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ABSTRACT

Purpose: We studied whether physical activity (PA) counseling for parents influenced the level of parental support of children's PA and leisure time PA in children of different levels of initial parental support. It was hypothesized that the initial level of parental support would moderate the intervention efficacy. **Methods:** Children ($n = 44$, $Mage = 6.09 \pm 1.17$ years) and their parents ($n = 61$) randomized to an intervention group received counseling for six months. Children of the control group ($n = 47$, $Mage = 6.12 \pm 1.11$ years) and their parents ($n = 63$) did not receive any counseling. Parental support was assessed using the Family Physical Activity Environment (FPAE) questionnaire and children's leisure time PA was recorded using triaxial accelerometers at baseline, at 6 months, and at 12 months. The efficacy of intervention was tested by linear mixed-effects modelling adjusting for confounding variables (Model 1), and additionally for children's participation in organized PA or sports (Model 2). **Results:** Parents within the lowest initial parental support intervention tertile significantly increased their support and their children's mean level of leisure time PA significantly improved compared to the corresponding controls during the counseling period. On the other hand, intervention was found to have an unfavorable influence especially in the PA of children of initially highly supportive parents. **Conclusion:** Targeting PA counseling for parents with low support of their children's PA could contribute to better family-based PA counseling efficacy.

Keywords: young children, physical activity behavior, family-based intervention, physical activity parenting

22 Parental Support and Objectively Measured Physical Activity in Children: a Year-Long Cluster
23 Randomized Controlled Efficacy Trial

24 The role of physical activity (PA) in health is well documented already in childhood
25 (Strong et al., 2005). PA may also play a crucial role in cognition (Tomporowski, Lambourne, &
26 Okumura, 2011) as well as in psychosocial wellbeing (Timmons et al., 2012). Due to a high
27 prevalence of inactivity among children (Spittaels et al., 2012) and a tracking of PA behavior
28 over time (Telama et al., 2014), there is a need to identify feasible and effective strategies to
29 influence the early formation of PA habits.

30 Leisure-time PA has been shown to be low and progressively decreasing during
31 childhood (Telford et al., 2013). Family influence has been recognized as one of the most
32 important predictors of children's overall, as well as leisure time, PA. Parental support of
33 children's PA (Beets, Cardinal, & Alderman, 2010; Cleland et al., 2011; Edwardson & Gorely,
34 2010; Loprinzi & Trost, 2010; Rhodes et al., 2013), parents' perceived behavior control over
35 children's PA (Rhodes et al., 2013), and parents' participation in PA with a child (Beets et al.,
36 2010; Edwardson & Gorely, 2010) have all been linked to greater PA in children. However,
37 parents' own PA level seems to be neither a prerequisite for children's PA nor is parents' own
38 inactivity a primary barrier for children's PA (e.g., Iannotti et al. 2005; Yao and Rhodes 2015),
39 but it is the case that physically active parents tend to more often support children's PA (Dowda
40 et al., 2011; Loprinzi & Trost, 2010). Sedentary behavior, based on the limited research literature
41 to date, does seem to associate between parents and their children (Jago, Fox, Page, Brockman,
42 & Thompson, 2010) and activities performed together as a family are typically sedentary in
43 nature (Thompson et al., 2010). Therefore, encouraging parental support for children's PA and

44 limiting co-participation in sedentary behaviors remain potential intervention strategies for
45 affecting PA in children.

46 Direct involvement of parents (e.g., parents' presence at education sessions, parents'
47 attendance and participation at counseling or training sessions or phone communication with
48 parents) is known to be a cornerstone of family-based nutrition (Hingle, Connor, Dave, &
49 Baranowski, 2010) and PA interventions (Brown et al., 2016; O'Connor, Jago, & Baranowski,
50 2009). Families are known to have heterogeneous work time demands and free time interests
51 (Thompson et al., 2010), and this may be a reason why focusing on small-step and gradually
52 increasing goal setting and encouragement have been shown to be key methods in family-based
53 PA enhancement in children (Brown et al., 2016; Rodearmel et al., 2006). There is however very
54 little support for the family-based PA intervention effectiveness on children's objectively
55 measured PA (Metcalf, Henley, & Wilkin, 2012). Therefore, there is a great need for examining
56 mechanisms, especially moderators and mediators, of the family-based PA interventions for
57 better understanding how PA in children should be promoted in a family context (Brown et al.,
58 2016; O'Connor et al., 2009).

59 We conducted a cluster-randomized controlled trial "A family-based tailored counseling
60 to increase non-exercise physical activity in adults with a sedentary job and physical activity in
61 their young children" (InPact, ISRCTN28668090) (Finni, Sääkslahti, Laukkanen, Pesola, &
62 Sipilä, 2011). The InPact study was designed to help parents' to find ways to decrease sedentary
63 behavior of their own and to increase PA in their children. PA counseling of the study was based
64 on social cognitive theory (Bandura, 1986) and theory of planned behavior (Ajzen, 1985). The
65 counseling was found to significantly decrease parents' muscle inactivity and to increase light
66 muscle activity in short-term (Pesola et al., 2014). However, PA in children of the intervention

67 group declined statistically significantly compared to their control peers although the
68 development of some domains of motor competence was positively associated with the
69 counseling (Laukkanen, Pesola, Heikkinen, Sääkslahti, & Finni, 2015). Results suggested
70 distinct counseling efficacy on parents and their children's PA behavior when treated at the same
71 time, and this is why we decided to study the counseling efficacy on children's PA behavior in
72 more detail.

73 Association between the parental support of children's PA and the children's PA is well
74 documented but little is known of how to influence changes in these variables (Davison et al.,
75 2013; O'Connor et al., 2009). We hypothesized that the initial level of parental support of
76 children's PA moderates the efficacy of family-based PA intervention. We based the hypothesis
77 on an assumption that parents who initially provide different levels of support (low or high) for
78 their children's PA have different potentials for supporting the change in their children's PA
79 behavior which may affect the counseling efficacy on their children's PA. Consequently, this
80 study examined whether the family-based PA intervention, consisting of individually tailored
81 face-to-face and phone counseling for the parents of children aged 4 to 7 years, influenced
82 parental support of children's PA and objectively measured leisure-time PA in the children with
83 the lowest and highest initial parental support. We aimed to complement interpretation of the
84 intervention efficacy analyses by describing intervention evaluation separately from the view of
85 parents with the lowest and highest initial parental support of children's PA.

86 **Methods**

87 The local ethics committee approved the study protocol (Dnro 6U / 2011) and all the
88 parents signed a written informed consent form for their own and their children's participation in

89 the study. A checklist of the CONSORT 2010 Statement for reporting randomized trials (Moher
90 et al., 2010) guided reporting of the methods and findings of this trial.

