreed to participate in an interview, and 51 (27.1%) completed an interview (Figure 2).
211 Interviews were audio-recorded and continued until theoretical saturation was reached for the
212 entire sample and the sub-groups. Parents were invited to participate by telephone between

213 July and October 2016, and interviews were conducted at the interviewee's convenience (37
214 during weekday daytimes (72.5%), 13 during weekday evenings (25.5%), and 1 on a
215 weekend evening (2%)). Participants were sent a £10 high street shopping voucher as a thank
216 you for their time.

217

218 An interview guide was developed and refined by the research team based on identifying
219 gaps in current knowledge and guided by the Year 1 B-Proact1v quantitative and qualitative
220 findings. This included questions relating to a variety of topics, including parents'
221 perceptions of their child's physical activity and screen-viewing behaviours,[48] strategies
222 for managing these behaviours,[49 50] understanding what has changed regarding these
223 behaviours,[17 40] and understanding how family dynamics influence children's physical
224 activity.[51] The need to engage more fathers in research was also identified as a priority.[31
225 51] Questions were posed in a non-leading manner to allow participants to shape the direction
226 of the interview, and issues that emerged were probed. Interviews were conducted by two
227 female researchers (qualified to at least MSc level) who were trained in conducting
228 qualitative interviews.

229

230 ***Data analysis***

231 *Quantitative data*

232 Means, proportions and Chi Square statistics were used to examine the distributions of
233 exposures, outcomes and co-variates between participants included and excluded in this
234 study, and between child and parent gender. Nearly all parents reported that both parents
235 "*should take the lead*" in supporting their child's activity (93.8%), therefore we could not
236 explore the association of parental attitudes towards who should support child physical

237 activity, as numbers were too small in the mother or father only categories. We used linear
238 regression models to examine the associations of parent support of child activity during the
239 week and weekend with the child's MVPA minutes per day and CPM, and logistic regression
240 models to examine associations with achievement of the MVPA guideline. Models were
241 adjusted for child age, gender of parent providing the information on support, and household
242 IMD score. Robust standard errors were used to account for the clustering of children in
243 schools for all models. Models were examined for all children, and separately for boys and
244 girls. Combined Wald tests were used to test for evidence of interaction between child gender
245 and the exposure of interest. All analyses were performed in Stata version 14.0 (StataCorp,
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

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

265

266 **RESULTS**

267 *Participant characteristics*

268 The characteristics of the participants included and excluded from the quantitative dataset,
269 and from the subset of interview participants, are shown in Table 1. Of the 944 included
270 families, the majority (680 (72%)) had data from a mother/female care giver, with 264 (28%)
271 from fathers/male care givers. Children excluded due to missing data were more likely to be
272 deprived and did less minutes of MVPA per day, but were otherwise similar to the included
273 dataset. Of the interview participants (N=51), 31 were mothers and 20 were fathers, with an
274 average age of 41.2 (SD: 4.5) years, and 94.1% were White British. The interview
275 participants were generally comparable to the main dataset, but tended to be less deprived.
276 Interview participants were also more likely to be fathers and have less active children
277 compared to the main dataset. The average interview duration was 34.4 minutes (SD: 8.0
278 minutes, range: 18 to 55 minutes).

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

Characteristic	Included (N=944)	Excluded		<i>p</i>	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	
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 ^b 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

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

281 Supplementary Table 2 shows the gender of the parent who reportedly supports child
282 physical activity by parent and child gender. Mothers reported that typically they led in
283 supporting their child's physical activity during the week, whereas fathers generally reported
284 that duties were shared between parents. Most mothers and fathers reported that both parents
285 shared the role of supporting their child's activity at the weekend, however, 31% of mothers
286 and 27% of fathers, respectively, reported that they led child activity.

287

288 The interview data generally supported this, with several mothers stating that they support
289 their child to be active during the week out of necessity because fathers were working long
290 hours or late into the evening. Some mothers also reported that they try to get the whole
291 family together to do activities at the weekend, although this isn't always the norm.

292

293 *“On a weekday it's just, you know, every night we've got one or the other [children] have got*
294 *a club on so it's just finish school and then me taking the children to their various clubs and*
295 *then coming home and it's, erm, you know, pretty much get ready for bedtime ... Weekends,*
296 *yeah, we try to do stuff as a family.” [Int 14, Mother, Girl, 63 MVPA minutes/day, Mother*
297 *supports weekday PA, Both parents support weekend PA]*

298

299 *“We like to do things as a family when we can; it's just all being around. My husband works*
300 *quite late hours and things like that ... He's, he's home when they're going to bed usually ...*
301 *but like last Sunday, we all went swimming together as a family thing... but that isn't – to be*
302 *honest, that isn't like, isn't like we would do that every weekend or anything” [Int 35,*
303 *Mother, Girl, 72 MVPA minutes/day, Mother supports weekday PA, Both parents support*
304 *weekend PA]*

305

306 Some parents indicated that they share the responsibility of supporting child physical activity,
307 due to sharing an appreciation for the benefits of physical activity or because they value
308 physical activity and feel a moral responsibility to fit activity in to the realities of life.

