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EFFECTS OF GROUND-BASED WALKING TRAINING ON DAILY PHYSICAL ACTIVITY IN PEOPLE WITH COPD: A RANDOMISED CONTROLLED TRIAL

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Take Home Message:

Walking training does not improve daily physical activity or reduce sedentary time compared to usual care in COPD.

Abstract

This study explored the effects of ground-based walking training on physical activity (PA) and sedentary time (ST) in people with chronic obstructive pulmonary disease (COPD). Participants were randomised to a walk group (WG) [supervised, ground-based walking training, two or three times per week for 8-10 weeks] or a control group (CG) [usual medical care]. Before and after the intervention period, PA and ST were measured using the SenseWear® Pro3 Armband. Of the 143 participants randomised, 101 (71%) had sufficient data for the primary analysis; 62 were from the WG (mean [SD] age 69 [8] years, FEV_1 42 [15] % predicted) and 39 were from the CG (age 68 [9] years, FEV_1 43 [15] % predicted). No between-group differences were demonstrated in any measure of PA or ST (all $p>0.05$).

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Secondary analyses (n=44) revealed that, compared to the CG, the proportion of waking hours spent in moderate intensity PA accumulated in uninterrupted bouts of between 30 to 60 min, increased in the WG by 0.8% (95% CI = 0.4 to 1.3). This study demonstrated that, in people with COPD, ground-based walking training alone had little, if any clinically important effect on daily PA and no effect on ST.

Keywords:

Chronic obstructive pulmonary disease, physical activity, pulmonary rehabilitation, exercise training

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INTRODUCTION

Pulmonary rehabilitation programs, consisting of short-term, supervised, exercise training with or without education, are considered an essential component in the management of people with chronic obstructive pulmonary disease (COPD). [1] Such programs have been shown to decrease symptoms of dyspnoea and fatigue, increase exercise capacity and health-related quality of life (HRQoL) [2] and reduce hospital admissions and length of stay. [3] Over the last decade, there has been increased interest in the effect these programs may have on daily physical activity (PA) and the accumulation of sedentary time (ST). This interest has resulted from evidence that people with COPD have low levels of daily PA when compared to the healthy population [4, 5] and that low levels of PA and greater ST increase the risk of hospitalisation and mortality. [6, 7] Given that pulmonary rehabilitation reduces symptoms of dyspnoea and fatigue and increases exercise capacity in COPD, [1] these changes might be expected to translate into increased levels of PA and reduced ST.

Several systematic reviews have examined the effects of exercise training on PA in COPD. [8-10] The most recent review synthesised data from three randomised controlled trials (RCTs) which compared various exercise training programs with education to usual care. [9] The meta-analyses demonstrated that exercise training produced a large and significant increase in PA compared to usual care [9] (standardised mean difference [95% CI]: 0.84 [0.44 to 1.25]). This finding was in contrast to an earlier review of uncontrolled studies which showed only a small, significant increase in PA following training (overall mean effect size = 0.12; $p = 0.01$). [8] An explanation for these contrasting results may be that the studies included in the more recent systematic review [9] were heavily influenced by one study, which was at considerable risk of bias.[11] The limited number of studies available for this meta-analysis [9] reduces both our confidence and the level of precision around any estimate

of the effect of exercise training on PA. Further, none of the reviews to date have investigated the effect of exercise training on ST or explored the effect on participation in PA at different intensities.

A recently published large RCT, demonstrated that supervised ground-based walking training improved exercise capacity and HRQoL in people with COPD. [12] The purpose of conducting this RCT was to establish supporting evidence for a simple exercise training mode which would suit locations where access to comprehensive pulmonary rehabilitation programs was poor. [13-15] As walking is the most common form of PA undertaken during daily life, it was hypothesised that a program which focused exclusively on regular walking exercise would translate into increased levels of PA and reduced ST.

The primary aim of the current study was to determine the effects of a ground-based walking training program on daily PA and ST in people with COPD. We also explored the effect of this intervention on patterns of accumulation of both PA and ST.

