BMJ Open

Active play exercise intervention in children with asthma: a PILOT STUDY

Thomas Westergren,[1] Liv Fegran,[1,2] Tonje Nilsen,[1,3] Kristin Haraldstad,[1] Ole Bjørn Kittang,[2] Sveinung Berntsen[1]

To cite: Westergren T, Fegran L, Nilsen T, *et al*. Active play exercise intervention in children with asthma: a PILOT STUDY. *BMJ Open* 2016;**6**:e009721. doi:10.1136/bmjopen-2015-009721

▶ Prepublication history for this paper is available online. To view these files please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2015-009721).

Received 14 August 2015
Revised 8 December 2015
Accepted 14 December 2015

[1]Faculty of Health and Sports Science, University of Agder, Kristiansand, Norway
[2]Department of Paediatrics, Sørlandet Hospital, Kristiansand, Norway
[3]Department of Physical Therapy, Sørlandet Hospital, Kristiansand, Norway

Correspondence to
Thomas Westergren;
thomas.westergren@uia.no

ABSTRACT

Objective: Increased physical activity (PA) may be beneficial for children with asthma. Knowledge about how to intervene and encourage children with asthma to be physically active is required. In the present study, we aimed to pilot a 6-week exercise intervention designed as active play and examine attendance rate, exercise intensity and children's perceptions of participating.

Methods: 6 children with asthma (4 boys, 2 girls) aged 10–12 years, participated in 60 min of active play exercise twice weekly. A mixed-methods design was applied. The data analysed included attendance rate, exercise intensity assessed by heart rate (HR) monitoring during exercise sessions, registration and description of the active play exercise programme, 3 semistructured focus groups, field observations of 5 exercise sessions, and preintervention and postintervention testing.

Findings: The average attendance rate was 90%. Intensity ≥80% of maximal HR (HR_{max}) was recorded for a median (IQR) time of 22 (8) out of 60 min per session. Median (IQR) HR during the sessions was 146 (9; 74% of HR_{max}) bpm. Children reported increased health-related quality of life (HRQoL) post-test compared with baseline. Children enjoyed participating and reported no limitations by asthma or serious asthma attacks. Instead, they perceived that their asthma and fitness had improved after the programme. The instructors created an inclusive atmosphere that was characterised by easy-to-master games, fair competition, humour and mutual participation.

Conclusions: The exercise intervention pilot focusing on active play had a high attendance rate, relatively high exercise intensity, and satisfaction; the children perceived that their fitness and asthma had improved, and reported increased HRQoL. A randomised controlled trial of active play exercise including children with asthma should be conducted to evaluate effect on PA level, physical fitness, asthma control and HRQoL.

Strengths and limitations of this study

- To our knowledge, this study is the first of its kind with a mixed-methods design combining attendance rate and exercise intensity with a qualitative in-depth exploration of children's perceptions and interactions.
- The active play exercise sessions are described comprehensively, and relations with measurements and children's perceptions are outlined and discussed.
- In-depth information about crucial elements of designing a randomised controlled trial of active play exercise in children with asthma is offered.
- The study has a limited number of participants, and we may not generalise about the effectiveness of the intervention.
- Participating children with asthma may not be representative of other children participating in future interventions.

INTRODUCTION

Children with asthma, particularly those who are newly diagnosed and/or have poor disease control, may be less physically active than healthy children.[1] Physical activity (PA) is recommended for children with asthma,[2 3] and a physically active lifestyle is feasible when the disease is controlled by the optimal use of asthma medication.[4] Increased PA is associated with enhanced psychological functioning and quality of life, improved cardiorespiratory fitness, and decreased morbidity.[2 5] If untreated, up to 90% of children with asthma will experience symptoms of asthma during vigorous PA, a condition called exercise-induced bronchoconstriction (EIB).[6] Increasing physical fitness may be beneficial for children with asthma by increasing exercise tolerance and capacity and, as a consequence, the threshold for inducing EIB.[7]

Physical fitness level may increase after exercise intervention in children with asthma.[2 3] Improvements in maximal oxygen uptake (VO_{2max}) of up to 20% have been reported.[8] However, the reports of exercise interventions vary methodologically in terms of asthma severity in the study group, and the mode, intensity, frequency and duration of exercise.[9] The reports of these interventions often lack details about the exercise

programme, including the structure, types of exercise and description of the intensity level.[10–12] General information about adherence and whether the children enjoyed taking part in the intervention are often reported insufficiently.[8 10 13–15] Only one intervention has included children's opinions of the exercise programme and whether they enjoyed taking part,[11] and no reports a comprehensive qualitative exploration in combination with physical measurements.

