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COPD

Effects of Ongoing Feedback During a 12-Month Maintenance Walking Program on Daily Physical Activity in People with COPD

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Abstract

This multi-centred, randomised controlled trial explored the effects of adding ongoing feedback to a 12-month unsupervised maintenance walking program, on daily physical activity (PA) in people with chronic obstructive pulmonary disease. Participants were randomised to either an intervention group (IG) or a usual care group (UCG). During the maintenance program, the IG received ongoing feedback (telephone calls, biofeedback provided via pedometer and progressive goal setting) and the UCG received no feedback. The SenseWear® Pro3 Armband was used to measure PA. Of the 86 participants {IG = 42, (mean [SD]: age 70 [7] years; FEV_1 43 [16] % predicted); UCG = 44, (age 69 [9] years; FEV_1 44 [15] % predicted)} included at baseline, 43 had sufficient data to be included in the final analysis. There were no between-group differences in any of the PA variables from baseline to completion of the program (all $p > 0.05$). Ongoing feedback was no more effective than no feedback in improving PA during a 12-month unsupervised walking program.

Trial Registration: The trial was registered in the Australia and New Zealand Clinical Trials Registry (ACTRN12609000472279).

Keywords Chronic obstructive pulmonary disease · Physical activity · Pulmonary rehabilitation · Exercise training

Introduction

In people with chronic obstructive pulmonary disease (COPD), increasing participation in physical activity (PA) is considered important with higher levels of daily PA associated with reduced hospital utilisation and mortality [1, 2]. One intervention that offers promise to increase PA is pulmonary rehabilitation (PR) [3–5]. This is because PR, with the core component being supervised exercise training, has been shown to improve exercise capacity and reduce symptoms of dyspnoea and fatigue [6]. Where access to comprehensive PR is poor [7–9], a simple program of ground-based walking training (GBWT) may be an alternative strategy for the provision of exercise training and has previously been shown to increase exercise capacity and health-related quality of life (HRQoL) [10]. Nevertheless, there is little

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evidence that gains made after a comprehensive PR program translate into an increase in participation in PA [3, 11]. In a recent meta-analysis, a significant increase in PA compared to usual care [4] [standardised mean difference (95% CI): 0.84 (0.44–1.25)] was demonstrated following exercise training but 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; $p = 0.01$) [3].

As walking is the most common form of PA undertaken during daily life, it was hypothesised that a simple program of supervised GBWT would translate into an increase in participation in PA but this was not the case in the short-term [12]. As studies in this area often assess the immediate or short-term impact of PR, it is conceivable that improvements in PA may take longer to attain, and may be achieved during a subsequent maintenance program that specifically includes interventions designed to encourage adherence to ongoing exercise training. Therefore, the aim of this study was, in people who had completed a program of GBWT, to evaluate the effects on PA of adding ongoing feedback (telephone calls, biofeedback via pedometer and progressive goal setting) to a 12-month unsupervised maintenance walking program compared to no feedback in people with COPD.

Participants and Methods

This brief report presents longitudinal PA data from a long-term, prospective, assessor-blinded, multi-centre randomised controlled trial (RCT) [13]. Participants with COPD were recruited from referrals to seven outpatient PR programs in two cities in Australia. The trial was registered in the Australia and New Zealand Clinical Trials Registry (ACTRN12609000472279). Details of inclusion and exclusion criteria, randomisation and stratification have previously been described [13]. Participants were randomised to either an intervention group (IG) or usual care group (UCG). Before commencing the 12-month maintenance period, both groups received the same 2-month intervention of supervised GBWT, two or three times per week with effects on exercise capacity, HRQoL and PA being previously reported [10, 12]. In the maintenance period, both groups were instructed to perform unsupervised walking training, 3 days a week for 12 months. In addition, the IG received telephone calls, feedback provided via a pedometer (G-Sensor accelerometer, Pedometers Australia, Cannington, WA, Australia) and progressive goal setting (based on pedometer data) as previously described [13].