309

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

312 Mother, Son, 59 MVPA minutes/day, Both parents support weekday and weekend PA]

313

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

318 parents support weekday and weekend PA]

319

320 *“So wherever we can we’ll always try and do the right thing [physical activity] and, you*
321 *know, sometimes if it’s not taking the car and it’s walking distance we’ll try and walk, and*
322 *things like that..”* [Int 18, Father, Son, 86 MVPA minutes/day, Father supports weekday and

323 weekend PA]

324

325 A few parents reported sharing the responsibility of supporting child physical activity, but
326 also doing activities separately due to child preferences. Examples included fathers and sons
327 using physical activity time to bond over shared interests, while also giving mothers a respite
328 for some “me time”, or parents taking children to separate activities to appease child

329 preferences, avoid conflict, and/or facilitate parent-child one-on-one time irrespective of
330 gender.

331

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

337

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

343

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

349

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

353 that they shared the responsibility of supporting child activity at the weekend, although
354 parents of girls were more likely to report that mothers supported their daughter's weekend
355 activity.

356

357 In contrast, the interview data revealed a mix of gender patterns associated with supporting
358 child physical activity, not just mothers supporting daughters and fathers supporting sons.
359 Some fathers reported that they supported their daughter's physical activity through
360 chauffeuring them to sports clubs, and expressed that they do so not just for logistical
361 reasons, but also because they get real enjoyment from watching. A few mothers reported a
362 lack of confidence in their own physical activity, because they aren't "naturally sporty" and
363 so they tend to let fathers take the lead in supporting child physical activity.

364

365 *"Yeah, she's been playing football for two and a half seasons now ... and she's passionate*
366 *about that. So I'm just a sort of chauffeur dad ... that stands on the touchline in the cold*
367 *windy rain. I enjoy that."* [Int 51, Father, Girl, 71 MVPA minutes/day, Father supports
368 weekday and weekend PA]

369

370 *"Not that confident cause, like I say, I'm not actually naturally sporty or active. So it would*
371 *be something that we would probably do as a family with their dad, and we could do it*
372 *together.....He's more confident, yeah, and he's more knowledgeable really with all that*
373 *kind of stuff. And he's a – and he's the kind of person that's very much into, 'Come on, let's*
374 *give it a go. Let's try and see. We might really enjoy it,' whereas I'm a bit more like, 'Oh no,*
375 *don't make me do this. I'm really nervous.'* And so I would probably shy away from it." [Int

376 24, Mother, Girl, 43 MVPA minutes/day, Mother supports weekday PA, Father supports
377 weekend PA]

378

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

380 Table 2 shows the mean difference in child MVPA minutes per day by which parent/s take
381 the lead in supporting child activity during the week and weekend. Compared to reporting
382 that mothers support child activity (reference group), reporting that parents share the role of
383 supporting child activity during the week was associated with children doing, on average, an
384 additional 3.5 minutes of MVPA per day. When examined separately by child gender, parents
385 sharing the role of supporting child activity during the week was associated with, on average,
386 an additional 5.9 minutes of MVPA per day for boys, and 0.4 minutes per day for girls, with
387 no strong statistical evidence of a difference between boys and girls ($P_{\text{interaction}} = 0.34$).

388 Fathers taking the lead in supporting child activity (compared to mothers) was more weakly
389 associated with child MVPA, with an inverse (rather than positive) association for girls, but
390 again with no strong statistical evidence for gender interaction. Associations for parent
391 support of child physical activity during the weekend showed very similar patterns to those
392 for weekday activity, but were somewhat weaker in magnitude. In general, the patterns of
393 association with achieving MVPA recommendations were similar to what was found for
394 MVPA as a continuous measure, including point estimates suggesting weaker or inverse
395 effects in girls but no evidence of gender interaction (Table 3). The one exception was that
396 fathers supporting activity at weekends had a similar magnitude of effect as both parents
397 being supporters.

398

399 The mean difference in children's CPM by parent/s who supports child activity during the
400 week also showed a similar pattern to that seen for time spent in MVPA (Table 2).

