Strategies to overcome perceived barriers to increase physical activity in people with asthma: a prospective study

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People with asthma report several barriers to increasing physical activity in daily life that can be overcome with appropriate behavioural intervention strategies. https://bit.ly/3O4cKHr

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Abstract

Background Physical activity (PA) is recognised as a nonpharmacological intervention that has benefits for people with asthma; however, motivating this population to engage in PA remains challenging. The aim of the present study was to identify barriers and provide strategies in a behavioural intervention (BI) to improve physical activity in daily life (PADL) among people with asthma.

Methods 96 individuals with moderate-to-severe asthma underwent an 8-week BI based on the transtheoretical model. Motivational interviewing, feedback and encouragement were provided to support the participants in overcoming barriers and reaching their goals. Assessments included PADL (triaxial accelerometer), self-reported barriers to PADL (19-item questionnaire), asthma control (Asthma Clinical Questionnaire (ACQ)), quality of life (Asthma Quality of Life Questionnaire) and anxiety and depression symptoms (Hospital Anxiety and Depression Scale).

Results Participants' median age was 53 years, body mass index 31.5 kg·cm^{-2}, forced expiratory volume in 1 s 61% pred and ACQ score 2.0. The most frequently reported barriers were fear of feeling short of breath (38%), a lack of energy (30%), being overweight (27%), physical limitations (27%), financial constraints (21%), laziness (20%) and the absence of professional support (20%). After the BI, most participants reached the minimal clinically important difference in PADL (54% for steps·day^{-1}) and the prevalence of barriers decreased between 65% and 77%.

Conclusion Our results reveal the barriers that individuals with uncontrolled asthma can overcome when appropriate BI strategies are used to increase PADL. Modifiable barriers following the intervention included fear of feeling short of breath, lack of energy, financial constraints and inadequate professional support.

Introduction

Asthma is a heterogeneous disease characterised by chronic inflammation of the airways. This disease is characterised by a history of respiratory symptoms, including shortness of breath, wheezing, chest tightness and cough, which fluctuate in severity over time, along with expiratory airflow variability [1]. People with asthma experience numerous health issues, including various symptoms and increased pulmonary and systemic inflammation, which can lead to poor quality of life [2]. The Global Initiative for Asthma (GINA) reports that people with asthma who engage in regular physical activity experience overall health benefits, with the highest level of evidence [1]. However, studies have shown that people with asthma exhibit lower physical activity levels than individuals without asthma [3].

Increasing physical activity in daily life (PADL) is a nonpharmacological approach that has been associated with improved clinical control and quality of life in people with asthma [4]. To achieve these

benefits, a minimal clinically important difference (MCID) of 1413 steps·day^{-1} or 8 min of moderate-to-vigorous physical activity (MVPA)·day^{-1} has been recently recommended for people with asthma [5]. Furthermore, DE LIMA *et al.* [6] demonstrated that people with moderate-to-severe asthma who walked ⩾7500 steps·day^{-1} had better clinical asthma control, regardless of the sedentary behaviour. In addition, other features, such as physical inactivity, anxiety and depression symptoms, are also associated with increased odds of uncontrolled asthma [6, 7].

Despite the benefits of physical activity, increasing PADL remains a challenge because of the many barriers faced by people with asthma. A narrative review revealed several barriers to increasing physical activity in this population [8]. Participants reported several barriers, including the fear of worsening and/or being embarrassed by symptoms during exercise, fear of exacerbation, and the belief that exercise can be dangerous [8]. In addition, perceived barriers to exercise were associated with symptom burden and psychological morbidity in difficult asthma, and interventions including cognitive behavioural therapy have been suggested [9, 10].

Recent studies have demonstrated that behavioural interventions (BIs) to increase PADL improve several clinical outcomes in people with asthma [4, 5, 11]. However, the barriers faced by this population in terms of increasing PADL and the strategies to overcome them remain poorly known. Identifying strategies to overcome barriers to PADL can be effective in encouraging behaviour modification towards a more active lifestyle in people with asthma and has been suggested in recent guidelines for asthma management [12]. Therefore, this study aimed to identify barriers and strategies in a BI programme to improve PADL among people with asthma.

Methods

Participants

The study included adults of both sexes aged 18–65 years with moderate-to-severe asthma according to the GINA guidelines [13] who were not physically active (<150 min of MVPA·week^{-1} [14], objectively assessed using a triaxial accelerometer (Actigraph-GT9X, ActiGraph, USA)) and had partially controlled or uncontrolled asthma (Asthma Control Questionnaire (ACQ) score ⩾0.75) [15]. The inclusion criteria were as follows: optimised medical treatment for at least 6 months and clinical stability (*i.e.* no hospitalisations, visits to emergency services or changes in medication in the past 30 days) [16]. The exclusion criteria included participation in another research study and difficulty understanding any questionnaires. The intervention was conducted between two medical visits and pharmacotherapy was maintained throughout the intervention period. The participants signed an informed consent form after being informed about the possible risks and benefits of the study. This study was approved by the Hospital Research Ethics Committee (protocol 51929221.7.0000.0068).

Study design

This prospective study was conducted at a tertiary university hospital that provides specialised treatment for moderate-to-severe asthma from May 2022 to December 2024. Individuals with asthma were identified after a routine medical consultation. Eligible participants underwent a BI protocol to increase PADL. All individuals completed an educational programme, followed by the BI to increase physical activity. The intervention consisted of eight face-to-face weekly individual sessions. Assessments were conducted before and after the intervention. The assessments included PADL, self-reported barriers to PADL, asthma clinical control, asthma-related quality of life and anxiety and depression symptoms. Assessments were conducted by an assessor who was blind to the intervention. The study followed the checklist for reporting behaviour change interventions [17].

