

1 **Perceptions of asthma and exercise in adolescents with and without asthma**

2 **Abstract**

3 **Objective:** To elicit the views of adolescents, with and without asthma, about exercise and
4 asthma, and the perceived benefits of and barriers to participation. The adolescent views
5 elicited would subsequently inform the design of a high-intensity exercise intervention to
6 improve asthma control.

7 **Methods:** Fifty-four adolescents (age 13.1 ± 0.9 years; 26 with asthma) participated in twelve
8 semi-structured group interviews. Questions were structured around knowledge, attitudes and
9 beliefs towards asthma and its impact on exercise participation and lifestyle. The interviews
10 were transcribed verbatim, thematically analysed and presented via diagrams of emergent
11 themes. Ethical approval was granted by the institutional research ethics committee.

12 **Results:** Fear of an asthma attack emerged as the main barrier to exercise, with many
13 adolescents with asthma withdrawing from exercise as a coping strategy; many healthy
14 adolescents perceived this withdrawal as laziness or an excuse. Despite this, the majority
15 (81%) of adolescents with asthma reported exercise to be their most enjoyable activity.
16 Adolescents suggested incorporating mixed activities, such as team games (e.g., rounders,
17 football, netball), for future interventions to ensure adherence.

18 **Conclusions:** Whilst exercise is important in the management of asthma, the tendency of
19 those with asthma to withdraw from exercise to avoid adverse events could be addressed
20 through a games-based high-intensity exercise intervention. Furthermore, educating all
21 adolescents on asthma could simultaneously reduce stigmatisation and enhance exercise
22 engagement.

23

24 **Introduction**

25 Asthma is one of the most common chronic diseases in the UK, affecting 1 in 11 children [1].
26 The benefits associated with exercise are well-recognised for healthy children, with
27 additional benefits, such as reduced symptoms and severity [2], for those with asthma.
28 However, whilst some children with asthma recognise that regular exercise is associated with
29 improved control of their asthma and enhanced physical self-perceptions [3], exercise
30 participation is typically lower in those with asthma compared to their healthy peers [4, 5].
31 Indeed, the attribution of normal symptoms of physical exertion to symptoms of asthma is a
32 common misconception [6, 7], which, when exacerbated by a lack of fitness [8], leads to a
33 greater manifestation of the apparent symptoms of asthma, resulting in further avoidance of
34 exercise and a vicious negative cycle.

35 Commonly cited barriers to exercise for adolescents include time constraints, school
36 work and lack of interest [9]; with additional barriers, such as fear of asthma symptoms, in
37 those with asthma [10]. Despite no differences in fitness levels [11], there is a perception that
38 children with asthma are less physically able than their healthy peers [12], potentially
39 reflecting a lack of understanding rather than true disease-related physiological limitation.
40 Teachers report that they have limited confidence when engaging children with asthma in
41 exercise and encourage them towards musical instruments rather than physical pursuits [13].
42 This perception is frequently reinforced by parents who restrict their children's activities to
43 minimise potential detrimental risks of asthma [14, 15]. These actions are likely to contribute
44 to the feelings of ostracization often cited by those with asthma, with some children
45 deliberately "struggling through" exercises with their healthy peers to avoid social isolation
46 [16] and being identified as different [17].

47 Although numerous studies have described the perceptions of those with asthma
48 regarding their ability to exercise and their perceived barriers and facilitators [18, 19], there is
49 little information on the perceptions of their healthy peers, which may impact participation.
50 Furthering our understanding of the perceptions of those with and without asthma is
51 fundamental to the design of interventions to increase exercise in adolescents with asthma,
52 thus breaking the vicious negative cycle of exercise avoidance [20]. Frequently reported
53 barriers to exercise interventions revolve around poor adherence due to monotony and
54 sustainability, for continuous aerobic exercise [21], and high-intensity exercise interventions,
55 respectively [22]. It is noteworthy that no studies to date have sought input from adolescents
56 with asthma themselves with regards to the intervention design and implementation.

57 The primary aim of this study was therefore to elicit views of adolescents, with and
58 without asthma, about exercise and asthma, and the perceived benefits of and barriers to
59 participation. The secondary aim was to inform the design of a future high-intensity exercise
60 intervention to improve asthma control.

