

Title

Exploring correlates of physical activity behaviour in UK children and their inter-relationships using a multidisciplinary approach: A concept mapping study

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1 **Abstract**

2 It is still unknown which correlates of physical activity behaviour (PAB) may be effective and
3 how they may influence PAB in UK children. The objective of the current study was to
4 generate a conceptual analysis of the correlates of PAB in UK children (5-12 years) using the
5 input of researchers in the field of physical activity (PA experts; PAE) and other fields (non-PA
6 experts; non-PAE). The concept mapping approach was used to identify potential (new)
7 correlates of PAB in children, assess their importance based on rating of potential
8 modifiability and effect, and generate a concept map depicting the associations between
9 them. In the first (brainstorming) stage (n=32 experts) yielded 93 correlates, including 14 new
10 correlates not identified in previous reviews. In the second (rating and sorting) stage (n=26
11 experts), 32 correlates were rated as important and four-cluster concept map was generated
12 including themes related to Society/community, Home/social setting, Personal/social setting,
13 and Psychological/emotional correlates. Two additional concept maps were generated for
14 PAE and non-PAE. From expert opinion, we identified new correlates of PAB that warrant
15 further research and we highlight the need to consider the interaction between intrapersonal
16 and external correlates when designing interventions to promote PA in UK children.

17 **Keywords**

18 Exercise, Youth, Cluster map, Modifiable correlates, Determinants, Correlates

19

20 **Introduction**

21 Despite the substantial focus on physical activity (PA) promotion to mitigate physical inactivity
22 among children, establishing long-lasting positive changes in PA behaviour (PAB) remains a
23 challenge (Sallis et al., 2016). To achieve the known health benefits of PA, the Chief Medical
24 Officers in the United Kingdom (UK) recommend children and adolescents aged 5-18 years to
25 perform ≥ 60 minutes of moderate-to-vigorous PA daily (Department of Health and Social
26 Care, 2019). However, only around half of children aged 7-8 years in England reach the
27 recommended PA levels, and significant increases in inactivity are reported as children
28 approach adolescence (Farooq et al., 2018; Griffiths et al., 2013; Guthold et al., 2020; Jago et
29 al., 2017). Although systematic reviews examining PA interventions have identified correlates
30 associated with PAB, little is known about how and to what extent they contribute to change
31 in PAB, which is crucial for designing interventions fostering long-lasting PAB in children (Atkin
32 et al., 2016; De Craemer et al., 2018; Sheeran et al., 2017). Correlates of PAB could mediate
33 PAB both internally (e.g., psychologically and/or physiologically) and externally (e.g., in the
34 immediate or the broader environment) and interact in different ways depending on the
35 setting (e.g., school, home or sports clubs; Brug et al., 2017). Therefore, to examine correlates
36 of PAB from a broad perspective and foster agenda setting and collective action to promote
37 PAB in children, it is necessary to consider the opinion and knowledge of experts from a range
38 of disciplines (e.g., education, health and social care, transport, urban planning, etc.;
39 Donaldson et al., 2021).

40 Concept mapping represents the combined articulated thoughts and opinions of experts into
41 a structured conceptualization (Trochim, 1989). Concept mapping is a systems-based
42 approach, used to combine input of experts across disciplines to achieve consensus around

43 settings-based approaches in health research, develop common cultures, establish
44 collaboration processes, and guide interventions (Geidne et al., 2019; Minkman et al., 2009;
45 Rosas & Kane, 2012; Trochim & Kane, 2005). The concept mapping procedure is performed in
46 stages with a mixed-methods approach, including brainstorming, rating, unstructured and
47 opinion-based sorting of conceptual relatedness, rigorous multivariate statistical analyses,
48 and group interpretation (Trochim & Kane, 2005). As such, the concept mapping methodology
49 can be used to complement and extend existing knowledge from primary (empirical studies)
50 and secondary (systematic reviews) sources through input of experts (Burke et al., 2005). This
51 approach has previously been adopted in PA research to translate available evidence to
52 develop strategies for implementation of PA interventions (Kelly et al., 2007; Ries et al., 2008),
53 develop research agendas (Brownson et al., 2008), better understand and contextualize the
54 available evidence (Condello et al., 2016; Mâsse et al., 2017) and evaluating partnerships in
55 health promotion through sport (Donaldson et al., 2021).

56 Condello and colleagues (Condello et al., 2016) generated a pan-European framework on the
57 correlates of PAB, based on perspectives of experts and stakeholders involved in relevant
58 roles in sports, exercise and PA. A Europe-wide view of correlates of PAB across the life course
59 (youth aged <19 years to older adults aged ≥65 years) was uncovered. Condello et al. (2016)
60 provided insight into the key correlates of PAB and how they are related to help practitioners
61 and policy makers develop strategies and PA interventions for Europe-wide implementation.
62 While the input from experts with roles relevant to PA may provide a homogenous PA
63 knowledge base, experiences and interests of experts with diverse areas of expertise in
64 children's behaviour, care and environments may uncover PA correlates, which may
65 otherwise be overlooked, and contribute subject-specific knowledge from their respective
66 roles (Hanson et al., 2013; Kane & Trochim, 2007). As such, a multidisciplinary approach may

67 benefit the integration of expert input and provide a broader perspective to inform future
68 interventions targeting PAB in children. Furthermore, focusing on opinions of researchers in
69 the UK could uncover key correlates (barriers or facilitators) associated with PAB within the
70 context of the UK as outlined by its economic situation, language, culture and geography, and
71 indicate their interaction to mediate PAB. To the authors' knowledge, no studies have used
72 the concept mapping approach to explore the correlates of PAB in children in the UK including
73 children's experts in both PA and other fields. Therefore, the overall objective of the current
74 study was to examine the correlates of PAB in children (aged 5-12 years) in the UK by
75 identifying and evaluating correlates of PAB using the input of researchers with expertise
76 relevant to PA (PA experts; PAE) and researchers holding a wide range of expertise in the child
77 population in other areas (non-PA experts; non-PAE). Specifically, the current study aims to
78 (1) identify potential correlates of PAB in children based on suggestions of experts and call to
79 attention any of the suggested correlates not identified in the existing literature; (2) assess
80 the importance of the identified correlates based on level of modifiability and effect,
81 indicating priorities for future research; (3) generate a UK-relevant concept map of correlates
82 of PAB in children based on perspectives from PA experts and from non-PA experts and
83 evaluate their respective contributions.

84 **Materials and methods**

85 Ethical approval was obtained from the University's Ethics Review Board at [Blinded]
86 (reference: 21047). The recruitment and the study protocol were carried out online between
87 March and July 2021. For each stage of the procedure, the participants were asked to
88 complete the tasks within a four-week period. A summary of the study procedure is provided
89 in Figure 1.