Procedures

Intervention

The intervention used in this study has been previously published [4, 18]. All participants attended a two-session asthma education programme that included group discussions and video presentations [19]. Subsequently, they participated in a BI to increase physical activity based on the transtheoretical model, which consisted of counselling and incentives to increase physical activity during daily routines [20, 21]. Each individual received a weekly daily step goal. The participants also received a commercially available activity tracker (Mi Band 5; Xiaomi, China) that vibrated after the daily step goal was reached, as well as after 60 min of uninterrupted sedentary behaviour. Participants were asked to wear the smartwatch every day during the 8-week intervention period. The implementation of the strategies was conducted by a previously trained researcher, who systematically applied all strategies based on prior BI theories [20–23]. The strategies included motivational interviewing, feedback and guidelines for overcoming barriers, as well as encouragement for participants to reach their goals. The programme consisted of eight weekly

face-to-face individual sessions, each lasting up to 90 min. Specific advice was provided based on the reported barriers in each week of the protocol. In addition, each session addressed different topics: week 1: lifestyle choices; week 2: why become physically active; week 3: sedentary behaviour; week 4: dealing with barriers; week 5: self-control; week 6: setting additional goals; week 7: being rewarded; and week 8: goal balance. In the last session, a motivational interview was conducted to identify the goals achieved, benefits gained and strategies used to overcome the most significant barriers. Additionally, attitudes were proposed to help participants maintain physical activity in the long term. The main objective of the BI was to increase PADL (steps·day^{-1}) and the secondary objective was to reduce sedentary time.

Outcomes

PADL

PADL was objectively assessed using a triaxial accelerometer (Actigraph GT9X, ActiGraph, USA), which measures physical activity volume, intensity and posture through variations in acceleration [24, 25]. Devices were set up to record data in 60 epochs on three axes *via* ActiLife 6.9.5 software, which was also used to analyse the data. The participants were instructed to wear the device on their waist, using an elastic belt, during waking hours only for seven consecutive days (pre- and post-intervention) and to remove it when bathing or participating in water-based activities. The Choi wear time validation option was used to assess the wear and nonwear time [26]. Data were considered valid if the wear time was $\geqslant$8 h·day^{-1} for at least 5 days, including at least one weekend day [27, 28]. The data are presented as the average number of steps per day, the time spent performing sedentary behaviour (defined as <100 counts·min^{-1}) and the time spent in MVPA (defined as $\geqslant$1952 counts·min^{-1}) [29]. Counts per minute are a measurement unit used by accelerometer devices that quantify acceleration (Δvelocity/Δtime) within a specific time interval (epoch), typically ranging from 10 to 60 s [30]. The counts recorded during a given time interval are linearly related to the intensity of an individual's physical activity during that time interval [31]. The normal filter, instead of the low-frequency extension filter, was applied for data processing. The MCIDs for steps·day^{-1} and MVPA·day^{-1} were 1413 and 8, respectively [5].

Barriers to performing physical activity

Barriers to PADL were assessed using a self-reported barriers to PADL questionnaire that addressed the most common barriers in adults [32, 33]. Barriers included fear of feeling short of breath, a lack of energy, overweight, physical limitations, financial constraints, laziness, the absence of professional support, the fear of getting hurt, a lack of equipment, a lack of interest, the absence of company, feelings of shame (body image), a lack of a safe environment, a lack of time, a lack of appropriate weather, a lack of space, a lack of knowledge/guidance, the absence of family support and disbelief in the benefits of physical activity [34]. The participants rated the frequency of experiencing each barrier on a five-point Likert scale ranging from 0 to 4, where 0=never present, 1=rarely, 2=sometimes, 3=almost always and 4=always. Those who answered "always" at baseline were classified as having a specific barrier. Each individual could report experiencing more than one barrier. The results are presented as frequencies. Barriers reported by at least 20% of the population [35] were further examined in terms of participant characteristics and potential specific strategies to address them. The self-reported barriers to the PADL questionnaire are available in the supplementary material.

Clinical asthma control

Clinical asthma control was assessed using the ACQ [15, 36]. Scores $\geqslant$1.5 indicate poorly controlled asthma, scores of 0.75–1.5 indicate partially controlled asthma and scores $\leqslant$0.75 indicate fully controlled asthma [15]. A change of at least 0.5 points in the ACQ score is considered to indicate an MCID [37].

Asthma-related quality of life

Asthma-related quality of life was assessed using the Asthma Quality of Life Questionnaire (AQLQ) [38]. The AQLQ score ranges from 0 to 7, with higher scores indicating better quality of life. A difference of 0.5 points is considered to be an MCID [39].

Anxiety and depression symptoms

Anxiety and depression symptoms were assessed using the Hospital Anxiety and Depression Scale (HADS) [40]. A score $\geqslant$8 in either domain indicates possible anxiety or depression symptoms [41]. MCID values for the anxiety and depression subscales of the HADS were 1.30 and 1.50, respectively [42].

Statistical analysis

The data were analysed using Prism version 9 for macOS (GraphPad Software, Boston, Massachusetts, USA), and graphical representations were generated using the same software. The Shapiro–Wilk test was used to assess data normality. Group comparisons were conducted using one-way ANOVA for normally

distributed data or the Kruskal–Wallis test for nonparametric data. The significance level was set to 5% ($p<0.05$).