61 **Methods**

62 **Participants**

63 Fifteen secondary schools in the UK were invited, as part of a wider randomised control trial
64 (the X4A trial: eXercise for Asthma with Commando Joe's), to participate in an exercise
65 intervention with the aim of improving asthma symptoms and quality of life. Subsequently,
66 one school was randomised to the intervention arm and four schools to the control arm of the
67 study. The current manuscript describes a qualitative study that was conducted using semi-
68 structured group interviews of adolescents with and without asthma. Ethical approval was
69 granted by the institutional research ethics committee (ref: PG/2014/29).

70 Five hundred and eighty five adolescents from the intervention school were eligible
71 to participate (aged 11-14 years) in the exercise intervention, of which 223 (48 with asthma;
72 24 boys) provided written parental consent and child assent. Using stratified randomisation, a
73 subsample of 60 adolescents, split by age, sex and asthma, were selected to participate in
74 formative group interviews. Three school year groups were used (11-12 years, 12-13 years
75 and 13-14 years) with ten adolescents with and ten without asthma from each, with an even
76 split of sex (n=60). From the 60 selected participants, six were absent on the day, and
77 therefore 26 and 28 participants with and without asthma, respectively, attended the
78 interviews (13.1 ± 0.9 years). Of the 26 with asthma, severity was classified as intermittent
79 and mild persistent (88%) and moderate and severe (12%) according to GINA criteria [23].

80 **Procedures**

81 Thirteen semi-structured group interviews consisting of 3-5 adolescents were conducted
82 separately grouped by age and condition. The group interviews were performed in a quiet
83 area of the school to avoid interruption; the interviews lasted 30.9 ± 3.2 minutes. Author three
84 conducted the interviews and was known by the participants, providing an interview
85 environment in which the adolescents could speak honestly and freely about their perceptions
86 [24]. Group interviews with adolescents have been found to be a viable method for exploring
87 perspectives provided the groups are small (i.e., 3-5 participants) [25, 26]. Questions were
88 structured around adolescents' knowledge, attitudes and beliefs towards asthma and its
89 impact on exercise participation and life. The questions were designed to elicit the
90 adolescents' perceptions of asthma and exercise, with questions in the asthma groups relating
91 to themselves and others with asthma, and questions in the groups without asthma relating to
92 their perceptions of those with asthma. Each group were also asked questions relating to the
93 design of a high-intensity exercise intervention in which they might participate. Sample

94 interview questions are presented in Table 1. All interviews were recorded using a digital
95 recorder (Galaxy S7 Edge, Samsung) and were transcribed verbatim.

96 **Data analysis**

97 The transcribed data were thematically analysed in a deductive manner and presented via
98 diagrams of key emergent themes (pen profiles), which are considered appropriate for
99 representing findings from large data sets in a manner understandable to both qualitative and
100 quantitative researchers [27, 28]. The pen profiles were first created by the first author and
101 subsequently by author two; the authors then brought the profiles together to deliberate
102 whether the findings were worthy of attention [29]. Following initial analysis, the two authors
103 then presented the pen profiles to the second to last author for co-operative triangulation. The
104 analysis was questioned and cross-examined in reverse from pen profile to transcripts until a
105 general consensus was reached. Finally, all authors were given the pen profiles where they
106 could comment and discuss any changes they deemed appropriate to either the themes or
107 quotes.

108 **Results**

109 Participants quotes are labelled in text by sex (B=boy, G=girl).

110 **Participants with asthma**

111 Key emergent themes have been structured around control, impact, perceptions and exercise
112 (Figure 1). The group interviews revealed that the majority of adolescents with asthma
113 controlled their condition using an inhaler (78%). Other participants, and indeed those who
114 could not access their inhaler during asthmatic symptoms, suggested altering their breathing
115 pattern as a mechanism to control their asthma. Only one person highlighted taking their
116 inhaler prior to an activity as a control strategy.

117 Asthma was found to impact adolescents during school and/or in a social context.
118 For example, participants felt that their asthma restricted them whilst they were with their
119 friends,

120 *“I just want to keep up but then I can't” B4,*

121 or resulted in them being left out altogether. Furthermore, some adolescents even reported
122 struggling when laughing with their friends,

123 *“I can't laugh a lot, it's really hard” G1.*

124 Symptoms of asthma experienced at night resulted in poor sleep quality and consequently
125 impacted on social aspects and a lack of concentration in school.