91 **Cluster Randomization and Recruitment**

92 We performed randomization and recruitment in a Scandinavian city with around
93 133,000 inhabitants living in a relatively small city center and topographically varied suburbs.
94 Based on a city registry and recreational city map, we identified equivalent suburbs in the city in
95 terms of amount of the children attending regional kindergarten(s) or day care center(s)
96 (henceforth referred as day care center) and school(s), mean educational level of the region, and
97 PA possibilities in natural landscapes. We then formed seven balanced counterpart regions
98 (henceforth referred as “clusters”, one to four day care centers or schools in each cluster) and
99 randomized to either the intervention or the control cluster between these counterparts. Families
100 were recruited from the intervention cluster regions to intervention group and from the control
101 cluster region to control group. Contamination between the intervention and control groups was
102 avoided by forming the balanced intervention and control regions on geographically opposite
103 sides of the city. Figure 1 illustrates the enrollment and allocation, as well as measurement and
104 analysis flow of the present study.

105 **Figure 1 here.**

106 Children attending less than 10 days a month in a day care center, and having a
107 developmental disorder or other disorders delaying motor development we excluded from the
108 study. Because the intervention was not only aimed at affecting behavior of children’s but also
109 their parents’, there were exclusion criteria also for parents. Accordingly, we excluded parents
110 sitting less than 50% of their work time or having chronic diseases, and pregnant parents. We
111 accepted families including both parent(s) and a child and fulfilling the study criteria for the

112 study. We recruited participants between April 2011 and April 2012. Altogether 35 and 36
113 children and their parents of the intervention and control groups begun in the study between May
114 2011 and December 2011, respectively. In addition, 16 children and their parents from both
115 randomized groups begun in the study between January 2012 and May 2012, respectively.

116 **Tailored Counseling**

117 **Theoretical Framework.** Behavior change techniques based on social cognitive theory
118 (Bandura, 1986) and the theory of planned behavior (Ajzen, 1985) were systematically used by
119 researchers in the counseling process. Description of the behavior change techniques utilized is
120 reported elsewhere (Laukkanen et al., 2015) and detailed here briefly. We utilized altogether 9
121 behavior change techniques in the counseling process: providing instruction (I), providing
122 information on consequences (IC), prompting identification as a role model (IRM), providing
123 general encouragement (GE), providing information about others approval (IOA), prompting
124 intention formation (IF), progressive goal setting (PGS), prompting barrier identification (BI)
125 and self-evaluation (SE). This process comprised of a lecture (I, IC, IRM, GE, IOA), individual
126 face-to-face counseling (GE, IF) and goal setting (PGS) given in a university seminar class in
127 two weeks after the baseline measurements, and phone consultation (GE, PGS, BI, SE) at 2 and 5
128 months after the baseline. The researchers (AL, male, approx. 30-years old, engaged; AP, male,
129 approx. 30-years old, married; TF, female, approx. 40-years old, married and a parent of 2
130 children) received orientation on good practices in PA counseling before the study.

131 **Lecture.** In the approximately 30 min lecture given by one of the researcher's (AL), one
132 hour of moderate to vigorous PA (MVPA) at leisure time each day was encouraged to be
133 targeted in the children (I). This target was justified by the research evidence indicating the high
134 proportion of children not achieving even a half (Spittaels et al., 2012) of the nationally

135 recommended level of two hours of MVPA each day (Sosiaali- ja terveystieteiden ministeriön oppaita,
136 2005) and by the assumed health and developmental benefits due to increased PA (IC). Specific
137 arguments related to the associations found between PA and health, motor competence and
138 cognitive functioning. We encouraged parents to give children possibilities for PA in everyday
139 leisure time, and also to enable PA in non-built environments such as heaths, forests, and hills
140 (Sallis, Prochaska, & Taylor, 2000) (GE). We encouraged efforts increasing PA especially in
141 winter time as this has been generally known to be a more inactive season in northern countries
142 (Carson & Spence, 2010). We emphasized the meaning of role modeling in PA by providing
143 examples where parents act as role models for their children, e.g. situations when they spend
144 time with their children and they have to choose between lift and stairs or between bicycling and
145 taking a car (IRM). During the lecture, opinions on and approval of restricting PA in children
146 (e.g., for the sake of convenience) were discussed by parents and researchers (IOA).

147 **Face-to-Face Discussion.** After the lecture, individual face-to-face discussion took place.
148 Following a fidelity checklist, a researcher asked a parent to describe their families' leisure-time
149 and PA habits at leisure time. Next, the same researcher encouraged the parent, first, to identify
150 contexts where PA in their children could be feasible to be enhanced, and second, to set small-
151 step goals aiming at increasing PA in the child(ren) (GE, IF). The small-step goals set were, for
152 instance, "I will let my child to walk to the day care center with me" or "We will go outdoors as
153 a family". Every goal was set on the scale from 1 to 4 depending on the frequency of the
154 intended implementation (1: randomly, 2: once or twice a week, 3: three to four times a week, 4:
155 daily). Gradually progressing goal-setting was recommended so that the baseline goals set would
156 be likely achievable and they could be progressively raised later in the phone consultations

157 (PGS). The goals set were written into an agreement form which was signed by the parent and
158 the researcher.

159 **Phone Consultation.** We enhanced compliance with the goal implementation by phone
160 consultations at two months and five months after the face-to-face counseling (GE). Compliance
161 with the goals and perceived barriers for implementation of goals were discussed and possible
162 modifications to the goals were suggested (PGS, BI). Furthermore, we promoted self-evaluation
163 of the compliance by a question “Did you do your best to achieve the goal?” and by asking
164 answer on a scale between 1 and 5 (1: not at all, 2: a little, 3: moderately, 4: relatively well, 5:
165 fully) (SE). Implementation of the goals was reinforced by monthly emails for the first six
166 months. Parents were instructed to continue the children’s PA promotion after the reinforced
167 intervention period.

168 **Parental Support**

169 We used the Family Physical Activity Environment (FPAE) questionnaire for
170 determining the parental support of children’s PA (Cleland et al. (2011). The test-retest
171 reliability of the questionnaire has been found good in 5-6 and 10-12-years old Australian
172 children (ICC = .81 – .90). The FPAE was translated into the mother tongue of the study
173 participants by an informed translator and by an uninformed one (Beaton, Bombardier,
174 Guillemin, & Ferraz, 2000). The two independent translations were compared in the second
175 phase of the translation process, and via the consensus of the translators, a synthesized version of
176 the questionnaire was formed. In the third phase, the translated questionnaire was pretested for
177 its clarity of language and suitability for the local culture by five experts in different fields
178 (physical education, exercise physiology, kinesiology, and health science). We chose three
179 sections consisting of altogether seven items from the FPAE to represent the rate of parental

180 support on children's PA. Each section consisted of two separate items considering the parental
181 support the father, and secondly, the mother has provided to the child. We saw this classification
182 suitable as the legal guardians of the children involved in this study were all either mothers or
183 fathers. The first section, family participation in PA, was assessed by the following items:
184 "Evaluate how often *father / mother* participates in physical activity with your child, such as
185 moving and playing games". Moreover, the first section included a third item: "Evaluate how
186 often you do physical activity, such as cycling, walking, playing outdoors or indoors, hiking,
187 playing games, together as a family". The second section, direct support on child's PA, was
188 assessed as follows: "Evaluate how often *father / mother* provides support for your child's
189 participation in physical activity, such as take him / her to PA hobby or training, provide money
190 for participation, buy sports clothing / equipment". The third section, reinforcement for PA, was
191 assessed by the following items: "Evaluate how often *father / mother* praises your child for
192 participating in PA, such as say positive things to him / her for being physically active". Parents
193 were asked to evaluate the frequency of support regarding the youngest child of the family
194 participating in the study on a six-step scale for each item (1 = never, 2 = less than once per
195 week, 3 = 1 – 2 times per week, 4 = 3 – 4 times per week, 5 = 5 – 6 times per week, 6 = daily).
196 We asked the same parent to fulfill the FPAE questionnaire in each time at baseline, 6 months,
197 and 12 months.