Children with asthma may experience frustration because of the limitations imposed by their disease, and they wish to have peer support and young role models to enhance their ability to participate in regular PA and to live a normal life.[16] Previous research suggests that the interpretation of normal breathlessness during exercise as being dangerous asthma symptoms may prevent children from being physically active.[17]

Active play is considered as an opportunity for increased PA in children through gross locomotor movement that are engaging and amusing.[18] Knowledge on how active play exercise could be implemented in an intervention targeting children with asthma is, however, needed. In the present study, we aimed to pilot a 6-week exercise intervention designed as active play for children with asthma. We quantitatively measured the exercise intensity and attendance rate, recorded cardiorespiratory fitness and health-related quality of life (HRQoL) preintervention and postintervention, and qualitatively explored children's perceptions of participating.

METHODS AND PARTICIPANTS

Study design

The study had a convergent parallel mixed-methods design.[19] We used systematic text condensation[20] to analyse the outcomes of semistructured focus groups and field observations in relation to calculations of the attendance rate records, measures of exercise intensity during the exercise sessions, and registration and description of the active play exercise programme. The Regional Committee for Medical Research Ethics in South East Norway approved the protocol (2013/1274). Written informed consent was obtained from guardians of all participating children, and accommodated written and oral information was offered to the participants.

Participants

Participants were recruited through a Norwegian regional hospital's outpatient clinic at a regular follow-up consultation between July and October 2013. The inclusion criteria, with reference to asthma diagnosis criterions of Global Initiative for Asthma including a history of variable respiratory symptoms and confirmed variable expiratory airflow limitation[21] were: (1) age 10–12 years; (2) a diagnosis of asthma; (3) use of asthma medication (β_2-agonists, corticosteroids, leukotriene antagonists, and/or combination formulation of long acting β_2-agonists and corticosteroids) during the past month; (4) dyspnoea, chest tightness and/or wheezing during the past month; and (5) reversible airflow limitation measured during the past year as measured by a 10% increase in forced expiratory volume in 1 s (FEV_1) 15 min after inhalation of 0.2 mg salbutamol per 10 kg body mass (maximum 0.8 mg).

A total of 23 children returned for the follow-up consultation. Ten children did not meet the inclusion criteria for asthma, and five children did not want to participate in the intervention. Reasons for declining were not registered. Eight children (6 boys and 2 girls) were included in the study. Two children (boys) withdrew before the test procedures started without report of motives.

Methods

Anthropometrics and lung function

The children's body mass (Seca 713, Birmingham, UK) and height (stadiometer) were recorded. Overweight was adjusted for age and gender and defined according to Cole *et al*.[22] Lung function was determined by measuring FEV_1. The predicted values of Zapletal *et al*[23] were used for comparison. The response to inhaled salbutamol (VentolinDiskus, Glaxo Smith Kline Inc, Ontario, Canada) was measured. A ≥10% increase in FEV_1 20 min after inhalation of salbutamol compared with baseline value was defined as a reversible airflow limitation.[24]

Cardiorespiratory fitness

Cardiorespiratory fitness was assessed by measuring VO_{2max} during maximal treadmill running (Woodway ELG55, Weil am Rhein, Germany) according to the method of Berntsen *et al*,[25] starting at 5 km/h (5.3% inclination). After 5 min running, speed increased with 2 km/h and thereafter 1 km/h each minute until 11 km/h. Thereafter, inclination of the treadmill raised 1% each minute until exhaustion. Minute ventilation (V_E), respiratory exchange ratio and oxygen consumption (VO_2) were measured using an oxygen analyser (Oxycon, Jaeger (BeNeLux Bv, Breda, the Netherlands). The highest VO_2 maintained during the last minute was defined as VO_{2max}. The highest measured heart rate (HR; Polar S610i, Polar Electro OY, Kempele, Finland) was defined as HR_{max}.