90 ***Figure 1 near here***

91 ***Participants***

92 Experts were academics currently employed at UK Universities with children aged 5-12 years
93 as the main target population of their research. Two groups of academics were approached
94 via email with information about the study aims and procedures and were asked to provide
95 their informed consent before taking part in the study. As previously discussed, the input of
96 experts in the sport, exercise and PA would likely be based by their knowledge of the literature
97 (Condello et al., 2016). Therefore, a second group was recruited, the objective behind which
98 was to achieve a wide variation in correlates of PA and opinions regarding their interrelations,
99 and levels of modifiability and effect. One group included academics with expertise relevant
100 to sport, exercise and PA (PAE; n=554) and whose research targeted the child population, and
101 whose research profiles indicated extensive and recent engagement in PA research in
102 children. The other group included academics holding a wide range of expertise relevant to
103 the child population but not to sport, exercise and PA (non-PAE; n=194). Participants were
104 identified using www.thecompleteuniversityguide.co.uk to generate lists of UK Universities
105 with sport/exercise science departments (and departments with sport related subjects) for
106 PAE and departments outside of PA research for non-PAE (including Childhood Education,
107 Child Care, Social Science, Developmental Psychology, Family and Child Law, Nursing,
108 Dentistry, City and Built Environment, Nutrition, Physiology and Medicine and Linguistics)
109 with the aim to include diverse expertise in children. Only UK-based academics were targeted
110 in the current study to focus on correlates of PAB that are applicable to the UK context, to
111 maintain a common terminology among participants, and to avoid variations in concepts
112 related to culture, policy systems, schooling, and infrastructure. To target correlates relevant

113 for the general child population, academics who primarily focus on children's disabilities or
114 specific medical conditions that may influence children's ability to participate in PA fully were
115 not included as they may add correlates based on limited movement ability or too specific to
116 certain conditions.

117 ***The brainstorming stage***

118 Participants were asked to provide a list of correlates that they considered to be associated
119 with PAB in UK children aged 5-12 years. They were asked to consider correlates in the existing
120 literature but were also encouraged to go beyond the current evidence base to include
121 potential correlates in any field/domain/context that may be relevant to PAB in children. For
122 each correlate, participants were asked to provide (a) the correlate, named according to
123 common terminology, (b) a brief definition of the correlate, including examples or context
124 where possible and (c) a short description of how the correlate may be associated with PA.
125 The correlates provided by the participants in the brainstorming stage were reduced to one
126 list using NVIVO 12 (QSR International Pty Ltd., 2020) while maintaining the original ideas of
127 the participants (Kane & Trochim, 2007). The list was coded by one author (MK) based on
128 common themes. Another author (FCML) checked the coding and discussed any
129 disagreements with MK to reach consensus. To maintain consistent understanding among the
130 participants in the subsequent stages, the final list of correlates was supplemented with
131 definitions and descriptions of the association to PA for all correlates.

132 ***The rating and sorting stage***

133 The final list of correlates with accompanying definitions and descriptions were shared with
134 the participants for rating and sorting in Minds2 (Severens, 2012), an online tool specific for
135 concept mapping procedures and analyses. In the rating exercise, participants were asked to

136 rate the correlates on two 5-point Likert scales – modifiability, referring to the extent to which
137 the correlate can be modified in an intervention (1 = not modifiable, 5 = very modifiable) –
138 and effect, referring to the effect that the correlate may have on PAB in children if it was
139 intervened with (1 = no effect, 5 = very large effect). In the sorting exercise, participants were
140 asked to group the correlates based on their own opinion on their associations within the
141 settings that UK children commonly find themselves in (W. Trochim & Kane, 2005).
142 Participants were also asked to provide representative labels to the groups they created.

143 ***The label agreement stage***

144 Following the sorting exercise, the analyses yielded a concept map with clusters of correlates.
145 The labels provided by the participants were combined and reduced to represent the overall
146 theme of the correlates within each cluster. One author (MK) reduced the list of labels and
147 discussed the suggested cluster labels with the remaining authors to reach an agreement. In
148 the label agreement stage, participants were provided with a link to an online questionnaire
149 (Qualtrics, 2005) containing the resulting concept map, the list of correlates in each cluster
150 and the suggested cluster labels. Participants were asked to rate the extent to which they
151 agreed that the label for each cluster was representative of its correlates on a 5-point Likert
152 scale (1 = Strongly disagree, 5 = Strongly agree), and to provide any comments on the labelling
153 and the resulting concept map.

154 ***Analyses***

155 To address the first aim, identifying (new) potential correlates of PAB, the list of correlates
156 was compared with identified correlates of PAB in children (around the age 5-12 years) in
157 previous systematic reviews applicable to children in the UK without disabilities or medical
158 conditions (Craggs et al., 2011; Ferreira et al., 2007; Hu et al., 2021; Marzi et al., 2018; Rhodes

159 et al., 2020; Ridgers et al., 2012; Sallis et al., 2000; Stanley et al., 2012; Uijtdewilligen et al.,
160 2011; Van Der Horst et al., 2007). Cronbach's alpha was calculated using the ratings of on
161 modifiability and effect, with $\alpha=0.91$ and $\alpha=0.96$, respectively. To assess the added
162 contribution of non-PAE, the correlates provided by the two groups in the brainstorming stage
163 were compared.

164 To address the second aim, rating plots were created using the rating scores for modifiability
165 and effect. The rating plots were scatter plots subdivided into four quadrants to isolate the
166 correlates rated high (above the mean) and low (below the mean) on the respective scales
167 (Trochim & Kane, 2005). For the subdivision, the mean rating on modifiability to divide the
168 plots vertically (on the x-axis) and the mean rating on effect to divide the plots horizontally
169 (on the y-axis). The correlates rated as both highly modifiable and highly effective are found
170 in the upper-right (4th) quadrant. The rating plots for PAE and non-PAE were combined to
171 identify the agreed correlates considered to be the most modifiable and effective (Trochim &
172 Kane, 2005). A series of the non-parametric Kruskal-Wallis test were performed in SPSS (IBM
173 SPSS, 2020) to investigate the difference between PAE and non-PAE in the ratings of
174 modifiability and effect on the list of correlates.