126 Poor school attendance due to asthma symptoms and doctors' appointments was
127 reported, with particular focus on reducing their involvement, or participation, in physical
128 education (PE) lessons. The majority of the participants alluded to their healthy peers having
129 a lack of understanding of their condition and often misinterpreting situations. Specifically,
130 those with asthma felt that they were often perceived as lazy or that they used their condition
131 as an excuse,

132 *“they think it might just be like an excuse” B3.*

133 Some participants reported being told to:

134 *“get on with it” B3*

135 by their healthy peers. Finally, some reported that healthy peers failed to appreciate when it
136 was their asthma symptoms limiting them,

137 *“they just misjudge everything, they think that you can do it when you can't” B2.*

138 Whilst some adolescents with asthma did acknowledge that they sometimes used
139 their asthma as an excuse,

140 *“When I don’t want to do something I use it as an excuse” G4,*

141 a more common perception was one of fear of exercise inducing an asthma attack leading to
142 decreased participation,

143 *“I do prevent myself from doing activity because I feel that I’m scared to have an*
144 *asthma attack” G3.*

145 In contrast, some reported that having asthma actually acted as a facilitator to exercise by
146 increasing their competitiveness to show that they are not affected by their condition,

147 *“I just want to do as much as everyone else” G2.*

148 Moreover, six of the participants found that being ‘fitter’ reduced their asthma symptoms and
149 therefore used exercise as a way to improve their health.

150 **Participants without asthma**

151 Similar to participants with asthma (Figure 1), key emergent themes have been
152 structured around control, impact, perceptions and exercise (Figure 2). Those without asthma
153 were less sure about how asthma is controlled; 39% demonstrated knowledge of the use of
154 inhalers and 11% suggested altering breathing as a form of asthma control. Similarly, healthy
155 counterparts were also less clear on the impact of asthma on school and social life, only
156 recognising the burden of carrying an inhaler and factors such as worrying about having an
157 asthma attack. Eight adolescents without asthma (29%) believed that asthma had no effect on
158 social or school life,

159 *“they’ve got their pump, it shouldn’t really affect anything” G12.*

160 Despite some thinking there was no effect, others noticed the issues during PE,

161 *“they slow down, take their pumps and then get going again” B23.*

162 School attendance was also noted as a potential issue for upcoming exams,

163 *“they have to leave the class ... they can't afford to miss out on work” B16.*

164 Two of the group had a complete lack of understanding of the condition, with five more not
165 providing an answer to ‘what is asthma?’ Adolescents who had some understanding outlined
166 breathing difficulties (68%) and reduced lung function (14%) as characteristics of asthma.
167 Indeed, breathing difficulties were outlined as one of the main barriers to exercise for
168 adolescents with asthma,

169 *“they can't breathe properly” G16.*

170 along with stopping often to take breaks (46%). These breaks were perceived by others as
171 laziness, using asthma as an excuse to avoid certain activities, especially in girls,

172 *“many girls use it as an excuse because they don't want to have PE” G12*

173 and as an excuse to avoid trouble, such as forgetting their kit. Other cited potential barriers
174 included fear of asthma attacks (14%) and not being able to participate in as much exercise
175 (21%). Participants without asthma perceived there to be relatively few facilitators of
176 exercise in comparison to their peers with asthma, citing only health benefits (18%).

177 **Views on an exercise intervention**

178 In response to the icebreaker question (‘what is your favourite thing to do?’), 77% of
179 participants referred to some form of exercise, irrespective of asthma status (81% of those
180 with asthma). Emergent themes are structured around activity type, high-intensity interval
181 training (HIIT), logistics and barriers (Figure 3).

182 All of the adolescents participated in some form of exercise; 38 in individual sports,
183 37 in team sports and 7 in dance. The participants identified five main categories of activity
184 type as enjoyable, with team games widely stated as the most enjoyable (76%). Due to its
185 popularity, running was categorised separately to other individual sports, with suggestions
186 that this activity type, particularly sprinting, was good to include given its simplicity.
187 Obstacle courses and circuits were both mentioned as a way of implementing many different
188 activities within the same session,

189 *'because it's a range of things. People might find some easier than others and others*
190 *might find it hard' G8.*

191 Some of the participants with asthma (n=4) raised the need for breaks within the exercise in
192 order for them to catch their breath or,