198 **Assessment of Leisure-Time Physical Activity, Anthropometrics and Socioeconomic status**

199 **Leisure-Time PA.** Children's PA was measured with triaxial X6-1a accelerometers with
200 a dynamic range of ± 6 g (Gulf Coast Data Concepts Inc., Waveland, MS, USA) at baseline, 6
201 months, and 12 months for six consecutive days at a time. For analysis we accepted recordings
202 that contained day care center or school time and leisure time longer than seven hours a day (420

203 min) on at least three days per measurement point (at minimum two weekdays and one weekend
204 day, for more see Penpraze et al., 2006). Because the intervention focused on time the parents
205 spend with their children, we examined changes in PA during leisure time. Based on diaries
206 completed by the parents, leisure-time PA was recorded on average for 5.86 ± 1.51 hr / day
207 (minimum 3.19 hr / day, maximum 9.87 hr / day, referring to out of school or day care center
208 hours) during 3.35 ± 0.79 weekdays. On average, 1.81 ± 0.39 weekend days with a mean of
209 11.25 ± 1.43 hr / day (minimum 7.08hr / day, maximum 15.64 hr / day) were recorded and
210 analyzed. Hence, the measured total leisure-time PA was on average similar between weekdays
211 and weekend days (19.6 hr vs. 20.4 hr). We calculated average counts per min (henceforth
212 CPM), indicating the mean level of PA (Cardon & De Bourdeaudhuij, 2008), for the leisure time
213 at each measurement point. Also, time (min) spent at sedentary, light and MVPA intensities were
214 calculated on the basis of validated cut-off points (van Cauwenberghe, Labarque, Trost, De
215 Bourdeaudhuij, & Cardon, 2011). We weighted PA data measured on weekdays' leisure time by
216 $5 / 7$ and on weekend days' leisure time by $2 / 7$. We assessed children's participation in
217 organized PA or sports by asking from the parents whether their child participating in this study
218 is involved in an organized PA or sports out of the day care center or school time. The answer
219 was coded as "yes" or "no".

220 **Anthropometrics and Socioeconomic Status.** We measured height and body weight in
221 the laboratory at 6 months and calculated body mass index (kg / m^2). The highest achieved
222 educational level was used as a measure of socioeconomic status (SES) and we asked parents to
223 evaluate it on the scale from zero to four (0 = elementary school, 1 = secondary school, 2 = high
224 school, 3 = vocational or intermediate degree, 4 = polytechnic or university degree). A mean of
225 the highest educational level of parent(s) was calculated and used for analyses. Besides, to

226 describe the SES among parents of the study sample, a dichotomous variable of “higher level
227 education” (value 4) and “no higher level education” (values 0 – 3) was formed.

228 **Intervention Evaluation**

229 Goals set by parents in the intervention group during the face-to-face counseling and in
230 the phone counselings 1 and 2 were categorized according to how PA in children was aimed to
231 be enhanced. Altogether we formed 5 categories (PA with family, PA with peers, PA outdoors,
232 PA in the backyard or in the neighboring area, PA indoors) covering 97 – 100% of all the goals
233 set. Proportion of the goal categories among parents of the lowest and highest initial parental
234 support tertiles was then calculated in relation to the total frequency of the goals in the
235 corresponding tertile and in the certain counseling time. We performed similar protocol for
236 evaluating the most common barriers for goal implementation perceived by the parents in the
237 phone counselings. We conducted evaluation of the perceived barriers separately for those
238 considering weekdays and weekend days. During a common feedback session in the end of the
239 study, we asked parents to rate the order of importance of the counseling tools. We evaluated the
240 counseling tool the more important the more often it was rated as the most important intervention
241 tool by the parents.

242 **Statistical Analysis**

243 We found internal consistency for all seven of the FPAE items to be good after testing
244 Cronbach’s alpha at baseline (0.83), 6 months (0.79), and 12 months (0.83). Pairwise
245 correlations ranged from low to moderately high between all seven items at different
246 measurement points (baseline, 6 months, and 12 months) ($0.334 < r < 0.718$), and removal of any
247 of the items would not have increased the consistency of the questionnaire. Therefore, we
248 calculated a sum factor of all seven selected FPAE items (mean 24.62 ± 0.88 , 23.81 ± 1.02 and

249 23.39 ± 0.96 at baseline, 6 months and 12 months, respectively) and used it as a parental support
250 factor for further analysis.

251 We formed tertiles of low and high initial parental support for examining the parental
252 support as a moderator of the intervention efficacy. The use of tertiles was aimed to facilitate the
253 drawing of conclusions and practical implications of the study. The tertiles were formed by
254 selecting the lowest and highest thirds (33 %) of the intervention and control families based on
255 the sum factor of the FPAE at baseline. There were higher FPAE sum factor scores among the
256 intervention group compared to the control group, and a one more family was included to the
257 highest intervention tertile and a one less to the highest control tertile for achieving a statistical
258 balance between the tertiles. The level of initial parental support was therefore statistically equal
259 between the children in the lowest tertiles of intervention ($n = 15$, mean 2.77 ± 0.33 , min. 2.14,
260 max. 3.14, range 1) and control ($n = 16$, mean 2.74 ± 0.37 , min. 1.86, max. 3.14, range 1.29), and
261 between the children in the highest tertiles of intervention ($n = 16$, mean 4.51 ± 0.46 , min. 4.0,
262 max. 5.71, range 1.71) and control ($n = 14$, mean 4.42 ± 0.55 , min. 3.57, max. 5.14, range 1.57).
263 We tested the intervention efficacy on changes in parental support and PA using the whole
264 sample ($n = 91$) and tertiles of parental support.

265 We tested differences between the intervention and control groups and the tertiles of
266 parental support in background characteristics by an independent samples t test (age of child and
267 parent(s), height, weight, BMI, log transformed PA variables, measurement length of PA per
268 day, parental support items and sum score), the Mann-Whitney U test (measurement days of
269 PA), and a chi-square (X^2) test (participation to organized PA or sports, higher level education,
270 being single parent, answerer's sex of FPAE). We calculated the Cohen's d for indicating the

271 effect sizes (ES) of the statistically significant differences in the background variables and they
272 were interpreted as small when $ES \geq 0.2$, medium when $ES \geq 0.5$ and large when $ES \geq 0.8$.

