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Title: A Comparison of Physical Activity Levels in Childcare Contexts among Finnish and Dutch 3-Year-Olds

Year: 2016

Version:

Please cite the original version:

Soini, A., Gubbels, J., Sääkslahti, A., Villberg, J., Kremers, S., Kann, D. V., Mehtälä, A., De Vries, N., & Poskiparta, M. (2016). A Comparison of Physical Activity Levels in Childcare Contexts among Finnish and Dutch 3-Year-Olds. *European Early Childhood Education Research Journal*, 24(5). <https://doi.org/10.1080/1350293X.2016.1213569>

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A Comparison of Physical Activity Levels in Childcare Contexts among Finnish

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and Dutch 3-Year-Olds

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11 Abstract

12 To determine Finnish and Dutch 3-year-old preschool children's physical activity (PA) levels and
13 how levels vary across gender, location, time of day and social contexts in both countries.

14 A modified version of the Observational System for Recording Physical Activity in Children-
15 Preschool (OSRAC-P) was used to measure children's PA levels and contextual variables (e.g., group
16 composition, prompts) of children attending childcare centres in Finland and the Netherlands. In total,
17 90 Finnish children (46 boys) and 97 Dutch children (46 boys) were observed. Three-level linear
18 regression analyses with cross level interactions were used to assess differences between the countries
19 in the association between the context variables and PA. During the observations, the present sample
20 of children was mostly sedentary in nature. Outdoor location and prompts (both positive and negative)
21 were associated with higher levels of activity in both countries. Non-solitary playing was associated
22 with higher activity levels in the Netherlands, but not in Finland, whereas child-initiated play was
23 positively associated with Finnish but not Dutch children's PA levels. Finnish children were more
24 active in the morning compared to the afternoon, while in the Dutch children PA was unaffected by
25 time. The present findings indicate that better understanding of the contextual factors and interactions
26 in children's PA behaviours across the two countries could help in planning childcare interventions to
27 increase the PA levels of preschool children.

28 Keywords: physical activity; direct observation; childcare centre; country comparison; preschool
29 children

30 **Introduction**

31 Nearly 70% of 3-year-old children in Europe attend childcare or early education services,
32 whereas in other continents the numbers are much lower (OECD Family database 2008).
33 There is some evidence that childcare centres influence children's physical activity (PA)
34 levels (Finn, Johannsen, and Specker 2002; Pate et al. 2004; Strong et al. 2005; Pate et al.
35 2008). Finn, Johannsen, and Specker (2002) concluded that among children attending
36 childcare, the childcare centre was the strongest predictor of activity levels, with more than
37 50% of the daily PA performed during childcare hours. However, various studies have
38 indicated that PA levels are generally very low among preschool children during their time in
39 childcare settings (Oliver, Schofield, and Kolt 2007; Pate et al. 2008; Brown et al. 2009-II;
40 Reilly 2010; Gubbels et al. 2011). A U.S. study by Brown et al. (2009-II) reported 94% of the
41 indoor activities observed to be sedentary. A smaller but nevertheless substantial proportion
42 (59%) of the indoor activities observed among Dutch children also classified as sedentary
43 (Gubbels et al. 2011), indicating that sedentariness might be more pronounced in U.S. pre-
44 schoolers.

45 In a light of the socio-ecological framework, Hinkley et al. (2008) reviewed correlates
46 of preschool children's PA level and showed that children's demographic and biological
47 characteristics, as well as their physical and social environments are significantly associated
48 with a children's total PA. Various studies have found links between physical environment
49 factors in the childcare setting (e.g., the ground surface, playground markings, open space,
50 play equipment) and children's PA (Zask et al. 2001; Dowda et al. 2004; Boldemann et al.
51 2006; Ridgers et al. 2007; Bower et al. 2008; Cardon et al. 2008; Hannon & Brown 2008;
52 Cosco et al. 2010; Gubbels, Van Kann, and Jansen 2012). Furthermore, boys have been found
53 to be more active than girls (Oliver, Schofield, and Kolt 2007; Hinkley et al. 2008; Pate et al.
54 2008), children are more active outdoors (Finn, Johannsen, and Specker 2002; Pate et al.