Results

The study flowchart is presented in figure 1. A total of 998 people with asthma were screened for eligibility and 96 met the inclusion criteria. The intervention adherence rate was 96%, as only four individuals discontinued the intervention. An intention-to-treat analysis was conducted and all 96 individuals were included.

The frequency of reported barriers to physical activity is shown in figure 2. Barriers reported by at least 20% of the population were further examined.

Table 1 presents the characterisation of the total sample and its stratification according to the main reported barriers to engaging in physical activity. Most participants were female, were using high doses of inhaled corticosteroids and had a high level of sedentary behaviour. There were no differences in the characterisation of the sample according to the barriers ($p>0.05$). The participants who reported "being overweight" as a barrier had, on average, grade II obesity, whereas those who did not report this barrier had grade I obesity. In addition, higher anxiety symptom scores were found in individuals who reported the barriers of fear of feeling short of breath, lack of energy and absence of professional support.

Table 2 shows specific strategies [22, 23] to overcome the most frequently reported barriers to engaging in physical activity.

The changes in the four most frequently reported barriers from baseline to post-intervention are shown in figure 3. After the intervention, these barriers were either no longer present or had been reduced for most individuals. Figures illustrating changes in the remaining three main barriers are provided in figure S1. Only 23–35% of participants continue to report "always" when assessing the main barriers to physical activity after the intervention.

The changes in physical activity levels (steps·day^{-1} and MVPA·day^{-1}) from baseline to postintervention for the total sample are shown in figure 4 and are stratified by reported barriers to engaging in physical activity. The total sample achieved the MCID for both steps·day^{-1} (54%) and MVPA·day^{-1} (44%). When the participants were stratified by barriers, the MCID for steps·day^{-1} was achieved among participants

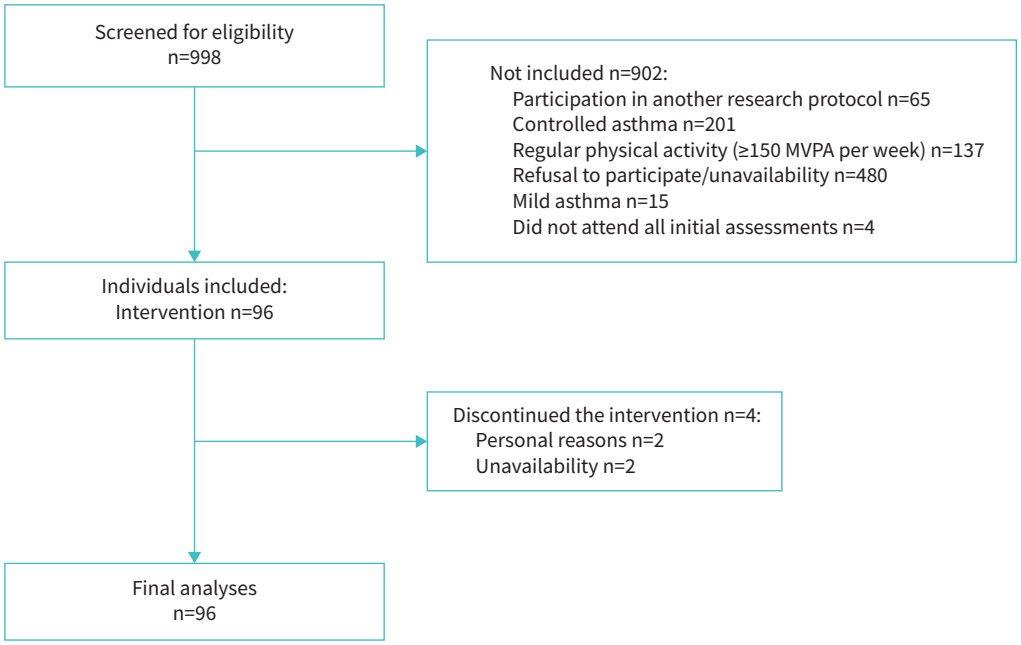

FIGURE 1 Flow diagram of participant recruitment, eligibility screening and follow-up. MVPA: moderate-to-vigorous physical activity.