273 We analyzed the efficacy of intervention with linear mixed-effects model fit by restricted
274 maximum likelihood using the Statistical Package for the Social Sciences (SPSS; IBM SPSS
275 Statistics 22). Analysis of the counseling efficacy was initially based on a three-level hierarchy
276 where children ($n = 91$) were nested within families ($n = 85$) and families were nested within
277 randomized clusters ($n = 14$). The children, families and clustered samples were considered in
278 the models as random grouping effects. However, we found the effect of family level and
279 clustered samples to be insignificant and they were therefore left out from the final models and
280 tests examining the counseling efficacy. The Group \times Time interaction formed a base for all
281 autoregressive covariance models (AR1) examining the efficacy of intervention on, first, parental
282 support, and second, on the mean level and specific intensities of PA in children with different
283 levels of initial parental support between baseline and 12 months. Based on this interaction, we
284 calculated mean change from baseline to 6 months and mean difference between groups in these
285 time intervals. We entered theory-based confounding variables (answerer's sex to FPAE, BMI,
286 total number of children in the family, age of mother and father, SES, age and sex of a child,
287 temperature of the measurement month, season started in the study, participation to organized
288 PA or sports, measurement length of PA per day, measurement days of PA and with regard to
289 parental support models also mean level of PA) one by one into the unadjusted Group \times Time
290 model. We entered all variables significantly interacting with the unadjusted model into the
291 adjusted mixed effect models.

292 Model 1 examining the intervention efficacy on parental support was adjusted (in the
293 order of statistical significance) for child's age, PA in leisure time, and average temperature of

294 the measurement month. When we examined the intervention efficacy on PA, we adjusted Model
295 1 for temperature of the measurement month, the child's sex, and the sex of the parent answering
296 the parental support questionnaire. Furthermore, we found the child's participation in organized
297 PA or sports to be a nearly significant confounding variable when examining the intervention
298 efficacy on parental support and a significant variable when examining the efficacy on PA.
299 However, interpretation of the interaction between participation in organized PA or sports and
300 the intervention efficacy on PA can be complex. Therefore, we applied model 2 when examining
301 the intervention efficacy on parental support and on PA by adjusting apart from other covariates
302 for participation in organized PA or sports. Finally, we performed a three-way interaction of
303 Group \times Time \times Sex in an unadjusted and adjusted models with the whole sample and separately
304 considering the tertiles of parental support for examining whether the intervention efficacy on
305 parental support or PA differed between the sexes of the children.

306 We reported means, confidence intervals (CI) and p -values for statistically significant
307 findings with respect to mixed models. A logistic regression was used to identify significant
308 predictors for dropping out of the study. All predictor variables were entered in the model
309 simultaneously. We set the level of significance to $p < .05$ for all analyses.

310 **Results**

311 **Baseline Characteristics of Parental Support Tertiles**

312 According to the whole study sample's initial parental support (mean 3.52 ± 0.82),
313 parents supported their children in PA approximately two to three times per week. Table 1 shows
314 the frequency of parental support among the tertiles. Initial parental support was higher ($F(1, 59)$
315 $= 4.19$, $p < .001$, $ES = 0.89$) among the intervention and control tertiles of the highest parental
316 support (mean 4.47 ± 0.50 , corresponding to four to five times a week of parental support)

317 compared with the lowest parental support tertiles (mean of sum factor 2.76 ± 0.35 ,
318 corresponding to less than once a week up to once a week of parental support). The mothers of
319 the intervention group were significantly younger ($F(1, 69) = 8.47, p = .001, ES = 0.37$) and
320 participated more in PA with their children ($F(1, 89) = 6.20, p = .02, ES = 0.25$) than mothers of
321 control children did. Additionally, girls in the lowest tertile of parental support were significantly
322 older ($F(1, 29), p = .045, ES = 0.35$) than the boys were.

323 **Tables 1, 2 and 3 here.**

324 The mean level of leisure-time PA at baseline was 567.70 ± 188.0 CPM and on average
325 $421.87 \pm 66.82, 23.88 \pm 9.15$ and 27.96 ± 14.19 minutes of the free time per day was spent at the
326 intensity levels of sedentary, light and MVPA, respectively. While boys were generally more
327 active ($F(1, 89) = 1.58 - 6.09, p = .001 - .007, ES = 0.27 - 0.35$) than girls in all PA measures at
328 the baseline, the difference between genders was significant among the tertile of the lowest
329 parental support ($F(1, 29) = 1.63 - 5.65, p = .011 - .037, ES = 0.39 - 0.41$) but not among the
330 tertile of the highest parental support. On the other hand, girls were significantly older than boys
331 ($F(1, 89) = 1.42, p = .045, ES = 0.21$) in general. On average, 63% of the children participated in
332 organized PA or sports at baseline and the prevalence of participation generally showed an
333 increasing trend over time, with a few exceptions: the children of the lowest intervention tertile
334 showed a decreasing trend of participation from baseline (53.3%) to 6 months (38.5%) and an
335 increasing trend to 12 months (80%), while children of the highest control tertile showed a
336 decreasing trend of participation from baseline (84.6%) to 6 months (71.4%) and 12 months
337 (66.7%).

338 Those families who dropped out of parental support measurements after baseline had
339 more children ($F(1, 89) = 0.009, p < .001, ES = 0.71$) than families who continued for the full

340 year. There were no other significant predictors for dropping out. In general, parents of the
341 children included in the analyses more often had a university or polytechnic degree when
342 compared with the mean of the whole recruitment region (84% / 35%) and were less often single
343 parents (4% / 27%).

344 **Efficacy of Intervention on Parental Support**

345 Parental support declined in the intervention and control groups with time, but this
346 overall decline was not statistically significant nor did the change differ between groups (Table
347 2). A significant decline in parental support took place within the highest initial parental support
348 tertile of the intervention group from baseline to 6 months (unadjusted mean -0.59, CI -0.96 – -
349 0.20, $p = .004$; Model 1 mean -0.44, CI -0.84 – -0.05, $p = .03$; Model 2 mean -0.52, CI -1.02 – -
350 0.01, $p = .046$) and to 12 months (unadjusted mean -0.57, CI -1.01 – -0.14, $p = .011$; Model 1
351 mean -0.43, CI -0.86 – -0.00, $p = .048$) and within the corresponding control tertile from baseline
352 to 12 months (unadjusted mean -0.72, CI -1.16 – -0.29, $p = .002$; Model 1 mean -0.65, CI -1.11 –
353 -0.19, $p = .006$; Model 2 mean -0.63, CI -1.13 – -0.13, $p = .015$). The decrease in parental
354 support did not differ between the highest intervention and control group tertiles. On the other
355 hand, parental support increased significantly within the lowest intervention support tertile from
356 baseline to 6 months (unadjusted mean 0.29, CI 0.04 – 0.53, $p = .021$; Model 1 mean 0.27, CI
357 0.03 – 0.52, $p = .032$; Model 2 mean 0.33, CI 0.06 – 0.61, $p = .018$), although this change was
358 not significant either when compared with the corresponding control tertile. The three-way
359 interaction of Group \times Time \times Sex indicated no differences between sexes in the intervention
360 efficacy on parental support.