Quality of life and asthma control

HRQoL was recorded using the Paediatric Asthma Quality of Life Questionnaire (PAQLQ) developed by Juniper *et al*.[26] The questionnaire comprises 23 items divided into three domains: activity limitation, symptoms and emotional function. All items use a seven-point Likert response scale, where 1=extremely bothered and 7=not bothered. Asthma control was recorded using the Asthma Control Questionnaire (ACQ) developed by Juniper *et al*.[27 28] The interviewer-administered form of the questionnaires was used. A total ACQ score >1.5 (cut-off point) was defined as having not well-controlled

asthma.[27] Both questionnaires were administered to the participating children only.

Physical activity

Habitual PA was recorded using the SenseWear Pro mini Armband activity monitor (BodyMedia Inc, Pittsburgh, Pennsylvania, USA) according to the method of Berntsen *et al*,[25] and energy expenditure were computed at 1 min intervals. The children received the monitor after their visit to the laboratory and were instructed to wear the monitor continuously for the following 7 days, except during water activity. The cut-off point for defining moderate-to-vigorous-intensity PA (MVPA) was three metabolic equivalents.

The active play intervention pilot

The 1 h guided active play sessions took place twice weekly for 6 weeks from October to December 2013. Active play exercises were designed and directed by experienced sport instructors from the University of Agder. The training location was an indoor gym (300 m^2) at a secondary school in Kristiansand, Norway. The children were instructed to use β_2-agonists as recommended by the doctor before sessions and, if needed, during the sessions. Equipment used in the active play programme were soft balls, Swiss balls, cones, beanbags, balloons, small mats, gymnastic mats, jumping ropes, vaulting boxes, benches and 'paintball bunkers'. Each session started with a 10–15 min warm-up, including various ball games and games of 'tag'. The main session (30–35 min) included more endurance-type activities such as team games, relays and tag. The last 5–10 min were a cool-down, during which the children played low-intensity games or relaxed by listening to music while sitting or lying on a mat. Descriptions of the exercises used in the programme are given in table 1.

To record exercise intensity, the children wore a HR monitor (Polar S610i, Polar Electro OY, Kempele, Finland) during each session. Three instructors were present at every training session—one instructor to

Table 1 Description of elements in the active play exercise

	Exercise	Description
Warm-up (10–15 min)	Frozen tag	With variations on how to be 'unfrozen' (eg, crawl between legs, perform 10 squats)
	10 ball	There are two teams. Each team makes 10 passes without losing the ball. The other team tries to get the ball
	Tail tag	A 'tail' (small rope) is attached to each child's pants. Each child tries to grab the tail from the other participants
	Chip and Dale	Two persons (Chip and Dale) sit back to back. When Chip is called, she/he must run a certain distance with Dale in chase, and vice versa
	Cleaning up	'Garbage' (15 beanbags) is placed on each side of a 'fence'. Two teams. Each team 'cleans' up by throwing as much 'garbage' as possible over the fence to the other team. Time: 30 s
	Naval battle	Two teams (ships) on each side of the room. Area between is 'water' with a 'canon' (Swiss ball). Each team throws soft balls to try to push the 'canon' on to the other team's 'ship'.
Main section (35–40 min)	Tarzan tag	All kinds of equipment (benches, mats, 'paint ball bunkers', hula hoops) are spread around the room. One tagger chases the others, and the children must avoid being tagged by moving between equipment without touching the floor
	Bus relay	One child is the 'driver' who runs around in the room with a long rope, picking up 'passengers' who hold onto the rope and run with the driver
	Deck of card relay	Two teams. Each team collects spades, hearts, diamonds, or clubs, and must perform various 'penalty loops' when they get the wrong card
	Team game	Two teams. Different stations (10 jumps on a bench, crawling on the floor, 10 high jumps on a gymnastic mat, jumping ropes) in a circuit. On the last station, pieces from a puzzle or monopoly money are collected. The team that completes the puzzle or gets the most money first wins
	Flipping cones	Two teams. 30 cones are spread around the room. One team runs and puts up cones and the other team turns them over. Time: 30 s
	Hunting beanbags	Two teams; five beanbags in each corner of the room. Each team has to 'protect' the beanbags in two corners, while at the same time taking beanbags from the other team
	Gym mat relay	Two teams. Relay with gymnastic mats to be pushed, rolled over, or lifted a certain distance
	Obstacle relay	Two teams. An obstacle course with 'obstacles' to jump over, crawl under, balance on, etc
	Station relay	Stations: jumping rope, squat jumps on a gymnastic mat, stepping on a bench, etc
Cool-down (5–10 min)	Untie the knot	Children stand in a circle holding hands and walk over/under arms and legs to make a 'knot'. One subject 'unties'.
	Relaxation	Lying on a mat listening to quiet music
	Shoe relay	A pile of children's shoes lie in the middle of the room. Two teams. Each child must find their own shoes, tie them, and run back to the starting position
	Waking up	Lights out. Individuals lie on mats. One calmly wakes the other individuals up