METHODS

Participants

Participants with COPD were recruited from referrals to outpatient pulmonary rehabilitation programs in two cities within Australia (Sydney, New South Wales and Perth, Western Australia). Inclusion and exclusion criteria have been previously described. [12] Written, informed consent was obtained from all participants.

Study design

This study was a prospective, assessor blinded, multi-centred, RCT with concealed allocation. Participants were randomised to a Walk Group (WG) or a Control Group (CG)

with a bias of 2: 1 ratio towards the WG for the purposes of a longitudinal follow on study as previously described. [12]

Intervention

Participants in the WG performed supervised, ground-based, walking training for between 30 to 45 minutes duration, two or three times a week for 8 to 10 weeks. Supervision was provided by experienced physiotherapists. The walking training commenced at 30 minutes duration and participants were instructed to walk at a pace which elicited a dyspnoea score of 3-4 on a modified 0-10 point category-ratio dyspnoea scale. [16] Further details of the intervention and training progression can be found in a previous publication. [12]
On completion of this program, the WG were encouraged to continue with similar walking training at home with no specific education provided regarding daily physical activity. Participants in the CG did not participate in any exercise training and were not given any instructions regarding exercise or daily physical activity.

Measures

Before (baseline) and after the 8-10 week intervention period (follow-up), measures of PA, ST, exercise capacity, HRQoL and spirometry (EasyOne spirometer, ndd Medical Technologies Inc., Andover, MA, USA) [17] were collected. To characterise the study sample, measures of resting lung volumes (body plethysmography) and single breath diffusion capacity of the lung (D_LCO). [18, 19] were collected and compared to normative data. [20-22]

Physical activity and sedentary time

For the primary analyses, using data collected by the SenseWear® Pro3 Armband (SWA) (Bodymedia Inc, SenseWear Professional version 6.1, Pittsburgh, PA, USA), participation in PA was expressed as energy expenditure (kcal), daily step count and time spent in sedentary activities (defined as time spent <1.5 metabolic equivalents [METs] minus sleep time), light intensity PA (defined as time spent between 1.5 and < 3.0 METs), moderate intensity PA (defined as time spent between 3.0 and < 6.0 METs) and vigorous intensity PA (defined as time spent at ≥ 6.0 METs). The SWA is a small device worn over the right triceps brachii muscle that estimates energy expenditure and steps using a biaxial accelerometer and non-invasive physiological sensors. It has been previously validated to give an accurate measure of energy expenditure in COPD [23]. Participants were instructed to wear this device for 24 hours a day (except during showering or bathing) over seven days. To be included in the primary analyses, at baseline and follow-up, participants needed to contribute SWA data over a minimum of three days. For participants who met these criteria, SWA data were averaged across every day during which data were available for at least 20 hours.

Secondary analyses explored the effect of walking training on ST and the way in which time in PA and ST were accumulated. To be included in the secondary analyses, participants needed to contribute SWA data over a minimum of four days (which included at least one weekend day) at baseline and follow-up. To allow the analyses of ST, overnight sleep time was removed using a custom Labview program (LabVIEW 8.6.1 National Instruments, Texas, USA). Specifically, using the inclinometer data exported from the SWA, overnight sleep time was defined as starting when the participant first accumulated at least 20 consecutive minutes of lying down after 20:00 and ceased when the participant first accumulated at least 20 consecutive minutes of time spent upright after 05:00. Once overnight sleep time was removed, days were included in these analyses only if they

contributed a minimum of 12 hours of data. For participants who met these criteria, at baseline and follow-up, SWA data were averaged across every day during which data were available for at least 12 hours.