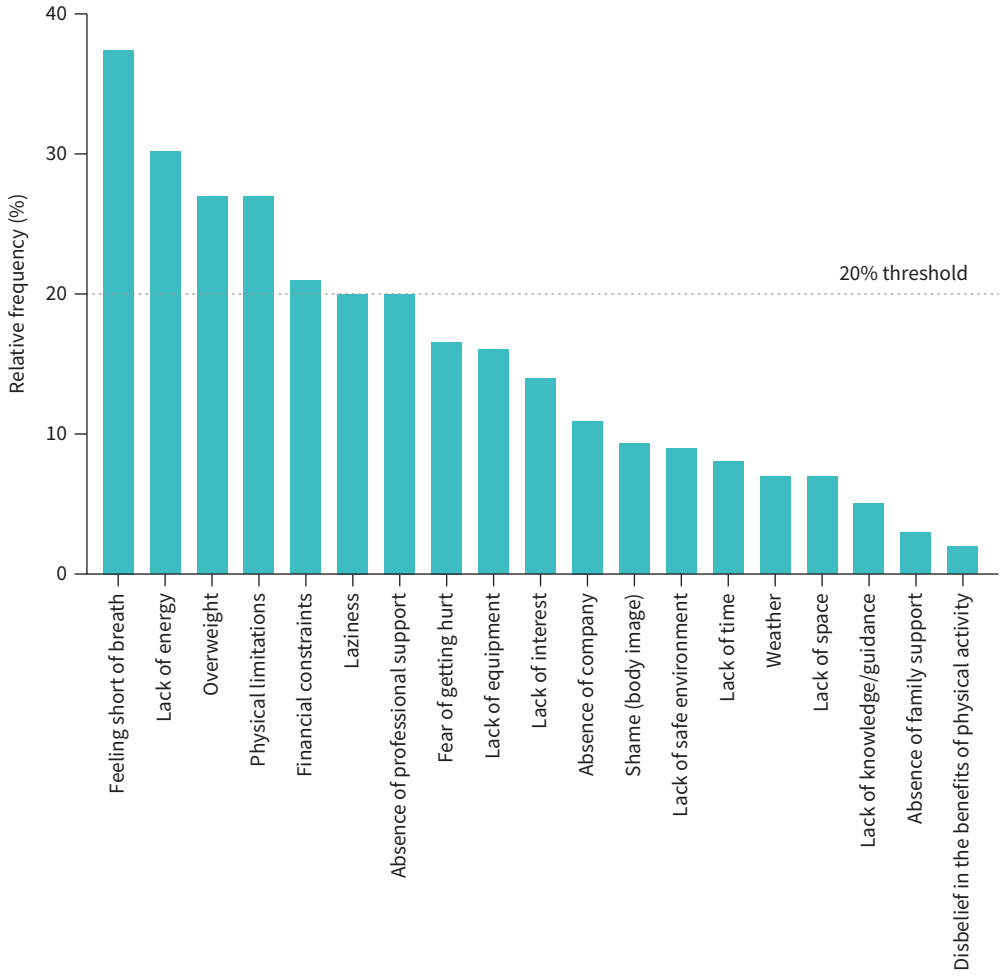

FIGURE 2 Frequency of reported barriers to physical activity in daily life. The red dashed line represents the barriers reported by at least 20% of participants.

reporting "a lack of energy" and "financial constraints" and for MVPA·day^{-1}, the MCID was achieved among participants reporting "the fear of feeling short of breath", "a lack of energy", "financial constraints" and "the absence of professional support".

The changes in asthma control (ACQ), quality of life (AQLQ) and symptoms of anxiety and depression (HADS) from baseline to post-intervention for the total sample are shown in figure 5, stratified by the four barriers most frequently reported to engaging in physical activity. The MCID for asthma control, quality of life and anxiety symptoms was achieved, considering all participants and all the most overcome reported barriers. The only exception was anxiety symptoms, considering the barrier "financial constraints" (figure 5). For depression symptoms, the MCID was achieved only among participants reporting "the fear of feeling short of breath".

Discussion

To our knowledge, this is the first study to present strategies to overcome barriers in a BI programme to increase PADL among people with moderate-to-severe asthma. The main reported barriers to engaging in physical activity were fear of feeling short of breath, a lack of energy, being overweight, physical limitations, financial constraints, laziness and an absence of professional support. The strategies to overcome each main barrier were described in detail and were effective at reducing the prevalence of barriers by 65–77%. After the BI, the barriers that the patients most overcame included the fear of feeling short of breath, a lack of energy, financial constraints and a lack of professional support. Our results show that patients achieved the MCID for clinical control and quality of life, in general, and considering all the most overcome reported barriers. Higher anxiety symptom scores were found in individuals who reported

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TABLE 1 Characterisation of individuals according to the most frequently reported barriers to physical activity in daily life

Outcomes	All participants (n=96)	Fear of feeling short of breath (n=36)	Lack of energy (n=29)	Overweight (n=26)	Physical limitations (n=26)	Financial constraints (n=20)	Laziness (n=19)	Absence of professional support (n=19)
Anthropometric data								
Sex, females, n (%)	85 (88)	34 (94)	27 (93)	25 (96)	23 (88)	17 (85)	17 (89)	17 (89)
Age, years	53 (47–62)	51 (44–61)	50 (46–61)	50 (47–61)	50 (46–62)	52 (50–62)	57 (44–64)	57 (45–64)
BMI, $kg \cdot m^{-2}$	31.5 (26.9–36.3)	32.2 (27.2–37.4)	31.2 (27.2–36.4)	35.3 (31.8–39.6)	34.3 (29.8–39.1)	31.8 (28.2–34.8)	31.1 (24.7–34.7)	31.6 (28.0–40.5)
Lung function and medication								
FEV_1, % predicted	61 (49–76)	56 (46–71)	66 (48–74)	60 (44–70)	67 (48–77)	64 (44–74)	71 (55–83)	56 (44–68)
FVC, % predicted	77 (68–89)	74 (67–86)	77 (67–90)	71 (62–82)	80 (68–89)	72 (67–84)	82 (71–92)	72 (66–80)
FEV_1/FVC	0.66 (0.58–0.74)	0.65 (0.56–0.71)	0.69 (0.60–0.73)	0.67 (0.61–0.73)	0.65 (0.60–0.74)	0.69 (0.59–0.74)	0.70 (0.62–0.74)	0.66 (0.54–0.73)
ICS, $\mu g \cdot day^{-1}$[#]	1200 (800–1600)	1200 (800–1900)	1600 (800–1800)	1200 (800–1600)	1200 (800–1600)	1200 (800–1600)	1600 (800–1600)	1200 (800–1600)
Health-related quality of life								
AQLQ, total score	4.1±1.2	3.4±0.9	3.8±1.0	4.1±1.1	3.8±0.9	4.3±1.4	4.1±1.3	3.6±1.2
Psychological distress								
HADS, anxiety score	9.4±4.9	12.1±3.7	11.3±4.8	8.9±4.9	9.4±4.2	9.3±5.1	8.4±5.3	11.2±5.5
HADS, depression score	8.4±4.9	9.7±4.3	9.8±5.2	8.1±5.1	8.6±4.5	8.3±5.2	8.9±5.2	9.5±5.6
Asthma control								
ACQ-6, score	2.0 (1.5–2.6)	2.5 (2.0–3.6)	2.1 (1.6–3.2)	2.1 (1.7–2.9)	2.2 (1.8–3.5)	2.0 (1.3–3.6)	2.0 (1.5–2.5)	2.1 (1.8–3.0)
Physical activity levels								
MVPA, $min \cdot day^{-1}$	10.0 (5.0–15.7)	11.0 (6.2–14.7)	10.0 (5.0–15.0)	9.5 (6.5–16.0)	8.0 (4.7–16.5)	8.0 (5.0–11.7)	9.0 (5.0–18.0)	8.0 (4.0–12.0)
Steps$\cdot day^{-1}$, n	4501±1634	4789±1724	4425±1602	4442±1922	4445±1767	4292±1899	4841±2245	4281±1796
Sedentary time, $h \cdot day^{-1}$	9.5 (7.9–10.4)	8.5 (7.1–9.7)	8.6 (7.4–10.0)	9.1 (8.6–10.4)	8.9 (7.7–10.3)	8.6 (7.7–10.3)	9.0 (8.3–10.3)	9.0 (7.1–10.1)