organise the exercises and the other two instructors to participate in the sessions and encourage the children.

Focus group interviews

To promote reflection and openness, all six participants were involved in three focus groups[29] conducted at the beginning of the 6-week exercise intervention pilot stage and after 3 and 5 weeks. The groups were moderated by the same researcher. The interview guide comprised questions about the participants' experiences and behaviours in relation to asthma, habitual PA and the intervention. All interviews were audiotaped and transcribed verbatim in Norwegian. Translation to English was done only in quotations reported in the manuscript.

Field observations

Field observations focused on the aerobic fitness testing and five exercise sessions observed during the intervention. The first author, whose previous experience includes paediatric nursing and volunteering as an exercise instructor at a local sports club, conducted all observations and moderated all focus groups. The objective of the observations was to observe the children's interaction with their peers, parents and instructors. The aspects of their interaction and discussions that might influence their exercise were explored,[30] including for example, their level of participation in different activities, symptom expressions, expressions about activities and individuals attending, or references from different social contexts.

During the field observations, the researcher assumed an 'observer–participant'[30] role by participating in the activities to make the participants comfortable with his presence. The researcher did not interfere with the instructions, and observed sessions included different warm-ups, main endurance parts and cool-down activities to represent the variety between sessions. To minimise interference, field notes including analytical notes, memos and the journal of fieldwork were written immediately after the sessions.[30] Observed behaviours and interactions were considered and discussed during the focus groups, and issues identified during the groups influenced the focus of subsequent observations.

Analysis of data

Quantitative data were calculated by median and/or range due to the limited number of participants, and further statistical analysis was not conducted.

Analysis of qualitative data from focus groups and field notes from observations was performed continuously throughout the study. Data were imported into the software *QSR International NVivo V.10* and analysed according to the method of Malterud.[20] First, the text was read as a whole while identifying emerging themes. Second, meaning units were identified and coded close to the participants' own experiences and descriptions. Meaning units were then condensed and regrouped more distant to the participants' own words concerning the underlying meaning, context, comparison between meaning units and symbols, and concealed motivations and interests of the participants. Finally, the condensed meaning units were synthesised into the following three main categories: 'interaction towards independence and normality', 'being different and being limited by asthma', and 'a new context of independence and normality'.

FINDINGS

Baseline and postintervention records

The baseline characteristics of the included participants are described in table 2. All children were classified as having well-controlled asthma. The total PAQLQ score was recorded with a range between 5.0 and 6.9, which means that the children experienced some degree of impairment ranging from a 'little bothered' to 'not bothered at all' on to the seven-point Likert scale ranging from 'extremely bothered' (=1) to 'not bothered at all' (=7) in the questionnaire. The domains of activity limitation (range 4.2–7.0), symptoms (range 4.7–6.9) and emotion function (range 5.4–7.0) also showed a small-to-moderate degree of impairment because of asthma, which ranged from 'quite bothered' to 'not bothered at all'. Participating girls reported the two lowest values in all three domains. One child was classified as overweight. The children reported asthma symptoms in relation to infections, cold air, pollen and exhaustion, and two children reported that asthma restricted their PA level. VO_{2max} ranged from 24.7 to 56.7 mL/kg/min. Four of six children (all boys) participated in MVPA above the recommended 60 min/day

Table 2 Baseline characteristics of participants (n=6)