For these secondary analyses, exposure variation analysis (EVA) was undertaken using the measures of METs obtained from the SWA data using a custom Labview program (LabVIEW 8.6.1 National Instruments, Texas, USA). [18] This program first grouped the data into different intensities corresponding to ST (defined as energy expenditure between 0.7 to < 1.5 METs), light, moderate and vigorous intensity PA, as defined earlier. Thereafter, to explore differences in the way in which ST and time spent in differing intensities of PA were accumulated during waking hours, EVA grouped time in categories according to uninterrupted epochs equivalent to; 0 to < 5 minutes, 5 to < 10 minutes, 10 to < 30 minutes, 30 to < 60 minutes and ≥ 60 minutes. To overcome the influence that differences in monitor wear time may have had on these results, EVA data were expressed as percentages of total awake time.

Exercise capacity and health-related quality of life

At baseline and follow-up, participants completed two six-minute walk tests (6MWTs), two incremental shuttle walk tests and two endurance shuttle walk tests (ESWTs), over two visits within a 7-day period. The test that yielded the greatest distance was recorded as the test outcome. Further details about how the exercise tests were conducted have been previously reported. [12] Health-related quality of life was measured with the SGRQ [24] and the interviewer-administered Chronic Respiratory Disease Questionnaire (CRQ) with the individualised dyspnoea domain. [25]

Sample size

As the primary aim of the original RCT was to examine the effect of supervised ground-based walking training on HRQoL in people with COPD, sample size calculations were undertaken to ensure adequate power to detect a meaningful between-group difference in the mean total CRQ score. These calculations determined that a sample size of 132 participants was required. [12] Regarding the analyses presented in the current study, a sample of 101 participants was sufficient to detect a between-group difference in average daily step count of 1131 steps assuming a SD of 2000 steps (two-sided α of 0.05, power of 80%). [26] An improvement of 1131 steps per day is a conservative estimate of the minimum important difference in this outcome. [27]

Data analysis

Data were analysed using SPSS software (Version 20 for Windows, SPSS Inc, Chicago, ILL, USA) and are presented as mean and SD unless otherwise stated. Between-group differences in average daily energy expenditure, step count, ST, and time in light, moderate and vigorous intensity PA were explored using an analysis of covariance, with measures collected prior to randomisation used as the covariate. Chi-square analysis was also conducted to determine any differences between groups in the proportion of participants who achieved a change of greater than 1131 steps/day following the intervention (representing an estimate of the minimum clinically important difference for PA). [27] Intention to treat analysis was conducted with no imputation of missing values. A p-value < 0.05 was considered significant.

RESULTS

Participant characteristics

Participant flow is presented in Figure 1. One hundred and forty-three participants were randomised, of whom 101 (71%; WG=62, CG=39) and 44 (31%; WG=21, CG=23) had sufficient SWA data to be included in the primary and secondary analyses, respectively. Table 1 presents the characteristics of participants who were included in the primary analyses as well as those who had insufficient data to be included in these analyses. In both the WG and CG, at baseline and follow-up, similar SWA data were available in terms of days the SWA was worn and the daily wear time (Table 2).

Physical activity and sedentary time

Results of the primary analyses are presented in Table 2. On completion of the intervention period, no significant between-group differences were demonstrated in measures of average daily energy expenditure, step count, ST and time spent in light, moderate or vigorous PA. Likewise, the proportion of participants who demonstrated an increase in their average step count of >1131 steps was similar in both groups (WG n=15/62, 24% vs CG n=8/39, 21%; p=0.67).

Results of the secondary analyses are presented in Table 3. On completion of the intervention period, when compared to the CG, the WG demonstrated a small but significantly greater increase in the time spent participating in moderate intensity PA for uninterrupted bouts of between 30 to 60 minutes (mean difference [95% CI]: 0.8% [0.4 to 1.3]). No other between-group differences were seen.

Exercise capacity and health-related quality of life

Measures of exercise capacity and HRQoL are presented in Table 4. The responses were similar to that shown for the larger RCT published previously. [12] When compared to the

CG, the WG demonstrated significantly greater improvements in performance on the ESWT, 6MWT, SGRQ total score and the domains of activity limitation and impact of disease, as well as CRQ total score and in the domains of emotional function and disease mastery.