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55 2004; Boldeman et al. 2006; Hinkley et al. 2008), and children's PA increases in warm
56 seasons and decreases in the colder seasons (Carson and Spence 2010).

57 Social environment factors, such as positive prompts by staff members (Brown et al.
58 2009-I) and peers (Gubbels et al. 2011), have been shown to be associated with children's
59 increased PA intensity. Despite these positive associations, teachers and peers rarely prompt
60 children to increase their PA. Moreover, teacher-initiated play was negatively associated with
61 children's levels of PA (Brown et al. 2009-II). European studies have also indicated negative
62 relationships between the presence of more childcare staff and peers (Cardon et al. 2008) or
63 direct involvement of staff and peers in children's play (Gubbels et al. 2011), and children's
64 activity levels.

65 Currently, there is a lack of observational studies on pre-school children in Europe.
66 Such observational studies provide valuable information on the context of PA behaviours,
67 which cannot be derived from studies using accelerometer or other objective measurements
68 of PA. Such contextual information can inform preventive interventions promoting PA in
69 childcare, and have implications for both practitioners and researchers. The childcare setting
70 holds great potential to make an important contribution to the welfare and health of young
71 children by promoting PA (Pate et al. 2004; Bower et al. 2008; Hinkley et al. 2008; Pate et al.
72 2008; Ward 2010). Furthermore, positive patterns of engagement in PA demonstrated during
73 childhood are critical for the maintenance of a physically active lifestyle during both
74 adolescence and adulthood (Strong et al. 2005).

75 The aim of this study was to determine existing PA levels among 3-year-old children
76 and how these vary by gender, primary location (i.e. indoor vs. outdoor), time of day (i.e.
77 morning vs. afternoon), social context (i.e. group composition, initiator of activity, prompts),
78 outdoor temperatures and weather conditions during childcare in Finland and in the
79 Netherlands.

80 **Methods**81 *Participants and Sampling*

82 **Finland.** Recruitment was performed in the city of Jyväskylä. A total of 14 childcare centres
83 volunteered their participation in the study. In Finland, 3-year-olds in childcare are most
84 commonly mixed in a group with 4- and 5-year-olds, while 1- and 2-year-olds are often
85 grouped together. Finnish childcare centres in the present study provided care for an average
86 of 74 children (SD = 20) in 4 groups (SD = 1). The mean number of staff members per centre
87 was 16 (SD = 5). All the families of the 3-year-old children attending the childcare centres (N
88 = 179) were invited to participate. One hundred and two (57%) parents provided informed
89 consents. The children's PA data were collected between August and October 2010. Six
90 children were not present and six children were attending for only half a day during the
91 observations, and were therefore excluded from the final sample of 90 children (46 boys and
92 44 girls) observed in Finland.

93 **The Netherlands.** A large Dutch childcare organization was approached to participate
94 in the study, and gave consent to conduct the study. All 9 childcare centres in Maastricht run
95 by this organization centres were approached and agreed to participate. In the Netherlands,
96 childcare centres offer care for babies as young as 6 weeks to children up to four years, 3-
97 year-olds are often grouped with 2-year-olds. In the present study, the Dutch childcare
98 centres provided care for an average of 92 children (SD = 28) in 5 groups (SD = 1). The
99 mean number of staff members per centre was 20 (SD = 6). All the parents of the 3-year-old
100 children attending these childcare centres were informed about the study, and none of them
101 refused to participate. Children's PA was observed in May and June 2008. A total of 97 3-
102 year-olds (46 boys and 51 girls) were observed in the Netherlands.

