Paper:
Abstract

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

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

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

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

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

Commonly cited barriers to exercise for adolescents include time constraints, school work and lack of interest [9]; with additional barriers, such as fear of asthma symptoms, in those with asthma [10]. Despite no differences in fitness levels [11], there is a perception that children with asthma are less physically able than their healthy peers [12], potentially reflecting a lack of understanding rather than true disease-related physiological limitation. Teachers report that they have limited confidence when engaging children with asthma in exercise and encourage them towards musical instruments rather than physical pursuits [13]. This perception is frequently reinforced by parents who restrict their children’s activities to minimise potential detrimental risks of asthma [14, 15]. These actions are likely to contribute to the feelings of ostracization often cited by those with asthma, with some children deliberately “struggling through” exercises with their healthy peers to avoid social isolation [16] and being identified as different [17].
Although numerous studies have described the perceptions of those with asthma regarding their ability to exercise and their perceived barriers and facilitators [18, 19], there is little information on the perceptions of their healthy peers, which may impact participation. Furthering our understanding of the perceptions of those with and without asthma is fundamental to the design of interventions to increase exercise in adolescents with asthma, thus breaking the vicious negative cycle of exercise avoidance [20]. Frequently reported barriers to exercise interventions revolve around poor adherence due to monotony and sustainability, for continuous aerobic exercise [21], and high-intensity exercise interventions, respectively [22]. It is noteworthy that no studies to date have sought input from adolescents with asthma themselves with regards to the intervention design and implementation.

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

**Methods**

**Participants**

Fifteen secondary schools in the UK were invited, as part of a wider randomised control trial (the X4A trial: eXercise for Asthma with Commando Joe’s), to participate in an exercise intervention with the aim of improving asthma symptoms and quality of life. Subsequently, one school was randomised to the intervention arm and four schools to the control arm of the study. The current manuscript describes a qualitative study that was conducted using semi-structured group interviews of adolescents with and without asthma. Ethical approval was granted by the institutional research ethics committee (ref: PG/2014/29).
Five hundred and eighty five adolescents from the intervention school were eligible to participate (aged 11-14 years) in the exercise intervention, of which 223 (48 with asthma; 24 boys) provided written parental consent and child assent. Using stratified randomisation, a subsample of 60 adolescents, split by age, sex and asthma, were selected to participate in formative group interviews. Three school year groups were used (11-12 years, 12-13 years and 13-14 years) with ten adolescents with and ten without asthma from each, with an even split of sex (n=60). From the 60 selected participants, six were absent on the day, and therefore 26 and 28 participants with and without asthma, respectively, attended the interviews (13.1 ± 0.9 years). Of the 26 with asthma, severity was classified as intermittent and mild persistent (88%) and moderate and severe (12%) according to GINA criteria [23].

Procedures

Thirteen semi-structured group interviews consisting of 3-5 adolescents were conducted separately grouped by age and condition. The group interviews were performed in a quiet area of the school to avoid interruption; the interviews lasted 30.9±3.2 minutes. Interviewers were all conducted by WTBE for consistency, who was known by the participants, providing an interview environment in which the adolescents could speak honestly and freely about their perceptions [24]. Group interviews with adolescents have been found to be a viable method for exploring perspectives provided the groups are small (i.e., 3-5 participants) [25, 26]. Questions were structured around adolescents’ knowledge, attitudes and beliefs towards asthma and its impact on exercise participation and life. The questions were designed to elicit the adolescents’ perceptions of asthma and exercise, with questions in the asthma groups relating to themselves and others with asthma, and questions in the groups without asthma relating to their perceptions of those with asthma. Each group were also asked questions relating to the design of a high-intensity exercise intervention in which they might participate.
Sample interview questions are presented in Table 1. All interviews were recorded using a digital recorder (Galaxy S7 Edge, Samsung) and were transcribed verbatim.

**Data analysis**

The transcribed data were thematically analysed in a deductive manner and presented via diagrams of key emergent themes (pen profiles), which are considered appropriate for representing findings from large data sets in a manner understandable to both qualitative and quantitative researchers [27, 28]. The pen profiles were independently constructed by both CONW and KAM prior to discussion on key themes, issues and findings [29]. Following initial analyses, both authors presented the pen profiles to MAM for co-operative triangulation, whereby the data was cross-examined in reverse from pen profile to transcripts until a general consensus was reached. This process was repeated, allowing all authors to offer alternative interpretations of the data, until a final acceptable consensus had been reached.