DISCUSSION

This study investigated the effects of a supervised, ground-based walking training program on daily PA and ST in people with moderate to severe COPD. The findings demonstrated that, when compared to usual care, there was no significant difference in daily PA following completion of a ground-based walking training program, despite significant differences in exercise capacity and HRQoL at the end of the intervention. Sub-group analyses showed no difference in ST, but demonstrated that, compared to the CG, those in the WG slightly increased the percentage of waking hours spent in moderate intensity PA accumulated in uninterrupted bouts of between 30 to 60 minutes.

In people with COPD, higher levels of PA have been associated with reduced hospital utilisation and mortality. [7, 28] Consequently, a key goal for exercise training programs should be to increase levels of PA but evidence to support the effectiveness of these training programs remains inconsistent in people with COPD. [10] The current study is one of only a few rigorous RCTs that have been conducted comparing the effects of an exercise training program to no training on PA in COPD. In addition to three RCTs included in a recent meta-analyses, [11, 29, 30] two further RCTs have been published subsequently. [31, 32] Of these five RCTs, two studies [29, 32] show no effect of exercise training on PA levels and three studies [11, 30, 31] show a positive effect. The studies with positive results investigated various modes of supervised exercise training for eight to 12 weeks which included outside walking with Nordic poles, [11] high intensity interval training [31] and upper body

resistance training [30] with all studies including an educational program. [11, 30, 31] However, methodological limitations such as a lack of concealed allocation and assessor blinding [11], lack of intention to treat analysis [30, 31] and large loss to follow up (57%) [30] may have introduced important biases which potentially compromises the validity of these positive findings. The current study is at low risk of bias and our results are consistent with a previous Australian study that reported no difference in PA on completion of an eight week tele-rehabilitation exercise training program that did not include any education. [32] The current study contributes important evidence to this body of work suggesting that a short-term exercise program of supervised, ground-based walking training alone is not sufficient to improve overall daily PA in COPD.

One explanation for the lack of effect of ground-based walking training on overall PA levels may be that the WG did not receive any specific behaviour change intervention which focused on increasing their participation in daily PA or reducing ST. That is, whilst the participants had the potential for increased PA, as evidenced by an increase in their exercise capacity, their daily routines and behaviour appear not to have been altered. This suggests that reductions in sedentary activity time and increases in PA may require multilayered interventions which both improve exercise capacity and assist behaviour change. Given that the source of behaviour stems from a complex interaction between capacity, motivation and opportunity,[33] it is perhaps not surprising that an intervention, such as ground-based walking training, which focused only on increasing the capacity to engage in PA, is of limited effectiveness. Alternatively, the changes in exercise capacity and health status observed in pulmonary rehabilitation may not be of a magnitude on their own, to impact established patterns of behaviour at home. Future studies need to understand the determinants of reduced participation in PA and high levels of ST in COPD. Once the determinants of behaviour have

been mapped and understood as barriers and enablers, this information can be used to design and implement a targeted behaviour change intervention. Other studies which have provided specific behaviour change interventions, [34, 35] have shown beneficial effects on PA levels. [9]

Despite the lack of effect of walking training on overall PA levels, this study did show a small increase in the percentage of waking hours spent in moderate intensity PA in uninterrupted bouts of 30 to 60 minutes in the WG compared to the CG. These results, although small are somewhat promising as it may indicate that participants in the WG did continue, as instructed, to perform unsupervised walking exercise following completion of their short-term, supervised, ground-based, walking training program. The finding highlights the importance of measuring, in addition to total physical activity time, the pattern of accumulation of physical activity through exploring bouts of activity at different intensities particularly in situations where the primary goal of the intervention focuses on exercise training at a set intensity. Patterns of physical activity accumulation have been examined previously in people with COPD, [36, 37] but reported outcomes could not be compared with the current study as bouts of activity were reported differently across studies.