103 The typical daily timetables in the Finnish and Dutch childcare centres are described
104 in Table 1. The ethics committee of the University of Jyväskylä, and the Social Affairs and

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105 Health officer of the city of Jyväskylä approved the study. The Dutch study complied with
106 the Dutch ‘Medical Research Involving Humans Act’.

107 INSERT Table 1 NEAR HERE (Table 1. Typical daily programmes in Finnish and Dutch
108 childcare centres.)

109 *Measures and Procedures*

110 A translated and modified version of the Observational System for Recording Physical
111 Activity in Children-Preschool Version (OSRAC-P; Brown et al. 2006) was used to measure
112 children’s PA intensity, location, contexts, prompts and interactions. The design of the
113 Finnish study was based on the Dutch study by Gubbels and colleagues (2011), with some
114 minor adjustments to adapt to the Finnish situation. Two researchers in each country
115 observed PA and contextual factors using a procedure in which an observation period of 15
116 seconds was followed by 30 seconds for recording the observation. This procedure was
117 repeated eight times for a total of six minutes per child. In Finland, each child was observed
118 twice a day, both in the morning (between 8 a.m.-12 p.m.) *and* afternoon (2 p.m.-5 p.m.),
119 yielding a total of sixteen observations per child. In the Netherlands, each child was observed
120 either in the morning *or* afternoon, yielding a total of eight observations per child. The total
121 number of single observations for both countries combined was thus 2,216 (1,440 in Finland;
122 776 in the Netherlands). In both countries, children were randomly selected for observation
123 and they were not observed during meals or rest times. To ensure accuracy of data, observer
124 training (e.g., initial observer orientation, study of the observation manual and the
125 memorization of codes and categories, direct in situ training session in field settings) is
126 recommended (Brown et al. 2009-III). Therefore in both countries, before the measurements
127 all field researchers were trained with the method by studying the instruments and
128 background information, and subsequently observing children via videotape and ‘live’ in the
129 childcare settings. Inter-observer agreement measures were done in both countries.

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130 Furthermore, to assess cross-country inter-observer agreement, a separate sample of
131 children not included in the final study, was independently observed via videotape by one of
132 the two researchers of each country. This resulted in cross-country coding of 305 observation
133 intervals, i.e. 13.8% of the observation intervals in the main study (2216 intervals), sufficing
134 the OSRAC-P norm of at least 12% independent coding (Brown et al. 2009-III).

135 PA intensity levels were measured on a five-point scale (1=stationary or motionless,
136 2=stationary with limb or trunk movements, 3=slow or easy movements, 4=moderate
137 movements, 5=fast movements) and reflected the highest intensity level reached by the child
138 during each 15-second observation period. For the purpose of this study and further
139 comparison, activity levels ≤ 2 were regarded as sedentary behaviour, activity level 3 as light
140 PA and 4–5 levels as moderate-to-vigorous physical activity (MVPA) (Bower et al. 2006;
141 Brown et al. 2009-II; Gubbels et al. 2011).

142 In addition to PA intensity, OSRAC-P scales assessing contextual variables primary
143 location (inside vs. outdoor) and time of day (morning vs. afternoon) were used (Brown et al.
144 2006). In addition, the following social OSRAC-P scales were assessed: group composition
145 (i.e., solitary, one-to-one adult, one-to-one peer, group of children, group of children with
146 adult(s)), initiator of activity (child or adult) and prompts (no prompts, staff member's/peers'
147 positive prompts to increase PA or negative prompts to decrease PA). Children's gender was
148 also recorded. Finally, weather conditions and outdoor temperatures were recorded per
149 observation day.

150 *Statistical Analyses*

151 The scores of both observers on dichotomous variables (e.g., prompt by staff, yes/no) were
152 combined by coding the variable as present (1) when one or both observers rated that variable
153 as present, and coding it as absent (0) when both rated it as absent. For the continuous
154 variables (e.g., activity intensity), the mean of the scores of both observers was calculated.