175 To address the third aim, a concept map was generated, consisting of clusters of correlates.
176 A multivariate analysis was performed in the Minds21 online platform (Severens, 2012), using
177 the outcomes of the sorting exercise. Minds21 created an individual matrix based on how
178 correlates were sorted for each participant, indicated in the matrix using 1 (grouped together)
179 and 0 (not grouped together). A similarity matrix was then created by overlaying the
180 individual matrices of all the participants, indicating the frequency with which the correlates
181 were grouped together (Severens, 2012; Trochim, 1989). Multidimensional scaling was used

182 to yield the distances between the statements on the similarity matrix. Principal component
183 analysis was used to translate the distances between statements (which can also be
184 considered correlations) to coordinates on a 2-dimensional coordinate system. Hierarchical
185 cluster analysis was used to generate clusters based on the distances between the correlates
186 in a backward stepwise grouping of the correlates (Abdi & Williams, 2010; Severens, 2012;
187 Trochim & Kane, 2005; Trochim, 1989). The authors selected the number of clusters based on
188 the conceptual coherence among the correlates included within each cluster of the resultant
189 concept map (Rosas & Kane, 2012; Trochim, 1989). To evaluate the contribution of the
190 respective groups, two additional concept maps were generated, using the sorting of PAE and
191 non-PAE, respectively. The same labels were applied to the additional concept maps.

192 **Results**

193 Out of the 554 non-PAE and the 194 PAE invited to participate, responses were obtained from
194 142 non-PAE (26%) and 64 PAE (33%). Participants did not take part either due to busy
195 schedules or not considering their expertise relevant for the study. Agreement to participate
196 in the study was obtained from 19 non-PAE and 13 PAE. The brainstorming stage included 32
197 participants (PAE n=13; non-PAE n=19) and resulted in a list of 430 correlates, which was
198 subsequently reduced to 93. See Supplementary Table 1 for a list of the correlates and their
199 descriptions. In the final list of correlates, 10 correlates were unique to non-PAE and 14
200 correlates were unique to PAE (Table 1). In comparison with previous systematic reviews on
201 the correlates of PAB in children, 14 (15%) correlates did not appear (Table 2).

202 ***Table 1 near here***

203 ***Table 2 near here***

204 The rating and sorting stages, and the label agreement stage included 26 participants (PAE
205 n=12; non-PAE n=14). The Kruskal-Wallis tests showed a significantly higher rating of
206 modifiability by PAE for Competition ($p=0.025$), Fundamental movement skills ($p=0.002$),
207 Influence from health risk behaviours ($p=0.015$), Parental engagement in PA with child
208 ($p=0.009$), Parental instrumental support for PA ($p=0.026$) and Policy of urban and built
209 environment ($p=0.018$). For effect, a significantly higher rating by PAE was found for Creativity
210 - Own solutions, practice conditions, play ($p=0.049$) and Personality traits ($p=0.014$). See
211 detailed results in Supplementary Table 2.

212 The combined rating plot (Figure 2) showed 41 (44%) correlates in the 4th quadrant and that
213 32 (34%) correlates were rated high for modifiability and high for effect by the two groups.
214 The rating plot for PAE (Figure 3) showed 44 (47%) correlates were located in the 4th quadrant,
215 whereas 36 (39%) correlates were located in the 4th quadrant of the rating plot for non-PAE
216 (Figure 4).

217 ***Figure 2 near here***

218 ***Figure 3 near here***

219 ***Figure 4 near here***

220 A four-cluster concept map was generated following the rating and sorting stage (Figure 5).
221 The initial cluster labels were yielded from the rating and sorting stage, which were adjusted
222 using the participant rating and feedback in the label agreement stage: (Cluster 1) Society and
223 community correlates of PAB; (Cluster 2) Personal and social correlates of PAB and (Cluster 3)
224 Psychological/emotional correlates of PAB; (Cluster 4) Home and social setting correlates of

225 PAB. Two additional four-cluster concept maps were generated representing the sorting for
226 PAE and non-PAE, respectively (Figures 6-7).

227 ***Figure 5 near here***

228 Two distinct themes could be identified on the concept map, one comprising
229 society/community and home/social setting correlates, and one comprising personal/social
230 and psychological/emotional correlates. A similar structure can be identified in the concept
231 map for non-PAE. In the concept map for PAE, a different structure was found, as
232 psychological/emotional correlates were more distanced from societal/community correlates
233 and home/social setting correlates with personal/social correlates in between. A difference
234 was found between PAE and non-PAE in the number of correlates in clusters 2 and 3 (Cluster
235 2: 46 correlates for non-PAE and 20 for PAE; Cluster 3: 9 correlates for non-PAE and 32 for
236 PAE). All but two of the correlates found in cluster 3 for non-PAE were found in cluster 4 for
237 PAE.

238 ***Figure 6 near here***

239 ***Figure 7 near here***

240 **Discussion**

241 The overall objective of the current study was to examine the correlates of PAB in children
242 (aged 5-12 years) in the UK by identifying and evaluating correlates of PAB using the input of
243 researchers with expertise relevant to PA (PA experts; PAE) and researchers holding a wide
244 range of expertise in the child population in other areas (non-PA experts; non-PAE). In line
245 with the specific aims of the current study, (1) we identified a list of 93 correlates, of which
246 14 correlates were considered new; (2) assessed the modifiability and effect of the identified

247 correlates and found 32 correlates were rated as highly modifiable and effective and
248 therefore are considered important for intervention development; (3) generated a concept
249 map revealing two main themes (personal and societal), with some differences between PAE
250 and non-PAE on the relatedness between psychological/emotional correlates and societal
251 and social correlates. The strengths of the current study include the involvement of both PAE
252 and non-PAE, offering a multidisciplinary perspective, and focus on the UK (i.e., one country
253 to provide context-specific findings), of correlates of PAB that can be utilised to develop
254 effective PA interventions.

255 Regarding the first aim, the brainstorming yielded 14 potential correlates not identified in
256 previous systematic reviews on correlates of PAB in children. Several potential correlates that
257 were not identified in previous reviews (Caring responsibilities, Parental attitudes to PA,
258 Engagement in different roles in PA activities, Possibility for development into elite sports)
259 relate to provision and facilitation by parents, coaches/practitioners and organizations of
260 opportunities for PA participation (Li & Moosbrugger, 2021; Sutcliffe et al., 2021; Tessitore et
261 al., 2021; Varga et al., 2021). These correlates resonate with aspects of self-determination
262 theory, which suggests that opportunities to participate or engage in PA or the PA
263 environment in different ways (e.g., different positions of play, refereeing, coaching) feed into
264 need-support and increased motivation (Deci et al., 1996; Reeve et al., 2014). Several of the
265 new potential correlates that have not previously been addressed (Coping with having to be
266 more active, Experience of abuse, Fear of abuse, Fear of physical discomfort during PA,
267 Implicit attention to activities and objects) relate to emotions that may implicitly (non-
268 consciously and perhaps more directly) influence PAB and are predominantly barriers to PA
269 (Gyurak et al., 2011; Klos et al., 2020; St Quinton & Brunton, 2017). Little research exists on
270 the influence of such correlates on PAB in children, although these correlates have been

271 identified in adolescents and adults (Brand & Ekkekakis, 2018; Cheval et al., 2018; Hollands et
272 al., 2016; Sheeran et al., 2013). Although the current study aimed to generate new potential
273 correlates which are specific to the UK, the 14 new correlates relate largely to intrapersonal
274 processes, which may not be specific to geographical or cultural contexts like the UK but may
275 be applicable to them. Further research is needed to understand the influence of the new
276 correlates on PA behaviour in children in the UK, and elsewhere (Sheeran et al., 2017). Finally,
277 both non-PAE and PAE contributed unique correlates, although PAE appear to have
278 considered a more comprehensive approach to PA in children, by providing additional
279 correlates related to parenting and policy in addition to psychological correlates compared to
280 non-PAE.