This study demonstrated that people with COPD spent approximately 70% of their waking hours in ST and accumulated more than half of this time in prolonged uninterrupted bouts greater than 30 minutes. This is an important finding as there is growing awareness of the health consequences of accumulating prolonged periods of ST or ‘too much sitting’. Epidemiological studies have shown that ST, particularly when accumulated in uninterrupted bouts, is associated with increased risk of cardiovascular disease and diabetes and culminates in worse survival. [38] Data are now emerging of similar health risks of prolonged ST in

people with COPD. [39] Although ground-based walking training did not change ST or the way in which ST was accumulated, these data suggest that reducing the accumulation of ST in prolonged uninterrupted bouts, is an appropriate behaviour change goal for future interventions.

Limitations

A limitation in this study was the lack of available PA data for the primary analysis (16%). The main reason for the lack of data was due to participants declining to wear the SWA at follow-up which may have been caused by participants finding the SWA uncomfortable when they wore the device at baseline, which has been reported elsewhere. [40] Future studies should be cautious in their choice of monitoring devices to ensure adequate follow-up data. A further limitation is the possibility that the one significant finding in this study may have been caused by a type-1 statistical error (false positive) due to the multiple analyses performed. However this positive outcome, for periods spent in moderate intensity PA, is consistent with the intervention in the WG being to walk for at least 30 minutes a day at a moderate intensity.

Conclusion

In conclusion, although short-term, supervised, ground-based walking training improved exercise capacity and HRQoL, the intervention was not effective at improving overall daily PA compared to usual care in people with COPD. The lack of change in PA levels supports the idea that specific behaviour change strategies are necessary to effectively increase participation in PA and reduce ST.

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Table 1: Participant characteristics

	Walk Group		Control Group	
	Included in primary analyses	Excluded from primary analyses	Included in primary analyses	Excluded from primary analyses
Sample size	62	24	39	7
Age, yr	69 (8)	71 (9)	68 (9)	71 (7)
Males, %	61	63	62	57
Height, m	1.68 (0.10)	1.66 (0.89)	1.70 (0.11)	1.68 (0.62)
Weight, kg	71 (15)	72 (15)	79 (19)	77 (13)
BMI, kg/m^2	25 (5)	26 (5)	27 (6)	27 (5)
Resting pulmonary function				
FEV_1, L	1.14 (0.42)	1.20 (0.45)	1.21 (0.50)	1.10 (0.35)
FEV_1, % pred	42 (15)	47 (15)	43 (15)	45 (15)
FVC, L	2.74 (0.92)	2.73 (0.72)	2.78 (0.87)	2.88 (0.58)
FVC, % pred	74 (18)	78 (16)	74 (19)	85 (16)
FEV_1/FVC	0.43 (0.14)	0.44 (0.13)	0.44 (0.12)	0.39 (0.13)
TLC, % predicted	109 (18)	121 (45)	107 (19)	117 (19)
FRC, % predicted	136 (47)	152 (74)	131 (49)	146 (31)
RV, % predicted	145 (49)	139 (35)	146 (54)	148 (43)
D_L,CO, % predicted	44 (16)	47 (16)	43 (15)	41 (13)

Data presented as mean (SD) unless stated otherwise. BMI: body mass index; D_L,CO: single breath diffusing capacity for carbon monoxide; FEV_1: forced expiratory volume in 1 second; FRC: functional residual capacity; FVC: forced vital capacity; RV: residual volume; TLC: total lung capacity; yr: year

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Table 2: Primary analysis of physical activity data in the Walk Group and Control Group