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155 Cohen's kappa was used to determine the inter-rater reliability (IRR) of the two observers for
156 the observations of the OSRAC-P variables (i.e., activity intensity, type of activity, group
157 composition, indoor and outdoor contexts, initiator of activity, prompts). The mean IRR of
158 the variables assessed was 0.6 ($SD = 0.2$; $p < .001$) in Finland, and 0.7 ($SD = 0.2$; $p < .001$) in
159 the Netherlands. The intraclass correlation used to determine cross-country IRR of two
160 observers for the activity intensity variable was 0.7 ($p < .001$).

161 Differences in the contextual variables, social context and gender between Finnish
162 and Dutch children were examined using chi-square tests. Differences in mean activity
163 intensity between the Finnish and Dutch children were examined using independent sample t -
164 tests.

165 The association between gender (boy vs. girl), primary location (outdoor vs. indoor),
166 time of day (afternoon vs. morning), group composition (non-solitary vs. solitary), initiator of
167 activity (child vs. adult), prompts (no prompt vs. positive or negative prompt), temperature
168 (linear) and weather condition (rain vs. sunny, with a clear sky or cloudy and dry) as
169 independent, and mean PA intensity levels as dependent variables was examined using three-
170 level linear regression, with cross-level interaction (MLR; with measurement level, child
171 level, centre level) to examine differences between countries in these associations. All
172 analyses were performed using SPSS 18.0 and STATA 12. In all analyses, P -values $< .05$
173 were considered statistically significant.

174 **Results**

175 ***Temperature and Weather Conditions***

176 The mean outdoor temperature was 12.5°C during the Finnish observations (range: 2°C-20°C)
177 and 20.5°C during Dutch observations (range: 14°C-26°C). This difference was significant (p
178 $< .001$). Most of the time weather was cloudy and dry (53%) or sunny with a clear sky (33%);
179 the least prevalent was rain (14%). Differences between the countries in temperature

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180 categories and weather conditions, and in sedentary and MVPA associated with these
181 categories are described in Table 2.

182 INSERT Table 2 NEAR HERE (Table 2. Differences between countries in percentages of
183 observations observed and levels of sedentary activities and MVPA (N = 187).

184 *Contextual Variables and Activity Levels*

185 According to Chi-Square tests, children's indoor PA levels were mostly sedentary in nature:
186 79% of total intervals recorded as sedentary, and only 3% coded as MVPA. Outdoors, 53%
187 PA observations were classified as sedentary behaviour, whereas 10% were classified as
188 MVPA. The initiators of the activities were most frequently children (81%). Staff and peers
189 rarely prompted children to increase or decrease their PA: no prompts were recorded in 81%
190 of all observations. Cross-country differences were more pronounced in the social and
191 weather-related variables than in the non-social context variables. The Finnish children spent
192 significantly more time in sedentary-level activities and less time in MVPA compared to the
193 Dutch children in most of the observed categories (see Table 2).

194 *Associations Between Observed Contexts and PA*

195 The results of the multi-level linear regression are presented in Table 3. With respect to the
196 primary location of the observations, children were significantly more active outdoors than
197 indoors (activity intensity 2.65 vs. 2.18, respectively; $p < .001$). In the Netherlands, an
198 outdoor location had a stronger positive influence on children's activity levels than in Finland
199 ($p < .001$), although the influence was significant in both countries. All prompts (both
200 positive and negative) were associated with an increase in the children's PA level in both
201 countries. Non-solitary play was associated with higher activity levels in the Netherlands,
202 whereas in Finland child-initiated play was positively associated with the children's PA
203 levels. Finally, the Finnish children were less active in the afternoon compared to the
204 morning, while the Dutch children's PA levels were unaffected by time of day.

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205 INSERT Table 3 NEAR HERE (Table 3. Children's mean PA intensity levels in Finland and in
206 the Netherlands: three level linear regression.)