193 *"take your pump if you need to" B1.*

194 High-intensity interval training was described by the majority as being hard work.
195 Interestingly, the perceptions of HIIT difficulty were vastly different between those with and
196 without asthma; only three of those with asthma thought that the difficulty would vary, with
197 thirteen of those without asthma thinking that,

198 *"it depends on what sort of exercise you do" B26.*

199 In contrast to participants with asthma who perceived HIIT to be difficult
200 specifically due to their asthma, their healthy counterparts attributed difficulty to a type of
201 training their bodies are not used to,

202 *"so like you're just instantly in something and it will be difficult" B20.*

203 Due to the structure of the school day, the adolescents were only able to participate
204 in the exercise intervention out of school hours, resulting in a split for delivering the
205 intervention before or after school, citing barriers such as after school activities. The majority
206 of the participants would have preferred if the sessions were run outdoors (61%), with 22% of
207 participants asking for a combination of both indoor and outdoor activities, dependent on type
208 of activity and weather.

209 A range of barriers to future exercise interventions were reported, such as illness or
210 injury, or clashes with other activities, such as homework or paid work. The data revealed
211 that 35% of the participants believed that those with asthma did not participate in as much
212 exercise as their healthy peers, 48% perceived them to participate in the same amount and the
213 remaining 17% believed that it was dependent on the activity in question. Lack of enjoyment
214 of both team and individual sports was alluded to as one of the main barriers, contradicting
215 previous activity choices. Running was specifically highlighted as a form of exercise that
216 some participants without asthma found to be boring, and those with asthma reported
217 difficulty breathing when running. In contrast to sprints, which were mentioned as an
218 enjoyable activity type, long distance type running was cited as a barrier which the majority
219 of asthma sufferers said they would find difficult. Being pushed too hard in the sessions was
220 also mentioned as a barrier as it would decrease adherence to the intervention.

221 **Discussion**

222 The primary aim of this study was to elicit perceptions about asthma and exercise from
223 adolescents with and without the condition and to compare their perceived benefits and
224 barriers to participation. Data were analysed thematically and presented using pen profiles,
225 facilitating more accessible qualitative data for quantitative researchers and reducing the
226 likelihood of skewed themes through dominating individuals in the interviews [27]. The

227 second aim of the study was to inform the design, the content and delivery of a school-based,
228 high-intensity exercise intervention, the X4A trial: eXercise for Asthma with Commando
229 Joe's, which was achieved using a representative sample across the ages within the planned
230 intervention.

231 There are many known benefits of exercise for those who suffer from asthma [11,
232 30]; however, only 23% of participants with asthma and 18% of those without asthma were
233 aware of the potential health benefits of exercise in asthma. Previous research documents the
234 lack of knowledge of the benefits of exercise [31] and therefore further education is required.
235 Asthma guidelines highlight physical training as part of asthma management, with
236 appropriate precautions for exercise-induced asthma [32]. Exercise reduces the symptoms
237 and severity of asthma [2] and, as lung function and wheeze in those with asthma are not
238 adversely affected by exercise with appropriate treatment, there is no reason why they should
239 not participate regularly [20].

240 Adolescents with asthma perceived that their healthy peers lacked understanding
241 about the limiting effect of their condition on exercise, and that they use their condition as an
242 excuse to be lazy. This perception of laziness and lack of understanding about asthma was
243 confirmed by those without asthma. A minority of adolescents with asthma admitted to using
244 their condition as an excuse, in contrast to previous research [16]. These perceptions and
245 misconceptions must be addressed through improved education about asthma and its
246 implications for daily life and exercise. Indeed, two adolescents with asthma misjudged
247 others with asthma, demonstrating a lack of understanding of their own condition. Only one
248 person highlighted taking their inhaler prior to an activity as a control strategy suggesting a
249 need for improved education to manage exercise-induced symptoms.