					Mean Difference (95% CI)		
	Before intervention period		After intervention period		Within-group		Between-group (WG-CG)
	WG	CG	WG	CG	WG	CG	
Daily SWA wear time, hr	23.4	23.6	23.1	22.9	-0.2	-0.7	0.5
	(0.7)	(0.3)	(1.4)	(1.5)	(-0.6 to 0.1)	(-1.2 to -0.2)*	(-0.1 to 1)
SWA days worn	6.8	6.8	6.7	6.7	-0.1	-0.1	-0.01
	(0.4)	(0.5)	(0.7)	(0.8)	(-0.3 to 0.1)	(-0.4 to 0.2)	(-0.3 to 0.3)
Total EE, kcal	2088	2159	2083	2192	-5	33	-40
	(419)	(457)	(431)	(478)	(-44 to 34)	(-16 to 82)	(-102 to 22)
Average daily step count	5435	4609	5795	4820	361	212	151
	(2854)	(2326)	(3465)	(2533)	(-72 to 793)	(-316 to 740)	(-539 to 842)
Sedentary time, min/day	733	763	719	747	-14	-17	1
	(115)	(108)	(132)	(187)	(-35 to 8)	(-66 to 32)	(-46 to 48)
Time in PA, min/day							
Light intensity	233	214	229	210	-4	-3	4
(1.5 to <3.0 METs)	(76)	(70)	(75)	(64)	(-16 to 9)	(-18 to 11)	(-14 to 22)
Moderate intensity	54	46	59	51	4	6	0
(3.0 to <6.0 METs)	(43)	(39)	(51)	(49)	(-3 to 11)	(-3 to 14)	(-13 to 12)
Vigorous intensity	1	1	1	1	0	0	0
(≥6.0 METs)	(2)	(2)	(3)	(3)	(-0.2 to 0.5)	(-0.3 to 0.7)	(-0.8 to 0.8)

Data are presented as mean (SD) unless otherwise stated. Between-group mean difference calculated from adjusted means in the ANCOVA model. Sedentary time was defined as time spent < 1.5 METs minus sleep time. CG: Control Group; CI: confidence interval; EE: energy expenditure; METs: metabolic equivalents; min: minutes; PA: physical activity; SD: standard deviation; SWA: SenseWear® Pro3 Armband; WG: Walk Group; * $p < 0.05$

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Table 3: Secondary analyses of sedentary time and time spent in different intensities of physical activity and patterns of accumulation in the Walk Group and Control Group

	Before intervention period		After intervention period		Between group mean difference (95% CI) (WG-CG)
	WG	CG	WG	CG	
Daily wear time, hr	15 (1)	16 (1)	15 (2)	16 (2)	
Sedentary time, % awake time					
0 to 10 min	16 (4)	14 (4)	15 (4)	16 (5)	-4 (-2 to 0)
10 to 30 min	15 (8)	19 (5)	15 (8)	19 (5)	-1 (-4 to 2)
30 to 60 min	13 (6)	15 (5)	12 (6)	15 (5)	-1 (-3 to 2)
>60 min	26 (13)	20 (12)	26 (16)	18 (14)	2 (-5 to 8)
Total sedentary time	70 (7)	67 (10)	69 (10)	68 (10)	-2 (-6 to 2)
Light PA, % awake time					
0 to 10 min	19 (4)	20 (5)	20 (5)	20 (5)	0 (-2 to 2)
10 to 30 min	3 (3)	4 (4)	4 (3)	4 (3)	1 (-1 to 2)
30 to 60 min	1 (1)	0 (1)	1 (1)	0 (1)	0 (-1 to 1)
>60 min	0 (1)	0 (0)	0 (1)	0 (0)	-
Total time in light PA	24 (7)	25 (8)	25 (7)	25 (7)	1 (-2 to 4)
Moderate PA, % awake time					
0 to 10 min	5 (2)	5 (3)	5 (3)	6 (4)	0 (-2 to 2)
10 to 30 min	1 (1)	2 (2)	1 (2)	1 (2)	1 (-1 to 2)
30 to 60 min	0 (0)	0 (1)	1 (1)	0 (0)	1 (0 to 1) [#]
>60 min	0 (1)	0 (0)	0 (0)	0 (0)	0 (0 to 0)
Total time in moderate PA	6 (3)	8 (5)	7 (5)	7 (5)	1.0 (-2 to 4)
Vigorous PA, % awake time					
0 to 10 min	0 (0)	0 (0)	0 (0)	0 (0)	0 (0 to 0)
10 to 30 min	0 (0)	0 (0)	0 (0)	0 (0)	0 (0 to 0)
30 to 60 min	0 (0)	0 (0)	0 (0)	0 (0)	-
>60 min	0 (0)	0 (0)	0 (0)	0 (0)	-
Total time in vigorous PA	0 (0)	0 (0)	0 (0)	0 (0)	0 (0 to 0)