361 **Efficacy of Intervention on Physical Activity**

362 The control group had an increasing, yet insignificant, trend in the mean level of PA and

363 MVPA during the study year in comparison to the intervention group (Tables 2 and 3). However,
364 children in the lowest intervention tertile of initial parental support significantly increased the
365 mean level of PA between baseline and 6 months (unadjusted mean 160.17, CI 56.27 – 264.06, p
366 = .003; Model 1 mean 154.07, CI 41.69 – 266.44, p = .008; Model 2 mean 192.90, CI 76.90 –
367 308.89, p = .002) and this change was also significant compared to the lowest control tertile
368 (unadjusted mean 160.30, CI 15.68 – 304.93, p = .030; Model 2 mean 173.24, CI 16.18 – 330.31,
369 p = .031). The mean level of PA increased in that case approximately by 29 % in children of the
370 lowest intervention tertile between the baseline and 6 months. At the same time period, time
371 spent at MVPA significantly increased within the lowest intervention tertile of parental support
372 (unadjusted mean 12.32, CI 2.62 – 22.01, p = .014; Model 1 mean 11.50, CI 1.07 – 21.92, p =
373 .031; Model 2 mean 15.09, CI 4.46 – 25.72, p = .006) although this change was not significant
374 compared to the corresponding control tertile. On the other hand, children in the highest control
375 tertile significantly decreased the time spent sedentary compared to the corresponding
376 intervention tertile between the baseline and 6 months (Model 2 mean 79.80, CI 6.39 – 153.20, p
377 = .034). Additionally, mean level of PA significantly increased within the highest control tertile
378 of parental support between the baseline and 12 months (Model 1 mean 106.90, CI 8.37 –
379 205.43, p = .034). Although found statistically insignificant, there was an increasing trend of
380 MVPA in favour of the highest control tertile compared to the highest intervention tertile from
381 baseline to 12 months' follow-up. The three-way interaction of Group \times Time \times Sex indicated no
382 differences between the sexes in the intervention efficacy on PA.

383 **Intervention Evaluation**

384 The initial goals set by the parents in the lowest and highest tertiles concerned PA with
385 family (27% / 30% set this goal), PA with peers (21% / 12%), PA outdoors (19% / 28%), PA in

386 the backyard or in the neighboring area (18% / 28%) and PA indoors (12% / 2%), respectively.
387 The goals remained relatively stable both in the lowest and highest support tertiles, although the
388 frequency of the goals for PA with peers showed an increasing trend in the phone consultations
389 at 2 months (25% / 14%) and at 5 months (24% / 18%) among the parents of the lowest and the
390 highest tertiles, respectively. We found the compliance rate of phone consultations to be
391 generally high in both the lowest and the highest tertile parents at 2 months (95 % / 92 %) but
392 there was a decreasing trend to 5 months (74 % / 83 %). Parents of the lowest and highest
393 support tertiles and who were reached once or twice for the phone consultations perceived being
394 busy and other tasks (40% / 19% of all barriers), weather (30% / 24%), either their own or their
395 children's tiredness (20% / 33%), and sickness (10% / 19%) as the most common barriers against
396 meeting the goals on weekdays. Correspondingly, being busy and other tasks (55% / 53%),
397 tiredness (27% / 11%), weather (0% / 21%), and sickness (9% / 16%) were most often mentioned
398 as barriers among the lowest and highest tertile parents for meeting the goals on weekend days.
399 Parents perceived face-to-face counseling (32%) as the most useful intervention tool in general
400 followed by feedback from measurements (25%), counseling lectures (21%), phone consultations
401 (7%), printed material (4%), emails (4%), and the project website (0%). However, parents of the
402 lowest intervention tertile perceived the face-to-face counseling and feedback from
403 measurements clearly more often as the most important tool compared to the parents of the
404 highest tertile (44 % vs 14 % and 33 % vs 21 %, respectively). On the other hand, 14 % vs 0 %
405 of parents of the highest and lowest tertiles rated the phone counseling as the most important
406 intervention tool, respectively.

407 **Discussion**

408 Even though parental support has been documented as a key variable interacting with PA
409 behavior in children (Beets et al., 2010; Edwardson & Gorely, 2010; Loprinzi & Trost, 2010),
410 there is a lack of knowledge of how to affect parental support of children's PA for enhancing PA
411 in children (Brown et al., 2016; O'Connor et al., 2009). Family-based PA counseling was
412 previously shown to negatively influence the children's MVPA (Laukkanen et al., 2015), and
413 this study aimed to examine whether the initial level of parental support of children's PA
414 moderated the intervention efficacy on the parental support and objectively measured PA in the
415 children. We hypothesized that the initial parental support of children's PA would moderate the
416 intervention efficacy because parents with low or high initial level of parental support probably
417 have different potential to benefit from the tailored counseling. The novel finding of this study
418 relates to the children with lowest parental support at baseline who significantly increased their
419 objectively measured mean level of leisure time PA during the counseling period in the
420 intervention group when compared with their control peers. Importantly, parental support
421 provided to these children significantly increased within the lowest intervention tertile, although
422 this change was not significant compared to the corresponding control tertile. This study showed
423 that the unfavorable intervention influence found on children's MVPA (Laukkanen et al., 2015),
424 may be partly explained by allocation of the counseling to initially highly supportive parents.
425 Overall, the findings suggest that initial parental support may be a significant moderator of
426 family-based PA intervention efficacy on children's objectively measured PA.

427 The mean level (2 – 3 times per week) and declining trend of parental PA support along
428 the child's age are equivalent with the findings in Australian children with the same
429 measurement tool (Cleland et al., 2011). A unique finding of the present study was that the initial
430 level of parental support on child's PA was found to moderate the efficacy of family-based PA

431 intervention on children's objectively measured PA. Parents who reported the lowest baseline
432 level of PA support were also the ones who seemed to be the most sensitive for the PA
433 counseling. Although regression to the mean probably explains part of the increase of parental
434 support in the lowest tertiles (both intervention and control), the increase was significant only
435 within the lowest intervention tertile. In contrast, we found individual counseling not to be an
436 influential procedure for positively affecting parents of the highest support tertile. One
437 explanation for the common inefficacy of family-based PA interventions on affecting the
438 objectively measured PA in children (Metcalf et al., 2012; O'Connor et al., 2009) may be
439 therefore actually the lack of potential for change in parents support of children's PA. This is
440 because without an appropriate screening, family-based PA interventions may be
441 overrepresented by parents with high initial support of their children's PA, a fact which may
442 attenuate the intervention efficacy. Thus, efficacy of family-based PA counseling on 4-7-years
443 old children's PA should be further researched in parents belonging to the lowest third when it
444 comes to the validated measure of support of their children's PA.