281 Regarding the second aim, some differences were found between the expert groups in the
282 rating on modifiability and effect. Of the 93 correlates, ratings for eight correlates were
283 significantly different between the groups, all of which were rated higher on modifiability and
284 effect by PAE. The seven correlates have been associated with PAB in children in previous
285 research and in PA intervention studies (Li & Moosbrugger, 2021; Sutcliffe et al., 2021;
286 Tessitore et al., 2021; Varga et al., 2021). Additionally, as found in the rating plots, there
287 seems to be an overall agreement between PAE and non-PAE regarding the correlates found
288 in the 4th quadrant, with 32 correlates considered highly modifiable and effective by both
289 groups, and therefore, considered important for future research and interventions.
290 Interestingly, the 32 correlates have been identified in previous reviews, but their influence
291 on PAB in the long-term warrants further testing (Craggs et al., 2011; Ferreira et al., 2007; Hu
292 et al., 2021; Marzi et al., 2018; Rhodes et al., 2020; Ridgers et al., 2012; Sallis et al., 2000;
293 Stanley et al., 2012; Uijtdewilligen et al., 2011; Van Der Horst et al., 2007).

294 As found in the group rating plots, PAE placed higher importance on the influence of
295 correlates related to policy and parenting on PAB than non-PAE. The role of parents in the
296 promotion of PA in children has been regarded as one of the main micro-environment drivers
297 to PAB (Craggs et al., 2011; Hu et al., 2021). The PAE group were likely aware of the increasing
298 calls for involvement of policy makers in implementing evidence-based strategies to increase
299 PA in children (Brug et al., 2017). These findings further echo the importance of including
300 policy makers in the development of a framework for the correlates of PAB in children as they
301 can provide clearer perspectives regarding the role of policy in the conception and
302 implementation of PA interventions. The rating plots reveal that correlates which have not
303 been addressed in previous research (e.g., correlates which implicitly influence PA
304 participation in children) were generally rated as having low modifiability and/or effect. The
305 lack of understanding of such correlates in the child population may have contributed to the
306 low ratings, yet the mechanisms in which they influence PAB warrant further research
307 attention. Future research should explore when, how, and to what extent such correlates may
308 influence PAB to provide a better understanding of them and potential avenues to address
309 them in intervention studies (Sheeran et al., 2017).

310 Regarding the third aim, two overarching themes were identified in the concept map – the
311 internal/personal and external/social correlates, which suggests that there are two systems
312 underlying PAB in children. A similar structure was found by (Condello et al., 2016) who
313 identified two core themes – Person, relating to personal characteristics and the person’s
314 interaction with others in the environment; and Society, relating to an interaction between
315 the person and the environment with influence from political, social, economic, scientific,
316 cultural, and organization correlates. Condello et al. (2016) suggested that the person is
317 central to the promotion of PAB and that interventions should target individual responsibility,

318 personal commitment, and lifestyle choices for PAB, whereas society refers to the call for PA
319 promotion on policy level. The concept maps for each group were also explored to assess
320 their respective contribution to the concept map of the complete sample. The concept map
321 for PAE seems to suggest a disconnect between the psychological/emotional correlates and
322 the societal/community and home/social setting correlates, which relate to the child-
323 environment interaction at micro- and macro-level. This possibly suggests that PAE consider
324 the psychological/emotional correlates as a separate group of correlates from those relating
325 to the child's interaction with the environment and that further distinction should be made
326 within the person and society core themes in intervention studies. The location of the
327 psychological/emotional correlates in the concept map for non-PAE seems to suggest that
328 they are considered to have a stronger association to the societal/community and
329 home/social setting correlates, potentially recognizing an interaction among them. This may
330 be the main contribution of non-PAE as they seem to have brought the intrapersonal
331 correlates closer to the core of the concept map; an approach which has not been applied
332 traditionally in children's PA research. Interestingly, it has been suggested that the approach
333 adopted to address the obesity epidemic by policy makers in the UK largely targets individual
334 responsibility and agency to make a change rather than providing opportunities for regular
335 engagement in PA in the public domain, such as provision of spaces for and promotion of
336 active transport (Theis & White, 2021; Yesiltepe et al., 2022). The prevailing approach by UK
337 policymakers does not integrate the individual-level correlates with the population-level
338 correlates to account for the interaction that the societal/physical/social environments have
339 with individual correlates (Theis & White, 2021). The findings of the current study suggest
340 that future interventions could consider both intrapersonal and external correlates in
341 conjunction to investigate the level and effect of the interaction between them on PAB,

342 linking the two overall themes of correlates found in the current study as well as Condello et
343 al. (2016).

344 The current study included both PAE and non-PAE to assess the potential input of non-PAE.
345 The selection of participants into the study was purposeful in that PAE made up the expert
346 group, which has the in-depth knowledge about sport, exercise and PA in children, while non-
347 PAE included a wide variation in expertise around children and was selected to maximize this
348 variation. The inclusion of non-PAE was a particular benefit to the current exploratory study
349 as it helped uncover the views children's experts beyond what has been the focus in the PA
350 field (Condello et al., 2016). Whilst a consistency between the groups relating to the correlate
351 rating on modifiability and effect emerged, the non-PAE, indicated different correlates at the
352 brainstorming and different concept map structures, whereby the psychological/emotional
353 correlates were considered closer to the external correlates. The findings of the current study
354 affirm that the cooperation between different partners could provide a more comprehensive
355 approach toward awareness of PAB, the mobilization of actors for the implementation of PA
356 promotion initiatives and intervention programmes, and the advancement of cross-sectional
357 studies tackling facilitators and barriers for active lifestyles in childhood and adolescence
358 (Geidne et al., 2019; Johnson et al., 2020).

359 A limitation of the current study relates to the sample size. Although a sample of 20-30
360 participants was recommended for ensuring robustness of the results (Tullis et al., 2004;
361 Wood & Wood, 2008) our sample may just fall short of the recommendation. Nonetheless,
362 our results have provided preliminary insight into the correlates considered important to PAB
363 in UK children. Our findings could be extended in future research with a larger sample.