Data are presented as number of individuals and percentage, mean±SD, or median (25–75% interquartile range), according to data distribution. ACQ-6: Asthma Control Questionnaire 6; AQLQ: Asthma Quality of Life Questionnaire; BMI: body mass index; FEV_1: forced expiratory volume in 1 s; FVC: forced vital capacity; HADS: Hospital Anxiety and Depression Scale; ICS: inhaled corticosteroid; MVPA: moderate-to-vigorous physical activity. [#]: ICS doses are expressed in budesonide-equivalent $\mu g \cdot day^{-1}$.

TABLE 2 Frequently reported barriers to physical activity and proposed strategies to overcome them

Barriers	Strategies
Applicable to all barriers	• Show that you understand the problem (barrier), being empathetic with the individual • Create autonomy-supportive environments in which individuals make choices and participate in their care and respect their preferences in treatment plans • Develop patients' competence, such as providing feedback, facilitating ongoing learning, and acknowledging progress • Build patients' confidence in their ability to change • Help patients set realistic and achievable goals and develop action plans
Fear of feeling short of breath	• Advise that a strategy is to always be with rescue medication during the physical activity to avoid fear and use it if necessary • Clarify and highlight that at the beginning of the practice of physical activity, shortness of breath may be more intense; however, it decreases throughout the process of adherence to the new behaviour • Guide physical activity in short periods and intensity at the beginning, with progression during the process • Avoid extreme weather temperatures (cold or hot)
Lack of energy	• Clarify that the lack of energy may be due to a lack of physical activity • Encourage engagement in physical activity, reinforcing that there will be improvement in energy/disposition as the new behaviour is acquired • Guide physical activity in short periods and intensity
Overweight	• Referral to a professional who gives nutritional support to help with weight loss • Guide physical activity in short periods and intensity at the beginning, with progression during the process • Establish achievable goals • Inform that physical activity reduces anxiety symptoms, which can help reduce emotional triggers that lead to unnecessary food intake
Physical limitations (muscular and/or joint)	• Referral to a professional specialised in the type of limitation presented for follow-up during the process • Guide physical activity in short periods and intensity (boots) • Establish achievable goals within the limitations presented
Financial constraints	• Guide walking, as it is free of charge • Suggest structural options and environments for practising physical activity at no cost (*e.g.*, squares, parks, forests, walking trails) • Provide an operating schedule for the suggested spaces, if any
Laziness	• Guide to avoid procrastination in the moments just before physical activity • Guide physical activity in short periods and intensity at the beginning, with progression during the process • Set small and achievable goals initially (a small increase in the number of daily steps)
Absence of professional support	• Highlight that from that moment on, the individual will be supported by the professional who will be performing the intervention • Provide all the information necessary for a safe performance of physical activity • Inform that all questions regarding physical activity can be clarified at any time with the professional who is carrying out the intervention • Provide communication channels for support in addition to the face-to-face consultation (*e.g.* telephone number, virtual chat)

the barriers of fear of feeling short of breath, lack of energy and absence of professional support, classified as moderate-to-severe symptoms [40].

The most frequently reported barrier observed in our study was the fear of feeling short of breath. This barrier is probably the most reported because people with difficult-to-control asthma have comorbidities that can worsen symptoms [43], including obesity, breathing pattern disorders and intermittent laryngeal obstruction. In addition, up to 90% of the individuals with asthma may experience exercise-induced bronchoconstriction (EIB) [44, 45], which may limit their PADLs [12]. The pharmacological treatment for the prevention and management of EIB includes anti-inflammatory agents and relievers taken before exercise or as needed [12]. Our results contribute to the existing literature, demonstrating that the fear of feeling short of breath can be overcome in individuals with moderate to severe asthma. Our intervention, which utilises strategies to increase PADL, includes advising individuals to use medication properly, informing them that shortness of breath decreases with increasing PADL, recommending that physical activity be initially performed in short periods and at low intensity, with gradual progression and avoiding extreme temperatures. These strategies were effective, as evidenced by the fact that the fear of feeling short of breath was one of the barriers that individuals were able to overcome, reaching the MCID for PADL after the intervention, in addition to the considerable reduction in the perception of this as a barrier.