445 Promoting parental support in childhood would be important for maintaining the level of
446 PA across the childhood to adolescence (Kahn et al., 2008). Earlier evidence is stating that this
447 would be important especially in girls (Davison & Jago, 2009). We found intervention efficacy
448 to be independent of children's sex at the present study, so the family-based PA counseling may
449 offer a suitable tool for enhancing parental support in both girls and boys. Additionally, it is
450 important to note that regardless of the low absolute level, the positive change in parental PA
451 support can have a meaningful influence on the children's PA behavior. The 29% increase of PA
452 in children of the lowest intervention tertile in the end of the counseling period can be seen
453 practically meaningful as the mean level of PA in all children at the present (567.70 ± 188.0) was

454 found relatively low compared to the level of 701 CPM reported in 4-5-years old children
455 elsewhere (Cardon & De Bourdeaudhuij, 2008).

456 Interestingly, we found the changes of participation in organized PA or sports to have an
457 opposite trend compared to the objectively measured PA in children at the present study.
458 Children of the lowest initial parental support intervention tertile declined participation in
459 organized PA between the baseline and 6 months, at the same time when the parental support
460 showed an increasing trend and their measured PA was found to significantly increase compared
461 to the control peers. It can be speculated that the increase of physically active family time and
462 encouragement for PA in contrast to the declined participation in organized PA or sports
463 contributed to the increase of measured PA in these children. Further, we found children of the
464 highest control tertile to decline participation in organized PA or sports during the study year, at
465 the same time when their measured PA increased compared to the corresponding intervention
466 peers. It may be that the parents of the intervention group who already provided a high support
467 on their child's PA found organized PA or sports as an only feasible way to further enhance PA
468 in their children, a solution which was found to negatively influence measured PA in their
469 children.

470 **Future Directions of Family-Based Physical Activity Interventions**

471 Behavioral theories (e.g. Bandura, 1986), as well as quantitative (e.g., Telford et al.,
472 2013; Cleland et al., 2011) and qualitative (Thompson et al., 2010) research evidence state
473 family to be a primary context for enhancing habitual PA in children. With the exception of
474 some promising findings, attempts to enhance PA in children via the family context have been
475 inefficient (Brown et al., 2016; Davison et al., 2013; Metcalf et al., 2012; O'Connor et al., 2009;
476 van Sluijs et al., 2011). Consequently, there is a great need to find efficacious and well-detailed

477 family-based PA intervention methods, and on the other hand, to reveal those of found
478 inefficacious. This study suggests that affecting parental support of children's PA would be a key
479 factor in family-based PA interventions. It could be crucial to allocate the family-based PA
480 counseling on the basis of initial parental support level as it may be an important moderator of
481 the intervention efficacy. Influence of the family-based PA counseling on the parental PA
482 support should be further examined in fully powered efficacy trials with optimal and highly
483 controlled PA counseling circumstances, and if found consistently efficacious, in fully powered
484 effectiveness trials, e.g. in community-based lifestyle programs.

485 It has been shown that perceived control over supporting a child in PA may be a primary
486 outcome to focus on in family-based PA interventions. Although the attitude towards providing
487 support for children's PA is a strong correlate of the intention of providing support on child's
488 PA, especially the parent's perceived confidence on supporting PA has been shown to associate
489 with the child's PA (Rhodes et al., 2013). Therefore, it can be assumed that the mode of delivery
490 may play a crucial role in the PA intervention counseling. Almost half of parents in the lowest
491 initial parental support tertile rated the individually tailored face-to-face counseling as the most
492 important intervention tool at the present study. It is possible that the confidence on providing
493 support on child's PA was best promoted through individual face-to-face discussions where a
494 parent had a possibility to freely and without a feeling of hurry to tell a researcher about, e.g. the
495 barriers against PA promotion. Although direct involvement of parents has been generally shown
496 to be a key for successful PA and nutrition programmes (Hingle et al., 2010; O'Connor et al.,
497 2009), there is a need to find both efficacious and efficient (i.e. cost-effective) ways of
498 promoting parental support on child's PA. Therefore, research on alternative methods to face-to-
499 face PA counseling and on an optimal combination of face-to-face counseling and other

500 intervention delivery methods are needed. In more detail, there is a need to examine ways to
501 effectively support behavior change of PA parenting via general encouragement, progressive
502 goal setting and other behavior change techniques which have a solid social cognitive theory
503 basis on the behavior formation.

504 Parental support on children's PA may not be well explained by volitional intention
505 (Rhodes et al., 2013). Parents of the present study reported similar barriers against PA promotion
506 than parents of 10-11-years old children in the United Kingdom (Thompson et al., 2010).
507 However, the barriers reported were somewhat different between the lowest and highest tertiles
508 of parental support in the present study. Although individualization of PA intervention is most
509 likely important, it would be beneficial to further research the challenges parents providing low
510 support on their children's PA systematically face in everyday family life. Besides, positive
511 intervention influences were found among the lowest parental support tertile during the 6 months
512 lasting counseling period but not during the follow-up period. Therefore, it is likely that these
513 families would need continuous reinforcement for maintaining the intended behavior.

514 **Study Limitations and Strengths**

515 When evaluating the contributions of this study, there are several aspects that should be
516 considered. The Family Physical Activity Environment (FPAE) questionnaire used in the present
517 study has been validated (Cleland et al., 2011) but not in the country where the present study was
518 conducted. However, we performed careful translation into the local language and suitability
519 testing for the local culture and the translated questionnaire was found to have an acceptable
520 internal consistency. Second, the intervention efficacy analyses were hindered by the small
521 number of participants in the tertiles of lowest and highest initial parental support. Therefore, the
522 results of the present study should be confirmed by larger and fully powered interventions. Third,

546 family-based PA interventions may not positively affect PA in children with a high initial level
547 of parental support.

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Table 1. Background characteristics of the study participants for analysis.

Variables	All					
	Means \pm SD (range)		Lowest parental support tertile		Highest parental support tertile	
	Intervention	Control	Intervention	Control	Intervention	Control
Children (n)	44	47	15	16	16	14
Girls (n)	21	26	8	10	8	7
Age (years)	6.09 \pm 1.17 (3.71)	6.12 \pm 1.11 (3.48)	6.53 \pm 1.26 (3.59)#	6.36 \pm 1.19 (3.48)#	5.89 \pm 1.18 (3.42)	6.14 \pm 1.18 (3.42)
Height (cm)	112.21 \pm 8.71 (34.1)	113.91 \pm 7.79 (28.4)	117.14 \pm 8.22 (18.1)	114.26 \pm 7.75 (20.1)	110.94 \pm 7.52 (25.6)	111.1 \pm 5.36 (16)
Weight (kg)	20.08 \pm 3.47 (14.8)	20.31 \pm 3.16 (10.2)	20.95 \pm 4.24 (11.2)	20.13 \pm 3.62 (10.2)	19.73 \pm 3.15 (10)	19.73 \pm 2.48 (7)
BMI	15.88 \pm 1.2 (4.35)	15.6 \pm 1.16 (3.9)	15.17 \pm 1.48 (4.35)	15.32 \pm 1.3 (3.9)	15.96 \pm 1.06 (2.92)	15.95 \pm 1.12 (2.5)
Participates to organized PA (%)	60.5	65.2	53.3	68.8	62.5	84.6
Parents involved in the study (n)	61	63	19	21	23	17
Mother (n)	38	33	13	12	15	8
Age	34.9 \pm 4.11 (20)*	38.82 \pm 5.61 (19)	35.77 \pm 5.56 (20)	39.92 \pm 5.52 (19)	33.67 \pm 2.42 (9)	39.5 \pm 5.76 (17)
Higher level education (%)	82	72	80	81.3	75	57.1
Single parent (n)	1	3	0	1	1	1
Father (n)	23	30	6	9	8	9
Age	37.22 \pm 5.16 (23)	39.64 \pm 5.36 (20)	39.84 \pm 7.63 (21)	41 \pm 4.28 (15)	35.63 \pm 4.41 (11)	41.45 \pm 6.31 (16)
Higher level education (%)	55	66	33.3	62.5	56.3	57.1
Single parent (n)	0	0	0	0	0	0
Parental support on PA						