250 Exercise participation rates of those with and without asthma are considered to be
251 conflicting, with suggestions that adolescents with asthma participate in more [33, 34], less
252 [4, 35] or equivalent levels of exercise to their healthy counterparts [36-38]. While our study
253 did not specifically address levels of exercise participation, adolescents with asthma were not
254 perceived to engage in higher levels of exercise in comparison to their healthy peers, with
255 most (48%) stating that participation was similar or reduced (35%). In an attempt to
256 demonstrate that their condition does not negatively affect them, competitive motivation to
257 outperform their healthy peers, was found to be a facilitator to 15% of adolescents with
258 asthma, albeit more in terms of the intensity rather than volume of exercise [17]. Participants
259 without asthma discussed a wide range of barriers of asthma to exercise with relatively few
260 facilitators, with fear of having an asthma attack identified as the main barrier by participants,
261 irrespective of their asthma [7]. Despite fear of asthma attacks, 81% of those with asthma
262 stated that their favourite activity was exercise [39], demonstrating that these individuals
263 overcome their fear in order to exercise.

264 Asthma has been previously found to impact on social [40] and academic life [41],
265 often resulting in isolation [17]. In contrast to previous studies where those with asthma
266 reported being bullied or ignored due to their perceived limited physical capabilities [42],
267 adolescents with asthma in the present study did not report any form of bullying. However, it
268 is possible bullying would not have been raised in a group situation. School attendance was
269 only discussed by two participants with asthma, although this may be due to the participants
270 not perceiving absence from school as a negative factor [42]; participants without asthma
271 thought that poor school attendance may affect their upcoming exams [40]. As with previous
272 research [43], a lack of sleep due to asthma symptoms at night negatively impacted on
273 subsequent social situations and concentration in school.

274 The adolescents reported participating in a variety of physical activities; the vast
275 majority (76%) liked the idea of team games, such as rounders, football or netball, which
276 were commonly suggested by the participants, being incorporated into future interventions.
277 Interestingly, there were no differences in type of activities suggested by those with and
278 without asthma, with the exception of running, which was recommended by more adolescents
279 without asthma. Almost half suggested obstacle courses or circuits to ensure a variety of
280 different activities in each session, which might prevent burnout and boredom, and increase
281 enjoyment during the sessions [44]. Indeed, this variation was suggested as a tool to divert
282 attention away from the fear of an asthma attack and increase adherence to the exercise
283 programme. Intermittent activities were suggested by four adolescents with asthma in order
284 to catch their breath or take their medication. Given that it takes approximately 7.75 minutes
285 of continuous exercise to elicit bronchoconstriction [45], intermittent activities may
286 potentially reduce symptoms.

287 Participants with asthma generally thought that HIIT was difficult; this may be due
288 to past experiences and potentially poor asthma control. Whilst asthma should not interfere
289 with exercise if well controlled [46], congruent with previous research [42], adolescents with
290 asthma highlighted that their running ability was limited, impeding participation in the
291 majority of sports. The current study, however, revealed that it was not running per se, but
292 specifically long distance running that was difficult for those with asthma and therefore
293 sprints could still be used within intervention sessions, also facilitating regular breaks.

294 Whilst the present findings significantly advance our understanding of the
295 perceptions of those with and without asthma regarding exercise participation, and the ideal
296 constituents for future interventions, it is perhaps pertinent to note the potential influence of
297 self-selection bias on our findings. Such a self-selection bias would, however, be anticipated
298 in any voluntary exercise intervention and therefore the findings are generalizable to the

299 wider population with asthma. Further work is required that focusses on the engagement of
300 those with particularly low levels of physical activity. Furthermore, the positive outcomes of
301 the present study may be under-represented as the participants in each group often tried to
302 give answers that had not already been expressed. It is also important to highlight that the
303 interviews were conducted in the summer and therefore answers to the preferred location of
304 an intervention, time of day and types of sport may have reflected this. Contrary to previous
305 research, parent interviews were not used in the present study as it was believed that it is the
306 adolescents' engagement that is required for the sustainability of an intervention. Moreover,
307 parents' perceptions of exercise and asthma have been found to be less accurate than their
308 children with the condition [47].

309 **Conclusion**

310 Educating adolescents about asthma could simultaneously aid in reducing stigmatisation and
311 increasing the awareness of exercise-related health benefits, including better asthma control.
312 Whilst participants with asthma reported a fear of undertaking exercise, it was still
313 highlighted as their favourite activity, demonstrating promise for future exercise
314 interventions. Employing an inclusive exercise approach appears feasible given the similarity
315 in activity choices between those with and without asthma. High-intensity, intermittent,
316 varied exercise was highlighted as potentially effective at avoiding bronchoconstriction,
317 distracting those with asthma from their preconceptions regarding exercise, yet ensuring
318 enjoyment.

319

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