Boys*, n	4
Age (year), median (min, max)	10.5 (10, 12)
FEV_1 (% of predicted) †, median (min, max)	78 (74, 87)
PAQLQ‡, median (min, max)	6.3 (5.0, 6.9)
Activity scale, median (min, max)	6.1 (4.2, 7.0)
Symptoms scale, median (min, max)	5.8 (4.7, 6.9)
Emotion scale, median (min, max)	6.8 (5.4, 7.0)
ACQ§, median (min, max)	0.7 (0.4, 1.0)
Use of ICS, n	5
Daily, regular use of β_2-agonists, n	6
Overweight, n	1
MVPA (min/day), median (min, max)	68.6 (46.2, 125.2)
VO_{2max} (ml/kg/min), median (min, max)	48.7 (24.7, 56.7)

*With reference to girls.
†Missing data in one participant.
‡Possible score between 0 (severe impairments of asthma) and 7 (no impairments).
§Possible score between 0 (totally controlled) and 6 (extremely poorly controlled), missing data for one participant.
ACQ, Asthma Control Questionnaire; FEV_1, forced expiratory volume in 1 s; ICS, inhaled corticosteroids; max, maximum; min, minimum; MVPA, moderate-to-vigorous intensity physical activity; n, number; PAQLQ, Paediatric Asthma Quality Of Life Questionnaire; VO_{2max}, maximal oxygen uptake in mL/kg/min.

(range 64–125). The two girls participated in MVPA for 46 and 56 min/day, respectively.

Five children increased, and one maintained, their PAQLQ score postintervention testing ranging from 5.9 to 6.9. Three children (both girls) increased with ≥0.5 which is the established clinical Minimal Important Difference (MID) of PAQLQ.[26] Girls increased their score ≥1.0 in the activity and emotion domains, and one boy increased his score in the activity (+0.6) and symptom (+0.8) domain. Additionally, one boy increased his symptom domain with 0.6 but did not achieve a total MID ≥0.5 because of a non-MID decrease in the emotion domain.

Three children, similar to those increasing their HRQoL above MID, increased their VO_{2max} and post-test ranged from 31.6 to 57.9 mL/kg/min.

The intervention pilot—attendance and HR

The attendance rate during the intervention pilot was 90%. Two children completed all 12 sessions. One child missed three sessions, one child missed two sessions, and two children missed one session each. Exercise intensity ≥80% of HR_{max} was recorded for a median (IQR) time of 22 (8) out of 60 min/session (table 3). Median (IQR) HR during the sessions was 146 (9) bpm, which was equivalent to 74% of HR_{max} (table 4). The median (IQR) HR_{max} during active play was 198 (12) bpm (table 3). The active play exercises with the highest median intensity were the endurance-based and interval-based activities 'flipping cones', '10 ball', 'breaking balloons', 'naval battle', 'obstacle relay', 'bus relay', 'gymnastic mat relay', 'hunting beanbags' and 'Tarzan tag' (descriptions in table 1). These exercises were included mainly in training sessions 2, 3 and 4 (table 3). The median (IQR) intensity in these sessions was 152 (19), 151 (6) and 151 (31; 76% of HR_{max}) bpm, respectively (table 4).

Interaction towards independence and normality

The main theme describing the participants' experiences of everyday life and participation in the 6-week intervention pilot was 'interaction towards independence and normality'. They did not want their friends to care about their asthma.

> They (my friends) say I can start ahead of them…I just say, no thanks. (girl, 11 years)

In the interviews, all participants reported performing a variety of leisure activities including climbing, soccer, handball, swimming, track and field, ju-jitsu, dancing, choir, singing lessons, and Boy Scouts. Afternoon time was described as being busy, filled with school homework and leisure activities with meals in between.

Being different and being limited by asthma

Participants described their everyday life as being limited by asthma. Their asthma restricted their

Table 3 HR_{max} registrations and minutes per session at intensity ≥80% of HR_{max}

Participant number	HR_{max} (TR)	HR_{max} (TS)	Active play sessions												
			1	2	3	4	5	6	7	8	9	10	11	12	Total
1	212	208	14 (26)	22 (37)	–	–	16 (30)	12 (21)	17 (30)	9 (21)	18 (36)	18 (30)	–	–	17
2	197	194	11 (17)	25 (42)	24 (40)	–	22 (36)	21 (32)	–	26 (43)	25 (42)	–	29 (48)	–	25
3	218	220	13 (24)	27 (45)	16 (30)	11 (19)	15 (26)	8 (19)	18 (36)	–	17 (28)	–	18 (33)	–	16
4	199	198	12 (20)	35 (58)	31 (52)	32 (53)	21 (35)	19 (32)	19 (32)	22 (37)	29 (48)	26 (43)	22 (37)	8 (28)	22
5	197	197	5 (9)	29 (48)	24 (44)	24 (40)	21 (35)	16 (28)	10 (37)	22 (37)	14 (24)	–	26 (43)	18 (47)	21
6	187	196	–	–	–	–	23 (43)	29 (48)	24 (40)	15 (25)	28 (47)	–	21 (36)	20 (40)	23
Median	198	198	12	27	24	24	21	18	18	22	22	22	22	18	22
IQR	19	16	6	9	11	21	7	12	8	12	12	8	8	12	8