Answerer sex female (%)	72.7	53.2	80	62.5	75	57.1
Father participates in PA with a child	3.48 ± 1.21 (5)	3.11 ± 1.05 (5)	2.53 ± 0.64 (2)	2.63 ± 0.81 (3)	4.25 ± 1.13 (3)	3.86 ± 1.24 (4)
Mother participates in PA with a child	3.64 ± 1.13 (4)*	3.13 ± 0.88 (4)	2.93 ± 0.46 (2)	2.63 ± 0.62 (2)	4.25 ± 1.24 (4)	3.64 ± 1.09 (4)
PA together as a family	3.61 ± 1.13 (4)	3.38 ± 1.08 (4)	2.87 ± 0.64 (2)	2.56 ± 0.52 (1)	4.63 ± 1.03 (3)	4.36 ± 0.93 (3)
Father provides support for PA	3.27 ± 1.09 (5)	3.23 ± 1.22 (5)	2.4 ± 0.64 (2)	2.69 ± 0.8 (3)	4.06 ± 1.13 (3)	4.43 ± 1.35 (5)
Mother provides support for PA	3.23 ± 1.06 (5)	3.3 ± 1.02 (5)	2.47 ± 0.75 (3)	2.75 ± 0.69 (3)	3.75 ± 1 (4)	4.14 ± 1.17 (4)
Father praises for PA	3.95 ± 1.38 (4)	3.72 ± 1.38 (5)	2.87 ± 0.75 (2)	2.81 ± 0.75 (3)	5.25 ± 1.19 (3)	5.07 ± 1.15 (4)
Mother praises for PA	4.23 ± 1.2 (4)	4.04 ± 1.31 (4)	3.33 ± 0.62 (2)	3.13 ± 0.81 (3)	5.37 ± 0.89 (3)	5.43 ± 0.76 (2)
Mean of parental support	3.63 ± 0.82 (3.58)	3.42 ± 0.82 (3.29)	2.78 ± 0.33 (1)	2.75 ± 0.38 (1.29)	4.51 ± 0.47 (1.72)	4.42 ± 0.56 (1.58)

Note: Data are presented as mean ± SD and range (in parentheses) from baseline measurements, except height, weight and BMI (kg/m²) for children, which are presented from midline measurements. Scale for parental support on PA is 1 to 6.

Statistically significant differences at the level of $p < .05$ between intervention and control groups (*) and between sexes (#). Statistically significant values are shown in bold.

Table 2. Changes in parental support and mean level of physical activity within and between intervention and control support tertiles.

Outcome	Time (months)	Unadjusted mean (SD)		p-value	MODEL 1 Adjusted change between groups (95% CI)	p-value	MODEL 2 Adjusted change between groups (95% CI)	p-value
		Intervention	Control					
Parental support								
All	0	3.63 (0.82)	3.42 (0.81)					
	6	3.46 (0.61)	3.31 (0.83)	.102	0.07 (-0.19 to 0.32)	.612	0.04 (-0.23 to 0.32)	.751
	12	3.45 (0.70)	3.21 (0.80)	.915	0.10 (-0.23 to 0.44)	.543	0.08 (-0.26 to 0.43)	.635
Lowest parental support tertile	0	2.77 (0.33)	2.74 (0.37)					
	6	3.04 (0.41)††	2.90 (0.75)	.411	0.23 (-0.08 to 0.55)	.146	0.28 (-0.06 to 0.62)	.107
	12	2.95 (0.38)	2.78 (0.77)	.871	0.11 (-0.30 to 0.53)	.581	0.56 (-0.37 to 0.48)	.796
Highest parental support tertile	0	4.51 (0.46)	4.42 (0.55)					
	6	3.92 (0.56)††	4.20 (0.55)	.244	-0.22 (-0.80 to 0.36)	.450	-0.29 (-0.98 to 0.40)	.400
	12	3.96 (0.74)††	3.68 (0.71)††	.623	0.22 (-0.39 to 0.82)	.475	0.20 (-0.45 to 0.86)	.541
Mean level of physical activity								
All	0	590.93 (217.24)	519.82 (134.27)					
	6	645.81 (252.31)	538.59 (158.91)	.510	62.91 (-170 to 44.89)	.363	49.01 (-71.65 to 169.68)	.976
	12	557.66 (156.19)	561.10 (176.41)	.165	-69.67 (-185.66 to 46.33)	.158	-32.88 (-160.94 to 95.19)	.092
Lowest parental support tertile	0	515.81 (155.68)	531.82 (151.49)					
	6	666.49 (310.57)††	528.85 (199.35)	.030	157.27 (-18.0 to 332.54)	.091	173.24 (16.18 to 330.31)	.031
	12	531.84 (133.21)	521.36 (146.08)	.856	-2.25 (-211.78 to 207.28)	.969	-3.22 (-212.63 to 206.18)	.824

Highest parental support tertile	0	577.43 (132.58)	543.59 (135.62)					
	6	614.93 (238.31)	592.52 (99.67)	.939	-92.12 (-231.77 to 47.54)	.077	-57.39 (-220.52 to 105.74)	.415
	12	560.69 (162.40)	638.91 (190.21) †	.198	-65.02 (-207.30 to 77.263)	.145	-65.44 (-223.92 to 93.03)	.144

Note. Mean level of physical activity = mean accelerometer counts per minute at leisure time. 0 months = baseline.

| Within group change from baseline statistically significant at the level of $p < .05$ (unadjusted model).

† Within group change from baseline statistically significant at the level of $p < .05$ (model 1).

Within group change from baseline statistically significant at the level of $p < .05$ (model 2).

Statistically significant values are shown in bold.

Table 3. Changes in daily minutes spent at different physical activity intensities within and between intervention and control support tertiles.