Other frequently reported barriers in our study included a lack of energy, being overweight, physical limitations, financial constraints, laziness and a lack of professional support. A previous study revealed that

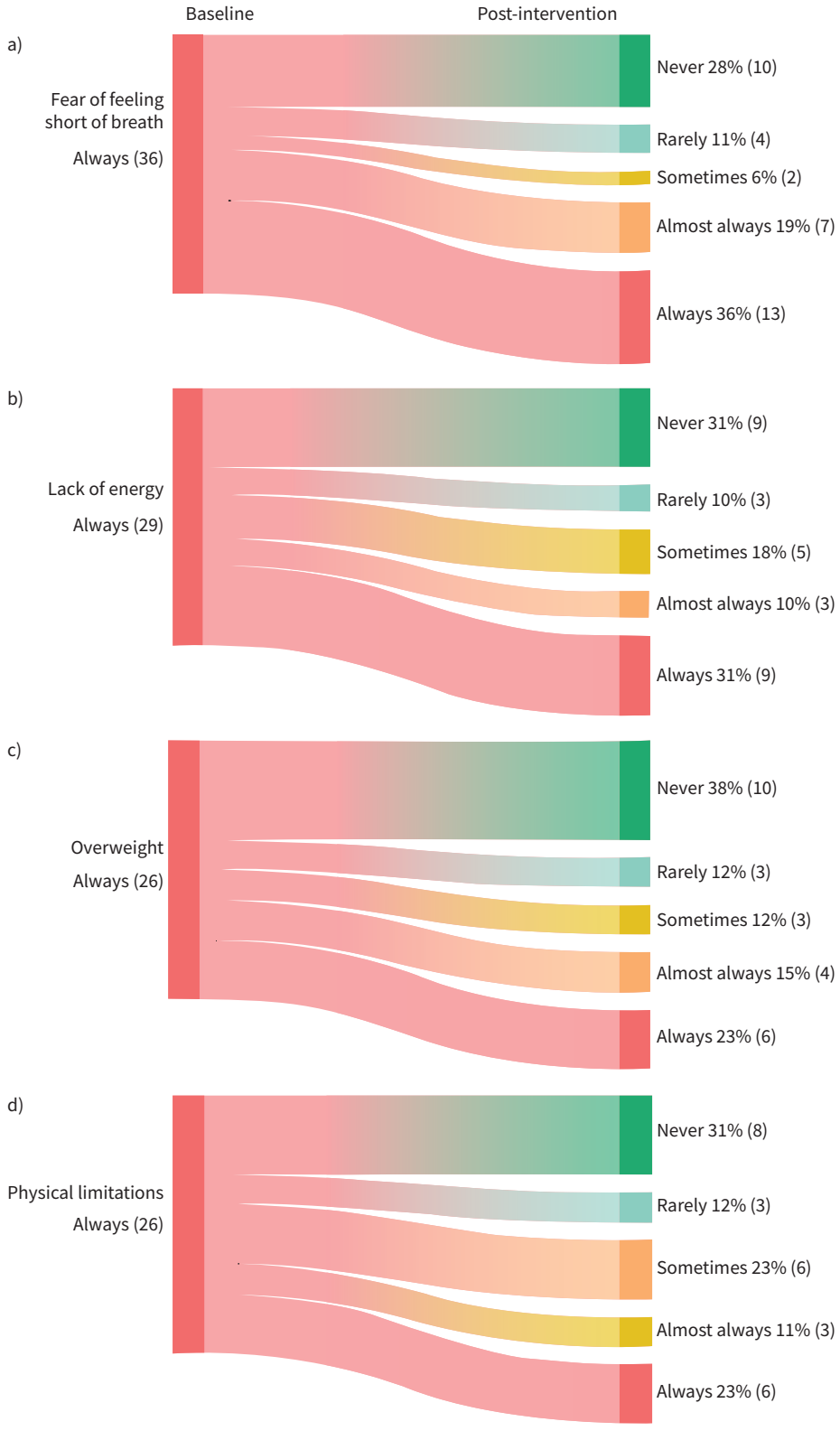

FIGURE 3 Sankey diagram illustrating changes in the frequency of the four most commonly reported barriers. a) Fear of feeling short of breath. b) Lack of energy. c) Overweight. d) Physical limitations.