**Results**

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

**Participants with asthma**

Key emergent themes have been structured around control, impact, perceptions and exercise (Figure 1). The group interviews revealed that the majority of adolescents with asthma controlled their condition using an inhaler (78%). Other participants, and indeed those who could not access their inhaler during asthmatic symptoms, suggested altering their breathing pattern as a mechanism to control their asthma. Only one person highlighted taking their inhaler prior to an activity as a control strategy.
Asthma was found to impact adolescents during school and/or in a social context. For example, participants felt that their asthma restricted them whilst they were with their friends,

“I just want to keep up but then I can’t” B4,

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

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

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

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

“They think it might just be like an excuse” B3.

Some participants reported being told to:

“get on with it” B3

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

“They just misjudge everything, they think that you can do it when you can’t” B2.
Whilst some adolescents with asthma did acknowledge that they sometimes used their asthma as an excuse,

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

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

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

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

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

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

Participants without asthma

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

“They've got their pump, it shouldn't really affect anything” G12.
Despite some thinking there was no effect, others noticed the issues during PE,

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

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

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

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

“they can’t breathe properly” G16.

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

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

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

Views on an exercise intervention

In response to the icebreaker question (‘what is your favourite thing to do?’), 77% of participants referred to some form of exercise, irrespective of asthma status (81% of those with asthma). Emergent themes are structured around activity type, high-intensity interval training (HIIT), logistics and barriers (Figure 3).
All of the adolescents participated in some form of exercise; 38 in individual sports, 37 in team sports and 7 in dance. The participants identified five main categories of activity type as enjoyable, with team games widely stated as the most enjoyable (76%). Due to its popularity, running was categorised separately to other individual sports, with suggestions that this activity type, particularly sprinting, was good to include given its simplicity. Obstacle courses and circuits were both mentioned as a way of implementing many different activities within the same session,

‘because it’s a range of things. People might find some easier than others and others might find it hard’ G8.

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

“take your pump if you need to” B1.

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

“it depends on what sort of exercise you do” B26.

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

“so like you’re just instantly in something and it will be difficult” B20.
Due to the structure of the school day, the adolescents were only able to participate in the exercise intervention out of school hours, resulting in a split for delivering the intervention before or after school, citing barriers such as after school activities. The majority of the participants would have preferred if the sessions were run outdoors (61%), with 22% of participants asking for a combination of both indoor and outdoor activities, dependent on type of activity and weather.

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

Discussion

The primary aim of this study was to elicit perceptions about asthma and exercise from adolescents with and without the condition and to compare their perceived benefits and barriers to participation. Data were analysed thematically and presented using pen profiles, facilitating more accessible qualitative data for quantitative researchers and reducing the likelihood of skewed themes through dominating individuals in the interviews [27]. The
second aim of the study was to inform the design, the content and delivery of a school-based, high-intensity exercise intervention, the X4A trial: eXercise for Asthma with Commando Joe’s, which was achieved using a representative sample across the ages within the planned intervention.

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

Adolescents with asthma perceived that their healthy peers lacked understanding about the limiting effect of their condition on exercise, and that they use their condition as an excuse to be lazy. This perception of laziness and lack of understanding about asthma was confirmed by those without asthma. A minority of adolescents with asthma admitted to using their condition as an excuse, in contrast to previous research [16]. These perceptions and misconceptions must be addressed through improved education about asthma and its implications for daily life and exercise. Indeed, two adolescents with asthma misjudged others with asthma, demonstrating a lack of understanding of their own condition. Only one person highlighted taking their inhaler prior to an activity as a control strategy suggesting a need for improved education to manage exercise-induced symptoms.
Exercise participation rates of those with and without asthma are considered to be conflicting, with suggestions that adolescents with asthma participate in more [33, 34], less [4, 35] or equivalent levels of exercise to their healthy counterparts [36-38]. While our study did not specifically address levels of exercise participation, adolescents with asthma were not perceived to engage in higher levels of exercise in comparison to their healthy peers, with most (48%) stating that participation was similar or reduced (35%). In an attempt to demonstrate that their condition does not negatively affect them, competitive motivation to outperform their healthy peers, was found to be a facilitator to 15% of adolescents with asthma, albeit more in terms of the intensity rather than volume of exercise [17]. Participants without asthma discussed a wide range of barriers of asthma to exercise with relatively few facilitators, with fear of having an asthma attack identified as the main barrier by participants, irrespective of their asthma [7]. Despite fear of asthma attacks, 81% of those with asthma stated that their favourite activity was exercise [39], demonstrating that these individuals overcome their fear in order to exercise.