Outcome	Time (months)	Unadjusted mean (SD)		p-value	MODEL 1 Adjusted change between groups (95% CI)	p-value	MODEL 2 Adjusted change between groups (95% CI)	p-value
		Intervention	Control					
Sedentary								
All	0	414.64 (71.83)	428.63 (61.77)					
	6	407.84 (75.44)	419.06 (60.03)	.721	0.94 (-29.41 to 31.30)	.951	4.84 (-27.53 to 37.20)	.768
	12	398.65 (67.11)	412.42 (67.02)	.871	-0.84 (-37.82 to 36.15)	.964	1.96 (-36.11 to 40.02)	.919
Lowest parental support tertile	0	440.30 (55.05)	439.52 (74.63)					
	6	423.40 (64.98)	440.46 (54.45)	.405	-14.71 (-62.44 to 33.02)	.537	-22.21 (-72.91 to 28.49)	.381
	12	419.28 (61.53)	425.15 (64.26)	.792	-7.35 (-69.80 to 55.10)	.815	-3.06 (-68.08 to 61.96)	.925
Highest parental support tertile	0	385.36 (63.63)	407.95 (64.77)					
	6	412.44 (86.18)	375.64 (58.31)	.097	53.45 (-10.71 to 117.61)	.100	79.80 (6.39 to 153.20)	.034
	12	379.13 (69.53)	395.51 (58.10)	.889	1.73 (-64.04 to 67.51)	.958	5.90 (-63.90 to 75.69)	.866
Light								
All	0	24.28 (9.67)	23.50 (8.72)					
	6	24.92 (10.44)	23.38 (8.62)	.753	-1.81 (-5.77 to 2.14)	.366	-0.64 (-4.90 to 3.62)	.766
	12	25.57 (10.25)	23.60 (7.89)	.684	1.49 (-3.32 to 6.31)	.541	0.90 (-4.04 to 5.84)	.719
Lowest parental support tertile	0	25.13 (12.49)	25.23 (11.78)					
	6	27.24 (14.19)	22.74 (10.29)	.105	4.43 (-1.55 to 10.41)	.142	5.82 (-0.36 to 12.00)	.064
	12	28.53 (10.28)	24.47 (9.92)	.362	4.30 (-3.94 to 12.53)	.300	3.53 (-4.85 to 11.91)	.402

Highest parental support tertile	0	22.28 (7.04)	24.87 (7.17)						
	6	23.33 (8.50)	25.74 (7.46)	.941	-2.79 (-10.66 to 5.07)	.477	-1.26 (-10.43 to 7.92)	.784	
	12	34.41 (10.77)	26.42 (7.62)	.899	-1.33 (-8.96 to 6.29)	.728	-2.38 (-10.47 to 5.70)	.557	
MVPA									
All	0	30.32 (15.57)	25.74 (12.53)						
	6	33.69 (20.49)	27.91 (17.84)	.782	-5.12 (-13.08 to 2.83)	.205	-1.81 (-10.07 to 6.46)	.666	
	12	27.10 (13.12)	28.46 (13.68)	.167	-6.36 (-15.44 to 2.71)	.168	-7.52 (-16.66 to 1.62)	.106	
Lowest parental support tertile	0	27.33 (13.69)	27.77 (14.58)						
	6	39.02 (27.21) †‡	30.56 (21.89)	.178	6.54 (-7.77 to 20.85)	.363	10.55 (-3.8 to 24.95)	.147	
	12	27.54 (12.12)	25.24 (13.25)	.854	-0.35 (-17.99 to 17.29)	.969	-1.46 (-19.13 to 16.21)	.869	
Highest parental support tertile	0	27.92 (10.73)	26.05 (14.22)						
	6	30.0 (16.18)	28.26 (9.72)	.912	-6.59 (-16.79 to 3.61)	.198	-3.14 (-15.53 to 9.25)	.610	
	12	25.33 (12.71)	33.52 (14.97)	.131	-9.04 (-20.28 to 2.20)	.113	-10.31 (-22.39 to 1.78)	.093	

Note. 0 months = baseline. MVPA = moderate to vigorous physical activity intensity.

| Within group change from baseline statistically significant at the level of $p < .05$ (unadjusted model).

† Within group change from baseline statistically significant at the level of $p < .05$ (model 1).

‡ Within group change from baseline statistically significant at the level of $p < .05$ (model 2).

Statistically significant values are shown in bold.

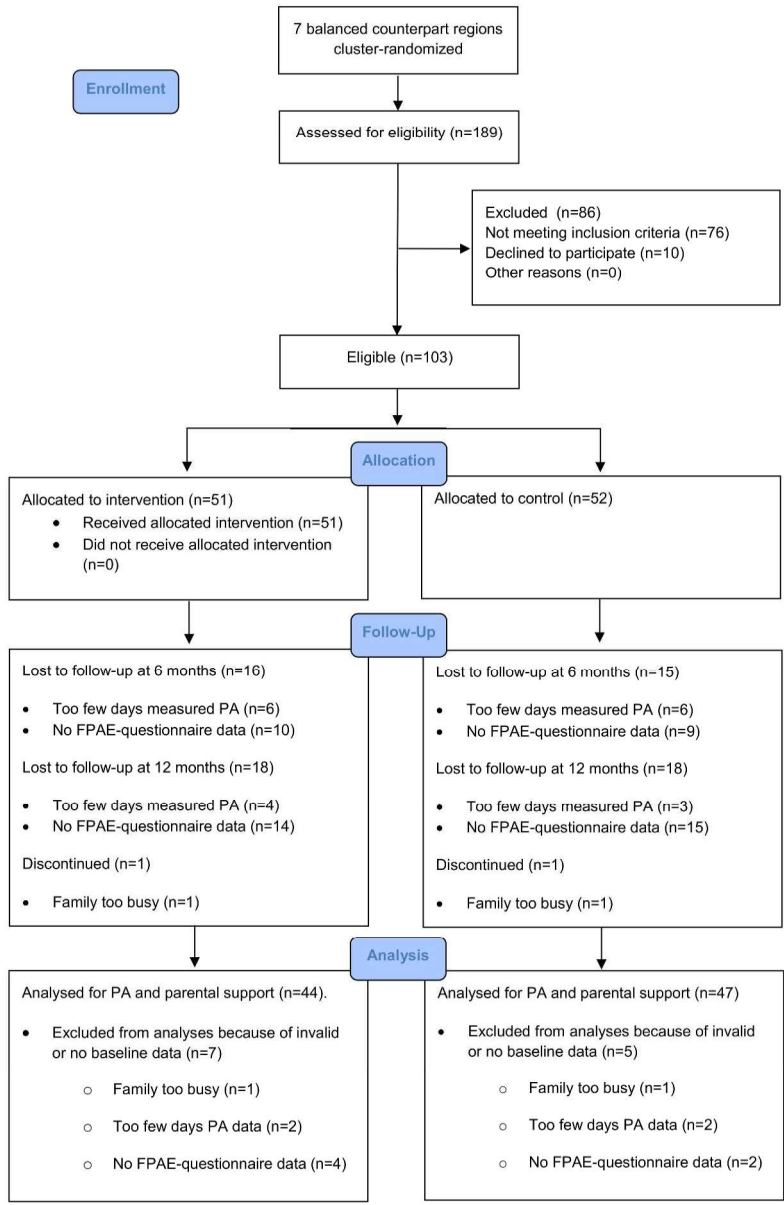


Figure 1. Flow of the study participants

250x385mm (600 x 600 DPI)