364 Additionally, future studies are needed to triangulate perspectives of different stakeholders
365 in different countries to advance this area of research.

366 **Conclusion**

367 In encompassing the view of PAE and non-PAE, the current study has provided a conceptual
368 overview of the correlates of PAB for PA promotion in the UK. The identification of new
369 potential correlates of PAB relating to emotional and implicit behaviour regulation (Coping
370 with having to be more active, Experience of abuse, Fear of abuse, Fear of physical discomfort
371 during PA, Implicit attention to activities and objects) calls for further investigation to
372 understand how and to what extent these correlates influence PAB. Furthermore, 32
373 correlates were rated as both highly modifiable and effective, suggesting that they are
374 potentially important and should be studied further to understand their implementation and
375 context challenges in interventions in children. Despite the present concept maps yielded the
376 person- and environment-related themes already highlighted in previous research, the
377 different findings between PAE and non-PAE for the psychological/emotional and the
378 societal/social correlates warrant integration of cross-sectoral partnerships to promote the
379 child's PA entourages and environments. Finally, the contribution of non-PAE has also
380 highlighted the importance of including a wide variety of expertise, which could be expanded
381 in future studies to include stakeholders as well as policy makers and practitioners.

382 **Acknowledgements**

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385 **Disclosure statement**

386 The authors report there are no competing interests to declare.

387 **Data availability statement**

388 The data that support the findings of this study are openly available in Figshare at

389 <https://figshare.com/s/a12f6d37996bf441471d> [Private link for peer review].

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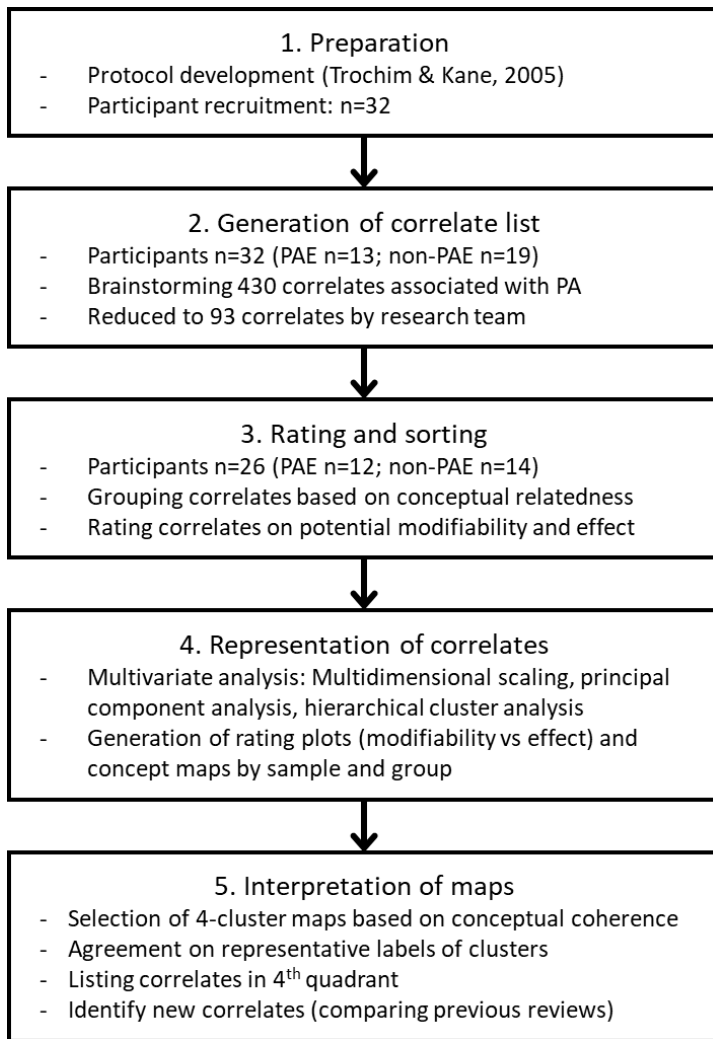
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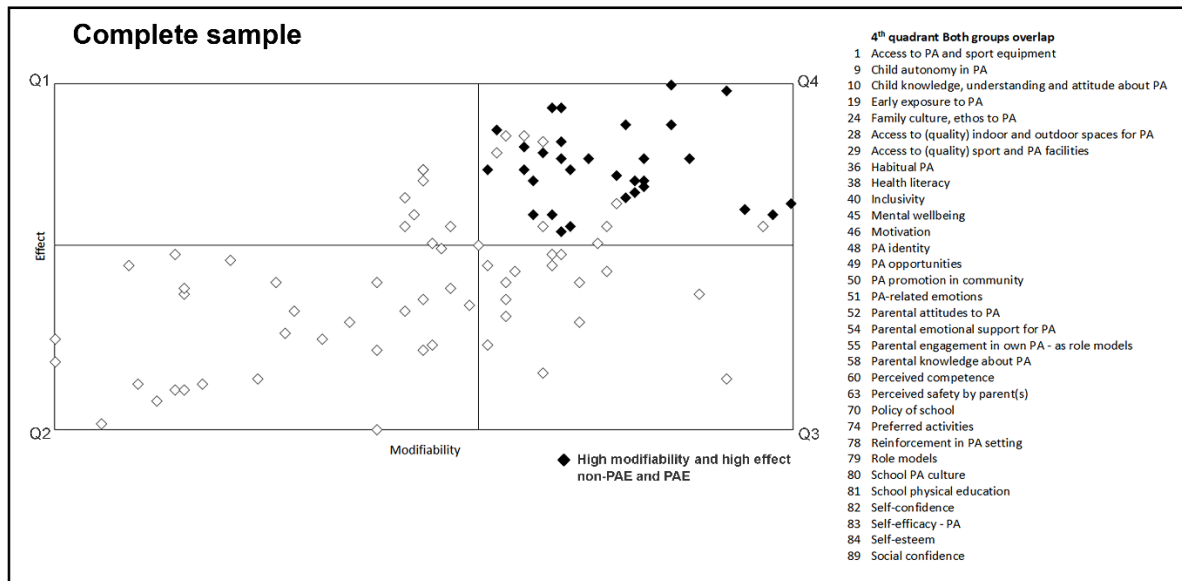
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584 *Figure 1. Concept mapping procedure as applied in the current study, adapted from the*
 585 *procedure described in Trochim (1989).*