Asthma has been previously found to impact on social [40] and academic life [41], often resulting in isolation [17]. In contrast to previous studies where those with asthma reported being bullied or ignored due to their perceived limited physical capabilities [42], adolescents with asthma in the present study did not report any form of bullying. However, it is possible bullying would not have been raised in a group situation. School attendance was only discussed by two participants with asthma, although this may be due to the participants not perceiving absence from school as a negative factor [42]; participants without asthma thought that poor school attendance may affect their upcoming exams [40]. As with previous research [43], a lack of sleep due to asthma symptoms at night negatively impacted on subsequent social situations and concentration in school.
The adolescents reported participating in a variety of physical activities; the vast majority (76%) liked the idea of team games, such as rounders, football or netball, which were commonly suggested by the participants, being incorporated into future interventions. Interestingly, there were no differences in type of activities suggested by those with and without asthma, with the exception of running, which was recommended by more adolescents without asthma. Almost half suggested obstacle courses or circuits to ensure a variety of different activities in each session, which might prevent burnout and boredom, and increase enjoyment during the sessions [44]. Indeed, this variation was suggested as a tool to divert attention away from the fear of an asthma attack and increase adherence to the exercise programme. Intermittent activities were suggested by four adolescents with asthma in order to catch their breath or take their medication. Given that it takes approximately 7.75 minutes of continuous exercise to elicit bronchoconstriction [45], intermittent activities may potentially reduce symptoms.

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

Whilst the present findings significantly advance our understanding of the perceptions of those with and without asthma regarding exercise participation, and the ideal constituents for future interventions, it is perhaps pertinent to note the potential influence of self-selection bias on our findings. Such a self-selection bias would, however, be anticipated in any voluntary exercise intervention. Further work is required that focusses on the
engagement of those with particularly low levels of physical activity. Furthermore, the positive outcomes of the present study may be under-represented as the participants in each group often tried to give answers that had not already been expressed. It is also important to highlight that the interviews were conducted in the summer and therefore answers to the preferred location of an intervention, time of day and types of sport may have reflected this. Contrary to previous research, parent interviews were not used in the present study as it was believed that it is the adolescents’ engagement that is required for the sustainability of an intervention. Moreover, parents’ perceptions of exercise and asthma have been found to be less accurate than their children with the condition [47].

Conclusion

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

Acknowledgments

The authors would like to thank the pupils and staff at the school involved with the planning and execution of the interviews. This work is funded by the Asthma UK Centre for Applied Research [AUK-AC-2012-01] and Swansea University Medical School. Commando Joe’s also assisted in funding for WTBE who conducted the group interviews.
Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.
References


Table 1. Example interview questions

<table>
<thead>
<tr>
<th>Group interview</th>
<th>Example questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>• What do you think people without asthma get wrong or don’t understand?</td>
</tr>
<tr>
<td></td>
<td>• How does your asthma affect you when participating in exercise?</td>
</tr>
<tr>
<td>Without asthma</td>
<td>• What is asthma?</td>
</tr>
<tr>
<td></td>
<td>• How do you think exercise affects people with asthma?</td>
</tr>
<tr>
<td>Intervention – Both with and without asthma</td>
<td>• What type of activities do you think would get your heart rate up high but be enjoyable?</td>
</tr>
<tr>
<td></td>
<td>• Where do you like to participate in exercise and what time of the school day would you like to participate?</td>
</tr>
</tbody>
</table>