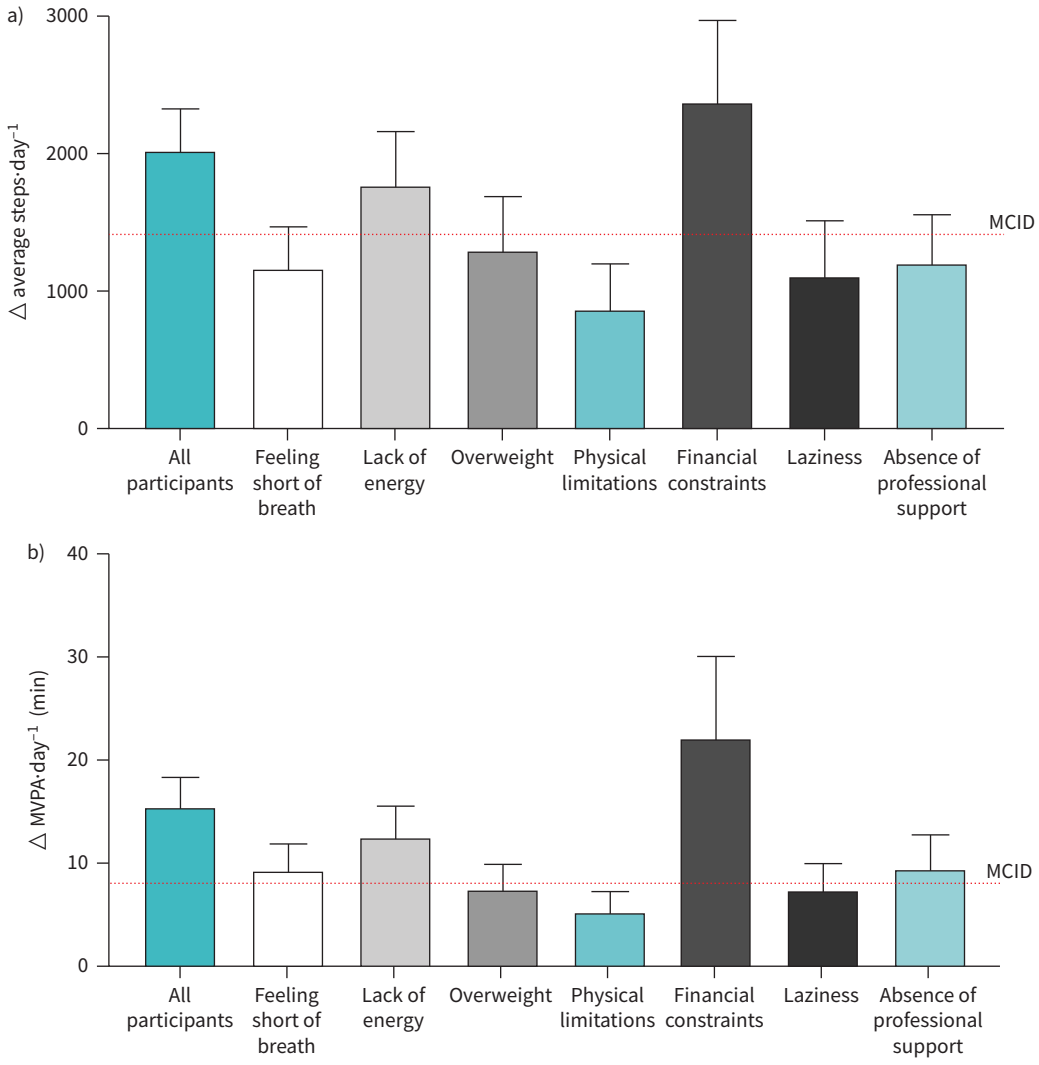

FIGURE 4 Changes in physical activity levels after the intervention. Data are expressed as mean and standard error. a) Change in average steps per day (Δ steps·day^{-1}). b) Change in moderate-to-vigorous physical activity per day (Δ MVPA·day^{-1}, in minutes). Data are presented for the total sample and stratified according to the main reported barriers to physical activity. The red dashed line represents the minimal clinically important difference (MCID) for each outcome.

the most common barriers to PADL of people with asthma were laziness, fatigue, musculoskeletal conditions and obesity [46]. Indeed, a higher BMI is a barrier to being physically active, even among individuals without asthma [47]. A systematic review revealed that illness or injury, as well as a lack of energy, were important barriers to the practice of PADL in older people [48], which is in line with our results. In general, strategies based on the taxonomy of behavioural change techniques have been suggested to increase physical activity [22, 23]. Identifying these specific barriers in people with asthma is important to add specific strategies to the management of the disease, which can facilitate the process of changing behaviour towards a more active lifestyle in this population.

Our study outlines strategies applicable to all barriers, as well as those specific to each individual barrier. After the intervention, the main barriers that were reported as "always" present decreased for most individuals (figures 3 and S1). Overall, individuals improved their PADL (steps·day^{-1} and MVPA·day^{-1}) by achieving the MCID for both outcomes [18]. However, when separating specific barriers, only individuals who presented with barriers, such as a lack of energy, financial constraints, a fear of feeling short of breath, and a lack of professional support, achieved the MCID for PADL. These results are very relevant because they show that these barriers are the most modifiable barriers to increasing PADL in people with asthma.