Missing values because of equipment error or non-attendance.
HR, heart rate; HR_{max}, maximal heart rate (bpm); TR, treadmill running; TS, training sessions.

Table 4 Median HR for each participant and median (IQR) HR for all children at each session

Participant number	Active play sessions											
	1	2	3	4	5	6	7	8	9	10	11	12
1	139	152	–	–	151	139	146	137	150	148	–	–
2	115	140	148	–	148	143	–	147	146	–	149	–
3	138	164	158	174	156	169	165	–	148	–	152	–
4	132	157	151	151	148	146	145	143	150	146	146	140
5	127	143	150	143	146	137	143	141	139	–	148	147
6	–	–	–	–	141	155	144	139	146	–	146	147
Median (IQR)	132 (18)	152 (19)	151 (8)	151 (31)	148 (8)	145 (20)	145 (12)	141 (7)	147 (6)	147 (2)	148 (5)	147 (7)

Missing values because of equipment error or non-attendance.
HR, heart rate.

participation in PA because they became rapidly exhausted. One of the participants said:

> …I always have to stop…to…breathe… (girl, 10 years)

Asthma was described as the reason for not attending physical education classes and as something that causes pain in the chest and heart. According to the participants, having asthma and using medications were associated with unwanted attention. The children described how parents alternated between a minimum focus on asthma and medication and then challenging their independence:

> Occasionally she (mother) somewhat disagrees…if I say it went well (managing medications and symptoms), she suddenly says 'no, it might have gone badly,' even if it went well. (boy, 12 years)

The intervention pilot—a new context of independence and normality

During field observations, the exercise intervention pilot appeared as an instructor-defined context of intense PA in which having asthma was considered normal. Parents were asked to leave the training facilities during sessions, and participants appreciated being acknowledged as competent:

> They (the instructors) want us to be really good. (boy, 12 years)

Despite observed wheeze and occasional asthma symptoms during the exercise sessions, participants did not report exercise limitations. Instead, they reported satisfaction and even improvements in their asthma.

> …you get better lungs…at least I can feel it…I just feel that I have good fitness. (boy, 12 years)

Several of the participants perceived that they could run faster. When they felt exhausted, this was interpreted as normal and not caused by asthma. The children enjoyed the activities, even though they considered them intense. They all stated that participating in the project had been fun and increased their effort:

> It is easier for me to push myself when it is fun. (girl, 11 years)

The boys were especially enthusiastic about the different ball games such as 10 ball, dodgeball and naval battle. Tarzan tag and the various obstacle courses (table 1) were also reported as fun.

During observations, the children seemed to be inspired by the competitions and adult instructors who joined in:

> I think it is fun when they are, when we are playing naval battle, they (instructors) are competing… (boy, 10 years)

They described the instructors as encouraging and kind. The participants also considered that the instructors' use of humour was a way to make the situation harmless and on the children's terms:

> …encouraging if we are doing wrong, and joking a lot. (boy, 12 years)

During competitive activities, the children were grouped by the instructors to create balanced teams. The instructors tried to include every child, and the participants increased their efforts when running near the adult instructors:

> When (name of the instructor) says; come on, you can do it…then I manage… (boy, 10 years)

By contrast, we observed decreased enjoyment when one of the teams lost repeatedly or when balls were thrown too hard, and some of the children became afraid of being hit.

Field observations revealed how interactions between participants during the exercise sessions were mainly about creating responses of acceptance of each other through joking, cheering and bonding. Instructors paid little or no attention to negative statements or lack of contribution.