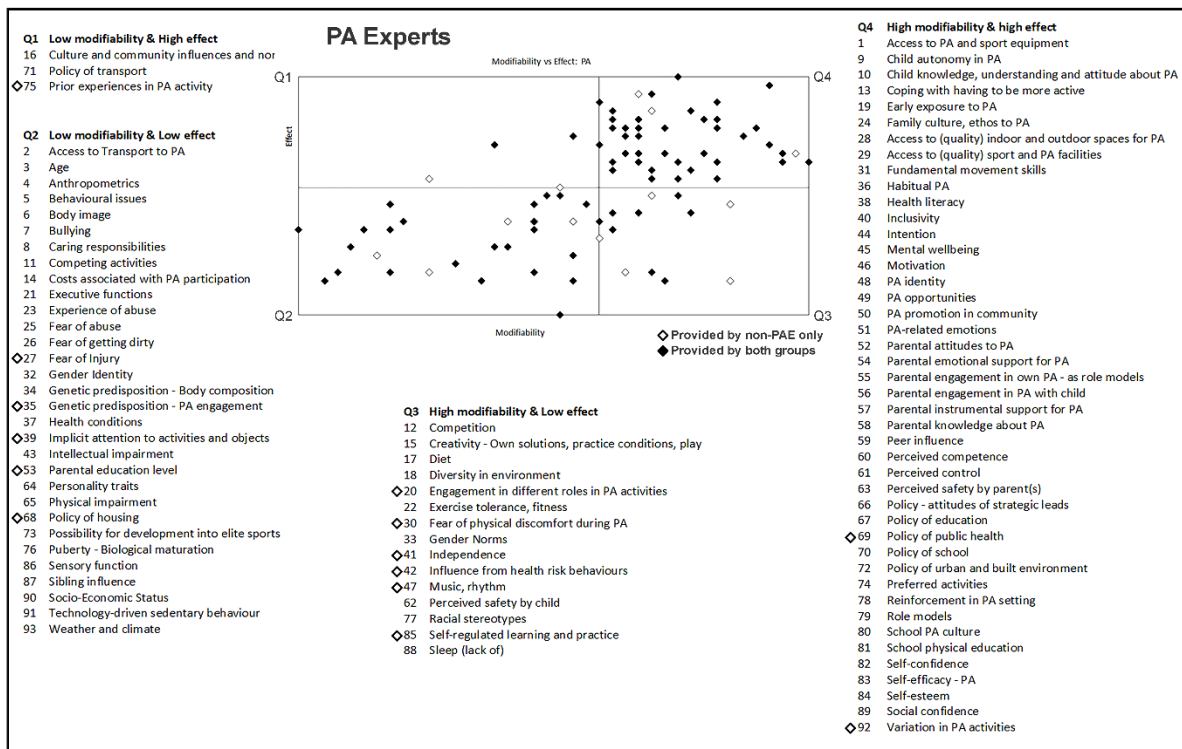
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587

588 *Figure 2. Plot of rating for modifiability vs effect by the complete sample. Quadrants divided*
 589 *using the mean rating for modifiability (vertical line) and the mean rating for effect (horizontal*
 590 *line). Black diamonds indicate the correlates in the 4th quadrant (rated higher than the mean*
 591 *for both modifiability and effect) according to the two groups, respectively.*

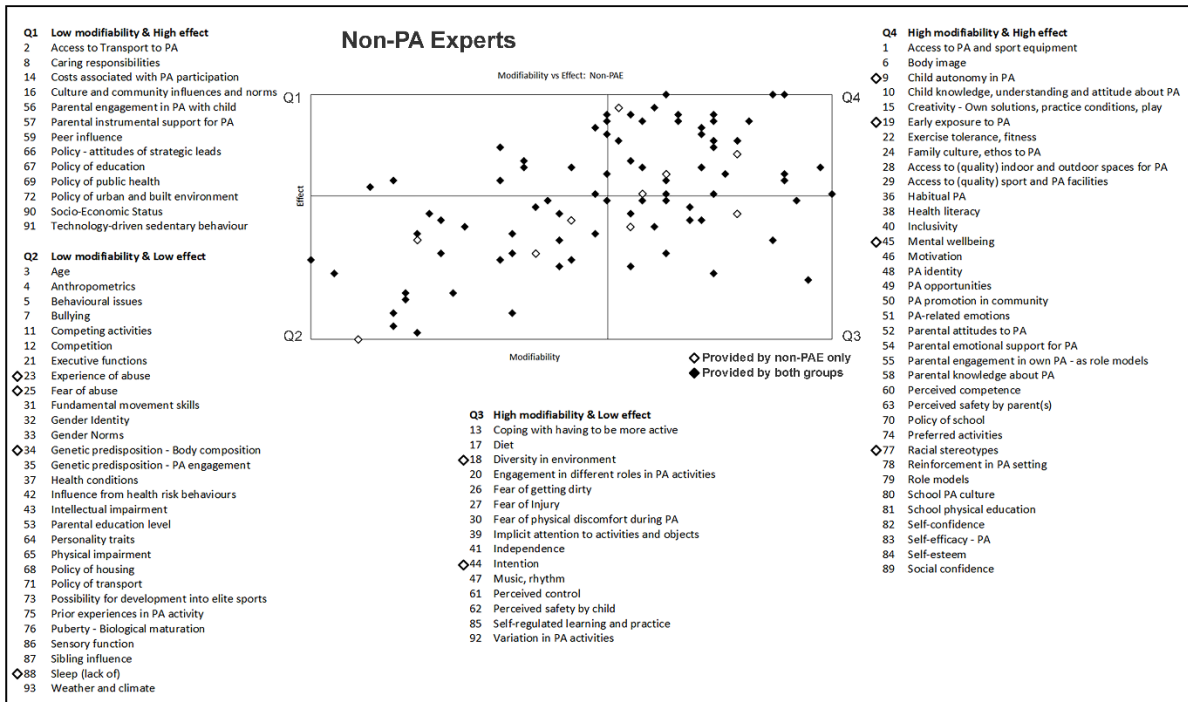
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593

594 *Figure 3. Plot of rating for modifiability vs effect by physical activity experts (PAE). Quadrants*
 595 *divided using the mean rating for modifiability (vertical line) and the mean rating for effect*
 596 *(horizontal line). Correlates of physical activity behaviour are listed by quadrant. Outlined*
 597 *diamonds indicate the correlates only provided by PAE in the brainstorming stage.*