Data presented as mean (SD). Between-group mean difference calculated from adjusted means in the ANCOVA model. Sedentary time: defined as 0.7 to <1.5 metabolic equivalents (METs), Light intensity PA: defined as 1.5 to <3 METs, Moderate intensity PA: defined as 3 to <6 METs, Vigorous intensity PA : defined as ≥ 6 METs; CG: control group; WG: Walk Group; [#] $p < 0.05$

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Table 4: Walk test and questionnaire data in the Walk Group and Control Group

	Before intervention period Mean (SD)		After intervention period Mean (SD)		Within group Mean difference (95% CI)		Between group Mean difference (95% CI)
	WG	CG	WG	CG	WG	CG	
6MWD, m	469 (86)	475 (89)	479 (91)	460 (89)	10 (-2 to 22)	-15 (-31 to 2)	24 (5 to 43) [#]
ISWD, m	327 (119)	335 (121)	348 (129)	338 (127)	21 (6 to 35) [*]	3 (-15 to 21)	18 (-5 to 40)
ESWT, s	318 (198)	295 (175)	546 (382)	313 (201)	229 (149 to 309) [*]	19 (-40 to 78)	210 (101 to 320) [#]
SGRQ							
Total score	47 (17)	47 (16)	41 (14)	47 (16)	-6 (-9 to -3) [*]	0 (-4 to 4)	-6 (-10 to -2) [#]
Symptoms	56 (22)	62 (21)	50 (23)	59 (21)	-5 (-10 to -1) [*]	-3 (-9 to 2)	-5 (-12 to 2)
Activity limitation	63 (19)	64 (20)	59 (18)	66 (20)	-4 (-7 to -2) [*]	2 (-2 to 6)	-7 (-11 to -2) [#]
Impact	33 (18)	33 (17)	27 (14)	33 (16)	-6 (-9 to -3) [*]	0 (-4 to 4)	-6 (-10 to -1) [#]
CRQ							
Total score	89 (18)	89 (17)	97 (18)	90 (18)	8 (4 to 11) [*]	1 (-3 to 5)	7 (2 to 11) [#]
Dyspnoea	16 (5)	17 (5)	19 (5)	18 (6)	2 (1 to 3) [*]	1 (-1 to 2)	1 (0 to 3)
Fatigue	17 (6)	17 (4)	19 (5)	17 (4)	1 (0 to 2) [*]	0 (-2 to 1)	1 (0 to 2)
Emotional Function	35 (8)	34 (9)	37 (7)	35 (9)	3 (1 to 4) [*]	0 (-2 to 2)	3 (1 to 5) [#]
Mastery	21 (5)	21 (5)	22 (5)	21 (5)	1 (1 to 2) [*]	0 (-1 to 1)	1 (0 to 2) [#]

Data presented as mean (SD) or mean difference (95% CI) between groups calculated from adjusted means in the ANCOVA model. Definition of abbreviations: CG: Control Group; CRQ: Chronic Respiratory Disease Questionnaire; ESWT: endurance shuttle walk test; ISWD: incremental shuttle walk distance; SGRQ: St George's Respiratory Questionnaire; WG: Walk Group; 6MWD: six-minute walk distance; [*]significant difference within groups; [#]significant difference between groups from ANCOVA

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FIGURE LEGENDS

Figure 1: Participant flow

CG: Control Group; n: number of participants; SWA: SenseWear® Pro3 Armband; WG: Walk Group