DISCUSSION

The children enjoyed participating without reporting limitations by asthma or serious asthma attacks, and they perceived that their asthma and fitness had improved. Attendance at exercise sessions was 90% and there were no drop-out. Exercise intensity was relatively high with a median time of 22 min at ≥80% of HR_{max} and a median HR during the entire sessions of 74% of HR_{max}. Highest intensity was recorded during endurance-based and interval-based activities. Children reported increased HRQoL post-test compared with baseline. Children appreciated being acknowledged as competent, and the intervention was placed within a context in which having asthma was considered normal. The instructors ensured that the activities were of high intensity and provided satisfaction while including games that were easy to master; they ensured fair competition and used humour, and also participated in the games.

Previously published exercise interventions for children with asthma have described various exercise modes, of which swimming,[8 14 31] running[13 32] and cycling[15 33 34] were used most frequently. None of these studies reported whether the children enjoyed taking part in these interventions or which interactions the children found most enjoyable. The mixed-methods design of the present study, however, enabled such reports.

We may assume that reported satisfaction and enjoyment motivated participants to exercise at a high intensity and contributed to the high attendance rate and zero drop-out during the intervention period. To our knowledge, only one study has reported on children's perspectives on exercise interventions; that study reported the children's perception of an increased ability to handle their asthma during exercise.[11] Unfortunately, the types of exercise and adherence were not reported.

The rates of attendance and drop-out during an intervention may give an indication of the children's motivation to take part and their preference for the modes of exercise. In interventions for children with asthma, drop-out rates of 22% in a 6-week individualised training on cycle ergometer[34] and 13% in a 4-month running programme[32] have been reported. Far lower drop-out rates were reported in a 3-month programme of regular group exercises with different activities in a gymnasium and home exercise (4%)[11] and in an 8-week basketball training intervention (3%).[10] The latter two studies were group based, which we assume included mutual support between participants. Peer support has been shown to be associated with level of vigorous PA regardless of asthma.[35] However, the reasons for dropping out were not described in any of the studies.

In the present study, we found a high attendance rate (90%) throughout the intervention. Graff-Lonnevig *et al*[12] reported a similar attendance rate in their controlled active play intervention. Their training group comprised children living close to the training location, which might have influenced attendance. In our study, the small study sample may have contributed to a stronger sense of commitment to attend the sessions than if the intervention had included a larger study sample. By contrast, Fitch *et al*[36] found an attendance rate of 68% in their intervention of running exercise for a relatively small study sample of 10 children. However, children with asthma may perceive running exercise as having different interactions and enjoyment compared with indoor play-based exercise, as used by Graff-Lonnevig *et al*[12] and the present study.

According to a recent systematic review of exercise training for children with asthma, intensity rather than the mode of endurance-based activity is one of the most important factors for improving physical fitness after an exercise intervention.[3] The reports from the children in the present study indicate that active play and enjoyment may be essential to increasing the effort and thereby intensity. In children without asthma, exercise at the anaerobic threshold or at an intensity >80% of HR_{max} induces greater improvements in physical fitness compared with lower intensity exercise.[37]

In the present study, the children exercised at a HR ≥80% of HR_{max} for a median time of 22 min. The overall intensity level during each session might have been lower because of the less active periods needed to organise the games and activities, including fitting and adjusting the HR monitors. Physical fitness improved in three of the children, and the baseline fitness levels in the three who did not improve were relatively high. The limited number of participants precludes us from drawing statistical conclusions. Nevertheless, qualitative data from the present study support an interpretation of increased perceived ability to manage intensive PA, either by enhanced perceived competence or increased perception of fitness.

The importance of feeling normal and competent for children with asthma and of children's adjustment to social norms is well documented.[16 38] Our study shows that instructors can create enjoyable, intense exercise programmes with high participation rates by focusing on the children's normality and independence, and by creating and defining the social norms within the group. One may suggest that these aspects of the instructor role and the exercise intervention are as important as the practical organisation including scheduling and leading and designing exercises. These findings are supported by studies suggesting that motivation and engagement in exercise are dependent on leadership; the supporting structure; and the basic psychological need for autonomy, relatedness and competence.[39] Our intervention design of active play-based exercise seemed to enhance enjoyment and mastery, and worked together with the instructors' deliberate creation of fair competition and emphasis on mastery, enjoyment, fellowship and treating the participants as competent. The findings of the limitations induced by asthma away from the intervention scene and the participants' desire to be normal despite

having asthma may reflect the interaction and experiences within the intervention. The instructors' deliberate emphasis on treating the participants as normal competent children may thus have appeared to these children with asthma as encouraging them to exercise and enjoy the programme despite the obvious presence of asthma.