598



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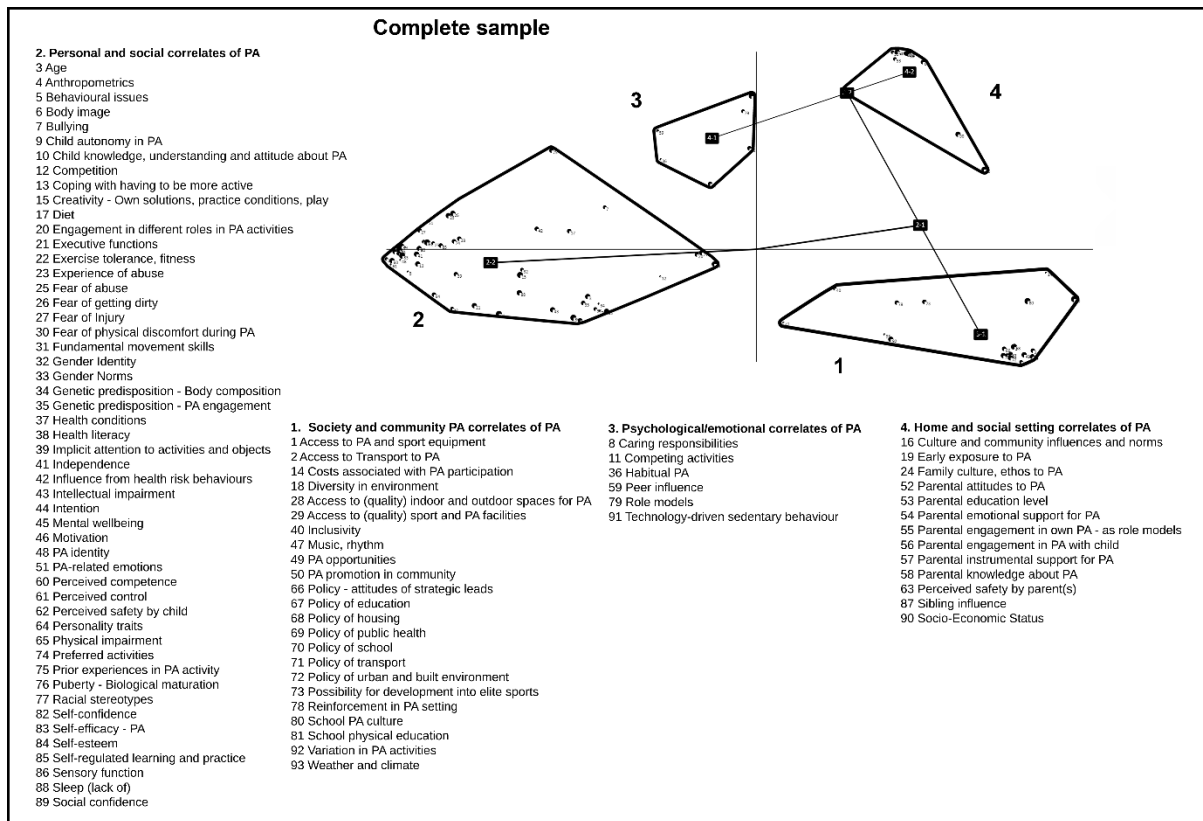
600 *Figure 4. Plot of rating for modifiability vs effect by non-physical activity experts (non-PAE).*

601 *Quadrants divided using the mean rating for modifiability (vertical line) and the mean rating*
 602 *for effect (horizontal line). Correlates of physical activity behaviour are listed by quadrant.*

603 *Outlined diamonds indicate the correlates only provided by non-PAE in the brainstorming*

604 *stage.*

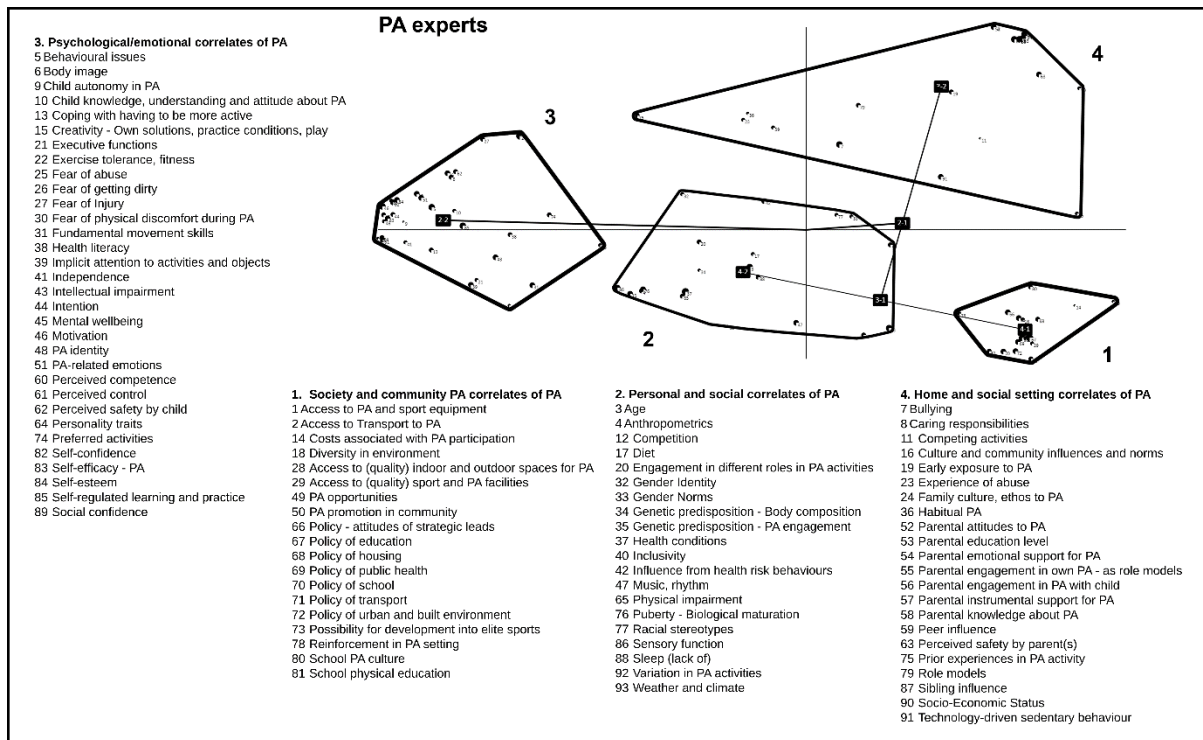
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606

607 *Figure 5. Concept map with cluster labels and list of correlates of physical activity (PA)*
 608 *behaviour by cluster for the complete sample. Cluster definitions: (Cluster 1) Society and*
 609 *community correlates of PA – The societal and community structure which moderate*
 610 *participation in physical activity PA, such as policy, culture and accessibility of PA; (Cluster 2)*
 611 *Personal and social correlates of PA and (Cluster 3) Psychological/emotional correlates of PA*
 612 *– Intrapersonal correlates that are both fixed (possibly non-modifiable) and dynamic (possibly*
 613 *modifiable), either personal characteristics or external social influencers which moderate the*
 614 *predisposition participation in PA; (Cluster 4) Home and social setting correlates of PA –The*
 615 *home environment, specifically the family and the social upbringing within the family.*