207 **Discussion**

208 The present study applied direct observation to compare Finnish and Dutch 3-year-old
209 children's PA behaviour during childcare. In line with previous findings (Oliver, Schofield,
210 and Kolt 2007; Pate et al. 2008; Brown et al. 2009-II; Gubbels et al. 2011), the present
211 sample of children engaged in sedentary activities in 79% of indoor and 53% of outdoor
212 observations. The results further showed significant differences between the countries in
213 children's PA levels: the Finnish children spent significantly more time in sedentary-level
214 activities and less time in MVPA compared to the Dutch children.

215 Several contextual variables had a differential influence on PA depending on the
216 country. Surprisingly, this mainly concerned non-social influences: time of day and location,
217 in addition to group composition. The significant interaction between country and time of day
218 showed that the Finnish children were less active in the afternoon compared to mornings,
219 while the Dutch children's PA levels were unaffected by time of day. The activities planned
220 during an average childcare day provide little explanation for this difference, as they were
221 very similar in both countries. The only difference worth noting is that in Finland fixed time
222 for indoor and outdoor playing was scheduled, while in the Netherlands afternoons were
223 spent flexibly, playing either indoors or outdoors, depending on, for instance, the weather and
224 opportunities that arose during the day.

225 In the present study, temperature and weather conditions varied significantly between
226 the two countries. However, we found no significant association between the temperature or
227 weather variables and children's PA behaviour, and the absence of significant interactions
228 between country and these variables indicates that these variables did not explain the
229 differences in PA levels between the two countries. In line with this, Finn, Johannsen, and

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230 Specker (2002) found no seasonal variations in children's PA levels. Baranowski et al. (1993)
231 indicated in their observational study that differences in children's PA were more related to
232 time spent outdoors than to season or weather conditions. To date few seasonal studies have
233 been conducted among preschool-aged children, and their findings have been conflicting
234 (Carson and Spence 2010).

235 Consistent with previous findings (Pate et al. 2004; Boldeman et al. 2006; Hinkley et
236 al. 2008; Brown et al. 2009-II), the present sample of children was physically more active
237 outdoors than indoors. Outdoor location had a stronger positive influence on PA in the Dutch
238 than Finnish children. Outdoor play in Dutch childcare centres is mainly unstructured, while
239 in Finland it often involves teacher-arranged and teacher-initiated activities such as hiking. In
240 general, children tend to be less active the more staff members there are present or involved
241 with children's play (Cardon et al. 2008; Brown et al. 2009-II; Gubbels et al. 2011). Also in
242 the present study, children were more sedentary when staff members were involved in
243 children's activities, or when the initiator of the play was an adult. Perhaps a more
244 unstructured and flexible approach is beneficial for raising children's PA levels. A Belgian
245 study reported significant increases in children's objectively measured PA intensity during
246 preschool recess and times of unstructured free plays that were taken as an opportunity to be
247 physically active (Verbestel et al. 2011).

248 It is a matter for concern that the majority of the observations did not include any oral
249 prompting by staff or peers, despite the fact that positive prompts were positively associated
250 with time spent in MVPA. Other studies have confirmed that positive prompts by staff
251 (Brown et al. 2009-I) and peers (Gubbels et al. 2011) have positive associations with
252 children's PA intensity.

253 The differences between the two countries in children's PA levels were pronounced,
254 although the differences in the social context, such as group sizes and numbers of children