401 **Table 2 Mean difference in the children’s average MVPA minutes per day and accelerometer counts per minute associated with gender**
 402 **of parent who supports physical activity during the week and weekend (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)	
Supports child activity during week	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)	
Supports child activity at the weekend	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)	
Supports child activity during week	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)	
Supports child activity at the weekend	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)	

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

421 **Table 3 Odds ratio for children achieving 60 minutes of MVPA per day associated with gender of parent supporting child physical**
 422 **activity during the week and weekend (N=944)**

Exposure		Meeting government guideline: odds ratio (95% confidence interval)			P for gender interaction
		All (N=944)	Boys (N=427)	Girls (N=517)	
Supports child activity during week	Mother (ref)	0	0	0	0.95
	Father	0.96 (0.54, 1.72)	1.61 (0.62, 4.21)	0.75 (0.34, 1.66)	
	Both parents	1.60 (1.20, 2.14)	2.23 (1.37, 3.62)	1.23 (0.83, 1.82)	
Supports child activity at the weekend	Mother (ref)	0	0	0	0.30
	Father	1.20 (0.78, 1.86)	2.10 (1.02, 4.32)	0.74 (0.40, 1.38)	
	Both parents	1.20 (0.86, 1.68)	1.81 (1.01, 3.24)	1.00 (0.64, 1.54)	

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

433 **DISCUSSION**

434 The data presented in this paper show that while the participants in this study believe the
435 responsibility of supporting child physical activity should be shared between both parents,
436 quantitative data suggest that families mostly share the role on the weekend, with mothers
437 primarily supporting child activity during the week. This finding was mirrored in the
438 interview data, where several mothers reported that they supported child activity during the
439 week, because fathers worked long hours or late into the evening. Despite families
440 traditionally functioning such that one parent (often the mother) takes on more childcare
441 responsibilities in general, it is interesting that parents still feel that supporting child activity
442 should be a shared responsibility. Indeed, traditional familial roles are shifting, and it is now
443 more common for both parents to work and for fathers to take on the role of primary care
444 provider,[54 55] so it may be expected that more fathers are taking an active role in their
445 children’s physical activity. We found that the majority of parents reported they shared the
446 role of supporting their child’s activity both during the week and at the weekend (40-65% of
447 mothers and fathers responded this way for both time points; Table S2).

448

449 In quantitative analyses for all three outcomes (time spent in MVPA, meeting MVPA
450 recommendations and CPM) we saw similar patterns of, in general, higher child physical
451 activity where parents reportedly shared the role of supporting their child’s physical activity
452 during both weekdays and weekends. For example, both parents supporting child activity
453 equally during the week was associated with boys doing an additional 40 minutes of MVPA
454 across the week, which could be the difference between a child achieving the recommended
455 guidelines or not. The one exception was for meeting MVPA recommendations at the
456 weekend, where associations of fathers reportedly leading the support were similar to those

457 when both parents shared the responsibility. There was some evidence that positive
458 associations were stronger for sons, and that some associations were inverse for daughters.
459 However, we found no strong statistical evidence that associations differed between sons and
460 daughters, and without further exploration in much larger numbers we cannot assume that
461 parental roles in supporting their child's activity differ by the child's gender.

462

463 There was some suggestion that mothers were more likely to support their daughter to be
464 active, while fathers were more likely to support their son's activity, though caution is needed
465 here given the disparity in which parents provide data, with 72% of families having data from
466 mothers only and 28% from fathers only. Several studies have reported that fathers may be
467 more involved in their son's physical activity,[15 31] or have found stronger links between
468 father-son and mother-daughter dyads in terms of their physical activity behaviour.[36-38] In
469 contrast, interview data from the current study revealed a myriad of gender patterns,
470 including examples from fathers supporting girls' physical activity because they were more
471 confident than mothers in supporting physical activity or because they enjoy watching their
472 daughter play football, and a mother taking her son mountain biking to engage in quality one-
473 on-one time. There were also examples of fathers taking sons to traditionally male-orientated
474 sports (e.g., rugby or football) to bond over shared interests and give mothers a respite from
475 parenting.

476

477 The results from the current study suggest intervention studies should be developed to engage
478 both parents, or specifically fathers, in supporting their children to be active, not necessarily
479 focused on children and parents being active together, but rather on how parents can work
480 together to schedule times for children to be active across the week in both structured and

481 unstructured activities, and how parents can share the role between parenting partners. Table
482 4 summarises the key findings and implications for how parents can support child activity
483 that have emerged from this study. These suggestions provide ways that researchers and
484 policy makers can help parents to support their child's physical activity, through providing
485 advice and encouragement to developing family physical activity plans. Research needs to be
486 conducted into how best to operationalise these suggestions and understand the channels that
487 parents typically use for finding parenting advice and ideas for physical activities. Potential
488 avenues for disseminating advice include encouraging sharing of advice and positive
489 affirmations via parents' peer networks, delivering information through schools, or
490 communicating advice via social media and parenting forums.