616



617

618 *Figure 6. Concept map with cluster labels and list of correlates of physical activity (PA)*

619 *behaviour by cluster for physical activity experts (PAE). Cluster definitions: (Cluster 1) Society*

620 *and community correlates of PA – The societal and community structure which moderate*

621 *participation in PA, such as policy, culture and accessibility of PA; (Cluster 2) Personal and*

622 *social correlates of PA and (Cluster 3) Psychological/emotional correlates of PA – Intrapersonal*

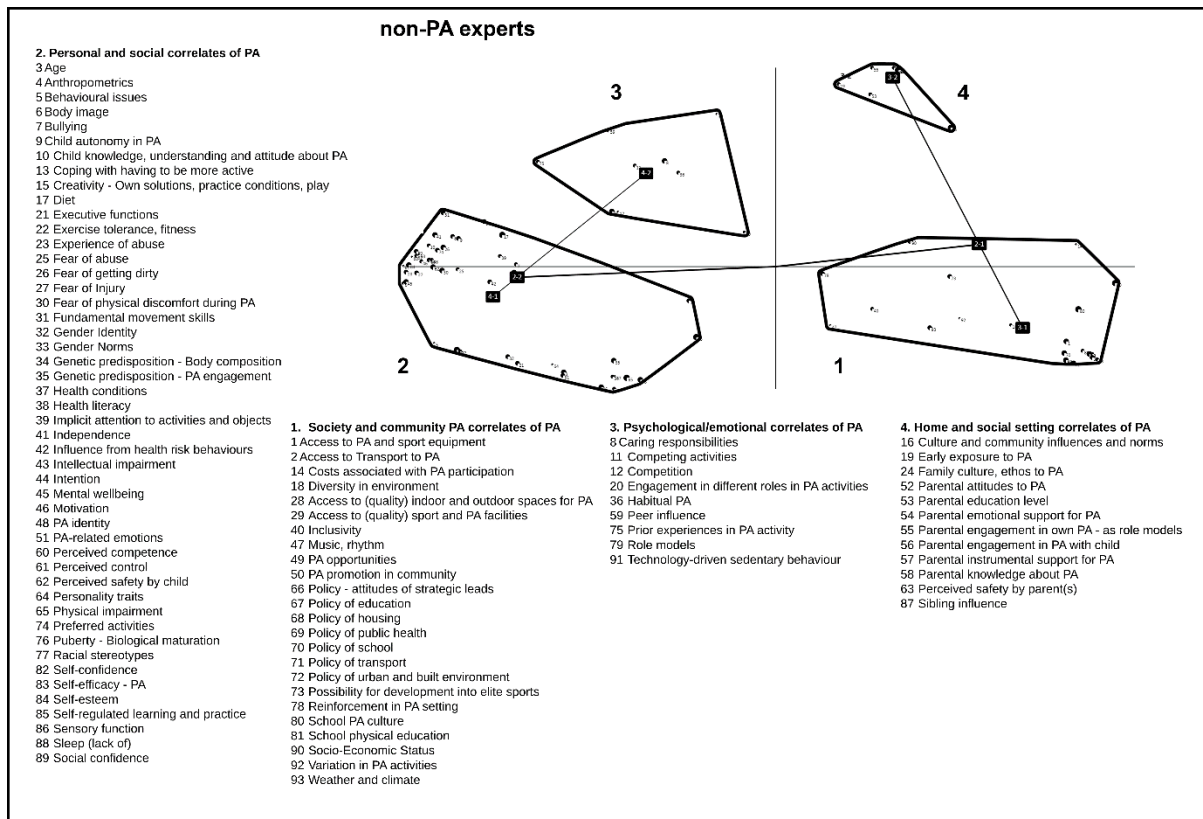
623 *correlates that are both fixed (possibly non-modifiable) and dynamic (possibly modifiable),*

624 *either personal characteristics or external social influencers which moderate the*

625 *predisposition participation in PA; (Cluster 4) Home and social setting correlates of PA –The*

626 *home environment, specifically the family and the social upbringing within the family.*

627



628

629 *Figure 7. Concept map with cluster labels and list of correlates of physical activity (PA)*

630 *behaviour by cluster for non-physical activity experts (non-PAE). Cluster definitions: (Cluster 1)*

631 *Society and community correlates of PA – The societal and community structure which*

632 *moderate participation in PA, such as policy, culture and accessibility of PA; (Cluster 2)*

633 *Personal and social correlates of PA and (Cluster 3) Psychological/emotional correlates of PA*

634 *– Intrapersonal correlates that are both fixed (possibly non-modifiable) and dynamic (possibly*

635 *modifiable), either personal characteristics or external social influencers which moderate the*

636 *predisposition participation in PA; (Cluster 4) Home and social setting correlates of PA –The*

637 *home environment, specifically the family and the social upbringing within the family.*

638

639 *Table 1. Correlates of physical activity behaviour provided at the brainstorming stage by either*
 640 *non-physical activity experts (non-PAE) or physical activity experts (PAE).*

#	Provided by non-PAE only	#	Provided by PAE only
9.	Child autonomy in PA	20.	Engagement in different roles in PA activities
18.	Diversity in environment	27.	Fear of Injury
19.	Early exposure to PA	30.	Fear of physical discomfort during PA
23.	Experience of abuse	35.	Genetic predisposition - PA engagement
25.	Fear of abuse	39.	Implicit attention to activities and objects
34.	Genetic predisposition - Body composition	41.	Independence
44.	Intention	42.	Influence from health risk behaviours
45.	Mental wellbeing	47.	Music, rhythm
77.	Racial stereotypes	53.	Parental education level
88.	Sleep (lack of)	68.	Policy of housing
		69.	Policy of public health
		75.	Prior experiences in PA activity
		85.	Self-regulated learning and practice
		92.	Variation in PA activities

Non-PAE = non-physical activity experts; PAE = physical activity experts; # = correlate number

641

642

643 *Table 2. New potential correlates of physical activity behaviour in the current conceptual*
 644 *framework, not considered in the systematic reviews on the of physical activity behaviour in*
 645 *children.*

#	Not in previous reviews
8	Caring responsibilities
13	Coping with having to be more active
15	Creativity - Own solutions, practice conditions, play
20	Engagement in different roles in PA activities
23	Experience of abuse
25	Fear of abuse
30	Fear of physical discomfort during PA
39	Implicit attention to activities and objects
43	Intellectual impairment
47	Music, rhythm
52	Parental attitudes to PA
65	Physical impairment
73	Possibility for development into elite sports
86	Sensory function

PA = physical activity; # = correlate number

646

647