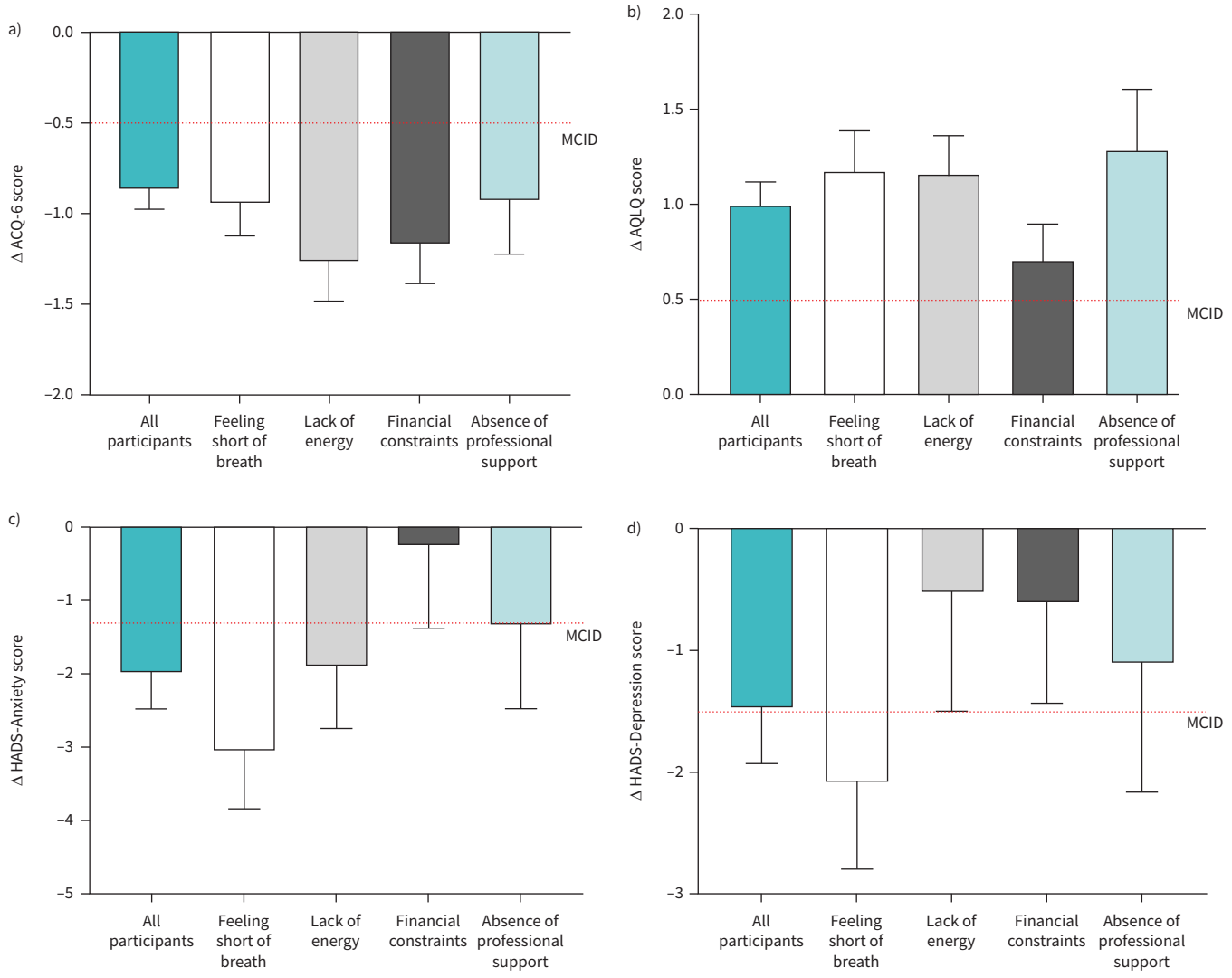

FIGURE 5 Changes in a) Asthma Control Questionnaire 6 (ACQ-6) score, b) Asthma Quality of Life Questionnaire (AQLQ) score, c) Hospital Anxiety and Depression Scale (HADS)–Anxiety and d) HADS–Depression after the intervention. Data are expressed as mean and standard error. The red dashed line represents the minimal clinically important difference (MCID) for each outcome.

Our findings have significant clinical implications for the management of individuals with asthma, particularly in those with low physical activity levels. Identifying strategies to overcome barriers to physical activity has been recommended in recent guidelines for asthma management [12]. In addition, our results are relevant because they provide insights to guide clinicians in modifying patients' behaviour toward a more active lifestyle. Furthermore, interventions to improve physical activity may be cheaper and safer than escalating to higher levels of asthma treatment. Indeed, a previous study shows evident long-term side-effects of oral and high-dose inhaled steroids, and there is clearly a high cost to biological therapies [49]. Nevertheless, it is necessary to consider that the intervention proposed in our study requires healthcare professionals specifically trained in behaviour change techniques to increase physical activity levels, with the skills to identify and help patients to reduce their barriers. On the other hand, the costs to participants of attending the intervention programme, including travel and lost time at work or other usual activities, would not be insignificant.

Our study has several strengths and limitations. The study included the largest number of patients with asthma submitted to a BI to PADL. In addition, this is the first study to report specific strategies for overcoming barriers among physically inactive people with moderate-to-severe asthma in a BI programme to increase PADL. The study also identified, for the first time, modifiable barriers to increasing PADL in this population. The PADL was quantified using a triaxial accelerometer, an objective, validated and

reliable tool. Furthermore, assessments were conducted by a blind assessor who was unaware of the intervention. A lack of a control group can be considered a limitation; however, previous studies using the same intervention have shown that the control group did not exhibit any changes in behaviour [4, 11]. The higher proportion of women included in this study may also be a limitation; however, this proportion reflects the asthma prevalence in this population [50]. Another limitation is the lack of evidence for sustained behaviour change following the intervention, since it was not assessed in this study. In addition, our results should be interpreted with caution, considering that our population consisted of older and overweight people with asthma. Future studies are suggested with longer follow-up periods and in different populations, such as young adults with asthma.

In conclusion, the most frequently reported barriers to engaging in physical activity for people with moderate-to-severe asthma were fear of feeling short of breath, a lack of energy, being overweight, physical limitations, financial constraints, laziness and the absence of professional support. The main strategies to overcome each barrier are described and the most modifiable barriers after the behavioural intervention were fear of feeling short of breath, lack of energy, financial constraints and the absence of professional support.

Data availability: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Provenance: Submitted article, peer reviewed.

Ethics statement: The Ethics Committee for Analysis of Research Projects approved the study (protocol 51929221.7.0000.0068) and all participants provided written informed consent.

Conflict of interest: All authors have confirmed that they have no conflicts of interest to declare.

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