491 **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

492

493 ***Strengths and limitations***

494 A main strength of the study is the mixed-methods approach, utilising both accelerometer-
495 assessed physical activity from a large sample of 8-9-year-old children and semi-structured
496 interview data with parents. This approach provides rich data about the gender roles
497 associated with how parents support their child's activity. Another strength is that we
498 interviewed a relatively large sample of parents, including 20 fathers, a group that are known
499 to be difficult to engage in research.[56] Limitations of the study include its cross-sectional
500 nature so causality could not be examined. In the main dataset, parents were primarily
501 represented by mothers (72%), which is likely to have biased how they responded to
502 questions about who supports their child's activity. In addition, because only one parent was
503 required to participate with their child, this study does not include information on whether
504 children were from same-sex families, single-parent families, or where primary caregivers are
505 grandparent or extended family. We had very limited power to explore gender interactions,
506 thus whilst our results suggest that parent support of their child's physical activity might have
507 a stronger positive impact on sons compared with daughters it would be wrong to conclude
508 that from these data, and much larger independent studies are required to explore that further.
509 Parental responses to our exposure questions provided no information on the type (quality or
510 quantity) of their supporting role, and thus it is not known whether both parents equally
511 supporting child activity is simply a proxy for greater support. Additionally, the variable
512 ascertaining which parent 'should take the lead in supporting child physical activity' did not
513 differentiate between weekdays and weekend days. 279 families were excluded from the
514 study due to missing data, which may have resulted in sampling bias, because these
515 participants differed from included participants in terms of their MVPA and household IMD
516 score. This study is also drawn from a single UK city area with a primarily White British

517 population, and as such our ability to extend findings to other settings countries, and
518 ethnicities is limited.

519

520 **CONCLUSIONS**

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

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

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

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

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

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

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

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

529 supporting roles (quality and frequency).

530

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540

541 **COMPETING INTERESTS**

542 All authors have completed the ICMJE uniform disclosure form at
543 www.icmje.org/coi_disclosure.pdf and declare: all authors had financial support from the
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547

548 **CONTRIBUTORS**

549 Conception / design: RJ, ESM, JLT, DAL and SJS.
550 Quantitative and Qualitative data collection: ESM.
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553 Final approval: All authors.
554 Accountability for study and manuscript: ESM, RJ.

555

556 **DATA SHARING STATEMENT**

557 The datasets generated during the current study are not publicly available as the project is
558 ongoing and data are not ready for archiving. We will make quantitative data available to the
559 wider research community once the project is complete in August 2019. Because of possible
560 disclosure with qualitative data we will consider requests to use and further explore those
561 data on a per request basis with an appropriate balance between sharing data as fully as
562 possible whilst maintaining participant anonymity.

563

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730

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

732

733 **Figure 2 Study flow of participants for the qualitative study**

Figure 1 Study flow of participants for the quantitative study

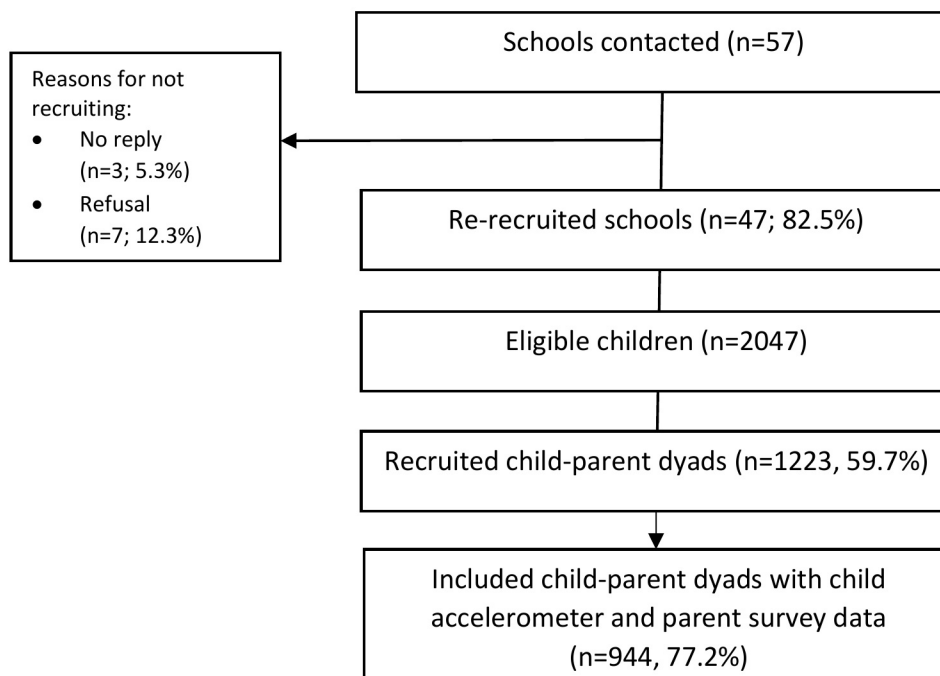


Figure 2 Study flow of participants for the qualitative study