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255 and staff members in the current childcare centres, were not. However, one notable difference
256 between the countries was revealed in the children's typical childcare attendance. If children
257 attend childcare once or twice per week, as is typical in the Netherlands (European
258 Commission's Expert Group on Gender and Employment Issues [EGGE] 2009), this factor
259 alone may positively influence their level of PA. For Finnish children, who often attend
260 childcare five days a week (OECD Family database 2008), childcare is part of their normal
261 daily routine and may not exert any particular influence on their PA. Another explanation for
262 the cross-country difference may be found in group membership: Finnish 3-year-olds were
263 grouped with 4- to 5-year-old children, whereas Dutch 3-year-old children were often
264 grouped with 2-year-olds. The Finnish observers may have unintentionally underrated the 3-
265 year-olds' behaviour when this was observed against the backdrop of the older, more skilled
266 children present, while in the Netherlands the opposite may have occurred: the observers may
267 have overrated the PA of the Dutch 3-year-olds by unwittingly comparing them with the 2-
268 year-olds. The sufficiently high cross-country IRR contradicts this explanation, though. A
269 final explanation might lie in differences in the physical childcare environment in the two
270 countries, which was not taken into account in the study. The physical environment has
271 previously been shown to significantly influence the activity levels of children in childcare
272 (e.g., Cosco et al. 2010; Gubbels, Van Kann, and Jansen 2012).

273 A strength of this study is that PA levels were directly observed using the OSRAC-P
274 method in two European countries. Observations were made in a total of 23 childcare centres
275 indoors and outdoors, and during both mornings and afternoons, thereby covering regular
276 childcare attendance times in both Finland and the Netherlands. The childcare daily schedules
277 and outdoor times in both countries were very similar, and no major differences were
278 observed in programmes. The benefit of the observation format was that it recorded not only
279 the intensity of activity, but also *where, how and in what kind of interaction* the activity was

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280 being engaged. Moreover, the OSRAC-P has been shown to be a valid and reliable tool for
281 measuring PA among preschool-aged children (Brown et al. 2006; Trost 2007; Pate, O'Neill,
282 and Mitchell 2010).

283 This study has limitations that should be noted. The generalizability of the findings
284 could be limited by the fact that in both countries all the participating childcare centres and
285 children were located in the same city, though, the samples represented the general
286 population structure. In Finland the number of observations was higher than in the
287 Netherlands, however, comparisons were made between mean values, therefore it was
288 possible to include all existing Finnish observations to provide more accurate data without
289 affecting the final results. Furthermore, the direct observation method is based on subjective
290 assessments. Indeed, the observers in the two countries were not the same, which might have
291 influenced the findings, possibly explaining the systematically higher PA levels found in the
292 Dutch compared to Finnish children. However, the interobserver reliabilities in both
293 countries, as well as cross-country indicated appropriate levels of agreement.

294 **Conclusion**

295 In light of the growing concern about children's PA behaviour, this study indicated
296 that interventions at the childcare level are needed to increase the PA levels of both Finnish
297 and Dutch 3-year-old preschool children. The findings emphasized that the childcare setting
298 itself may play an important part in promoting positive patterns of health behaviour during
299 early childhood. Interventions should focus on increasing children's outdoor time, free play,
300 positive prompting and encouragement by staff members. A better understanding of the
301 interactions between and within different contextual factors in children's behaviours should
302 help to identify ways of promoting participation in PA during childcare attendance.

303 ***Summary Bullets***

- 304 ▪ The present sample of children engaged in sedentary activities in 79% of indoor and

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305 53% of outdoor observations.

- 306 ▪ Children were more sedentary when staff members were involved in children's
307 activities, or when the initiator of the play was an adult.
- 308 ▪ The majority of the observations did not include any oral prompting by staff or peers,
309 despite the fact that positive prompts were positively associated with time spent in
310 MVPA.
- 311 ▪ The Finnish children spent significantly more time in sedentary-level activities and less
312 time in MVPA compared to the Dutch children.
- 313 ▪ The present findings indicate that better understanding of the contextual factors and
314 interactions in children's PA behaviours across the two countries could help in
315 planning childcare interventions to increase the PA levels of preschool children.

316 *Acknowledgements*

317 We appreciate the cooperation of the Finnish and Dutch childcare centres, children and their
318 parents who participated in this study.

319 **Conflict of interest**

320 The Authors state that they have no conflicts of interest.

321

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