Physical limitations may arise from physiological barriers caused by disease[1 4 40] or by poor psychological adjustment to the disease.[5] The present qualitative findings support the idea that physical limitations in addition depend on the situation and may change with the social context. Children and adolescents with asthma may experience frustration, embarrassment and low self-confidence because of their disease-related limitations.[16 41] They may also withdraw from PA because of their parents' fear and protectiveness.[17] Participants in the present study seemed to overcome those barriers and limitations, and the parents also supported their children's independence by being absent during intervention sessions. The participant's reports of perceived improvements in fitness, well-being and asthma symptoms highlight the benefits of creating different social situations and norms for interventions with children with asthma. Moreover, the girls' increase in HRQoL and VO_{2max}, particularly, support the possibility for change through intervention in girls who, with increased age, are reported to engage in less PA initiated and organised by themselves,[42] and have a decreased HRQoL compared with boys.[43]

The present intervention may be perceived as resource demanding. However; PA is associated with several positive outcomes in asthma,[2 5] and may possibly save indirect costs raised by morbidity and mortality and direct healthcare expenditures which range between 1% and 2% of total healthcare costs in developed countries.[44]

Strengths and limitations

The main strengths of the present study are the mixed-methods design including the exploration of children's perceptions and the objective measurements of each child's intensity level during sessions using HR monitors. No children dropped out during the intervention, and the attendance rate of 90% indicated strong adherence to the programme. We aimed to explore specific themes in depth and were able to return to these themes repeatedly during the study by triangulating those data with the physical records. In qualitative research, the researcher as interviewer, observer and analyser relates and interacts with the research field and the participants.[30] Qualitative empirical work is considered as interpretative and thus may not always be generalisable, but the information may be transferable through the interpretations of the reader.[45] We made an effort to enhance reflexivity during the analysis and interpretation of whether the findings relate to the data, and we have ensured that no extraordinary or unusual reports from participants were used to over-rule the issues noted repeatedly by participants.

The main limitation was the small study sample, which comprised only six children. A small exercise group made it more challenging to design feasible active play exercises of high intensity, especially when one or more children were absent during sessions. Three instructors were present at each session (2 participating actively), which might have influenced the children's participation level to a greater extent than if there had been larger groups. In addition, children in the present study reported that they enjoyed PA and had well-controlled asthma, a relatively high PA level, and physical fitness similar to that of children without asthma.[25] These children's views of the intervention and the active play exercises may not be representative of children with less experience with PA or with more severe asthma. However, the findings may be relevant to health practice by providing an understanding of how physical limitations and activity may be changeable and how exercise interventions may be designed to maximise enjoyment and exercise intensity for children with asthma.

CONCLUSIONS

The exercise intervention pilot focusing on active play had a high attendance rate, relatively high exercise intensity, and satisfaction; the children perceived that their fitness and asthma had improved, and reported increased HRQoL. A randomised controlled trial of active play exercise including children with asthma should be conducted to evaluate effect on PA level, physical fitness, asthma control and HRQoL.

Additional implications for clinical practice may be to more consciously create social situations in which children and adolescents with asthma are treated by the health or exercise instructors as competent and normal young people who are motivated to exercise because of the enjoyment and sense of mastery and fellowship.

Acknowledgements Authors would like to acknowledge sports students Betina Hissingby, Håvard Berg Vaule, Andreas Mathingsdal Pedersen and Christer Solberg for contribution and engagement within the intervention.

Contributors All authors contributed in the design of the study, and in writing, critically revising and finally approving the manuscript. Furthermore; TW contributed with collection and data analysis of qualitative data; LF contributed with analysis and interpretation of qualitative data; TN contributed with conducting exercise sessions, and collecting and analysing quantitative data; KH contributed with analysis of quantitative data; OBK contributed with recruitment of participants and collection and analysis of baseline data; and SB was the principal investigator of the project, and contributed with collection and analysis of quantitative data.

Funding This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Ethics approval The Regional Committee for Medical Research Ethics in South East Norway (2013/1274).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

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