Physical activity was measured using the SenseWear® Pro3 Armband (SWA) (Bodymedia Inc, SenseWear Professional version 6.1, Pittsburgh, PA, USA) worn by participants for 7 days on three occasions over a 14-month period as follows: T1 (baseline assessment), T2 (2 month assessment end of GBWT) and T3 (end of 12-month maintenance period). Measures of PA were expressed as daily energy expenditure (kcal), daily step count and time spent in sedentary activities [1.0 to < 1.5 metabolic equivalents (METs)], light intensity PA (1.5 to < 3.0 METs), moderate intensity PA (3.0 to < 6.0 METs) and vigorous intensity PA (time spent at ≥ 6.0 METs). To be included in the analyses, participants needed to contribute SWA data over a minimum of 3 days for at least 20 h each day. At all time points participants completed measures of HRQoL, exercise capacity and spirometric lung function as previously described [13].

Sample Size and Data Analysis

As the primary aim of the original study was to evaluate the effect of the intervention on HRQoL [13], sample size calculations were undertaken to ensure adequate power to detect a meaningful between-group difference in the mean total St George's Respiratory Questionnaire score between the IG and CG at T3. These calculations determined that a sample size of 88 participants was required. Regarding the analyses presented on the longitudinal PA data, a sample of 88 participants would be sufficient to detect a between-group difference in average daily step count of 1200 steps assuming a SD of 2000 steps (two-sided α of 0.05, power of 80%) [14]. Data were analysed using SPSS software (Version 20 for Windows, SPSS Inc, Chicago, ILL, USA). Linear mixed models were used to determine significance between groups across all time points using the sample that was available at each time point. Intention-to-treat analysis was conducted with no imputation of missing values. A p value < 0.05 was considered significant.

Results

Eighty-six participants {(IG = 42 (30 males; mean [SD]: age 70 [7] years; FEV_1 43 [16] % predicted); UCG = 44 (23 males; age 69 [9] years; FEV_1 44 [15] % predicted)} commenced the maintenance study. At T2, 62 participants (IG: 33, UCG: 29) and at T3, 43 participants (IG: 23, UCG: 20) had sufficient SWA data to be included in the analysis. The SWA was worn on average for six days (at least 23 h per day) in both groups at each time point. Results of the PA analyses are presented in Table 1 with change in average daily steps in both groups presented in Fig. 1. On completion of the maintenance period, no significant between-group differences were demonstrated in the change in average daily energy expenditure, step count or time spent in sedentary, light, moderate or vigorous PA from T1 to T3 or from T2 to T3.

Table 1 Physical activity results

	T3–T1 mean difference (95% CI)		Change scores T3–T1 between-group difference (95% CI)	T3–T2 mean difference (95% CI)		Change scores T3–T2 between-group difference (95% CI)
	IG	UCG	(IG–UCG)	IG	UCG	(IG–UCG)
Total EE (kcal)	−45 (−110 to 19)	−105* (−174 to −37)	−58 (−158 to 42)	−75 (−156 to 6)	−80 (−166 to 5)	17 (−131 to 164)
Average daily step count	−1 (−536 to 534)	−585* (−1155 to −15)	−757 (−1617 to 103)	−157 (−753 to 439)	−1051* (−1687 to −424)	−617 (−1669 to 435)
Time in (min/day)						
Sedentary activities	−8 (−38 to 22)	−20 (−51 to 12)	−15 (−63 to 32)	−9 (−34 to 17)	−13 (−40 to 14)	−8 (−50 to 33)
Light intensity	−4 (−29 to 20)	−14 (−40 to 12)	−15 (−49 to 19)	8 (−19 to 35)	−16 (−44 to 13)	−27 (−70 to 14)
Moderate intensity	−6 (−15 to 3)	4 (−5 to 14)	8 (−5 to 22)	−11 (−23 to 1)	−1 (−13 to 12)	20 (−1 to 41)
Vigorous intensity	0 (0 to 0)	0 (0 to 1)	0 (0 to 1)	0 (−1 to 1)	0 (−1 to 1)	1 (−1 to 2)

Within group change data presented as predicted between-time mean (95% CI) differences by group. Between-group difference data were determined from the predicted means from Linear Mixed Model (LMM). Sedentary activities: time spent in 1.0 to < 1.5 METs; Light intensity: time spent in 1.5 to < 3.0 METs; Moderate intensity: time spent in 3.0 to < 6.0 METs; Vigorous intensity: time spent in ≥ 6.0 METs

IG intervention group, *UCG* control group, *EE* energy expenditure, *kcal* kilocalories

T1: baseline; T2: 2-month assessment (end of supervised training); T3: end of 12-month maintenance assessment

*$p < 0.05$

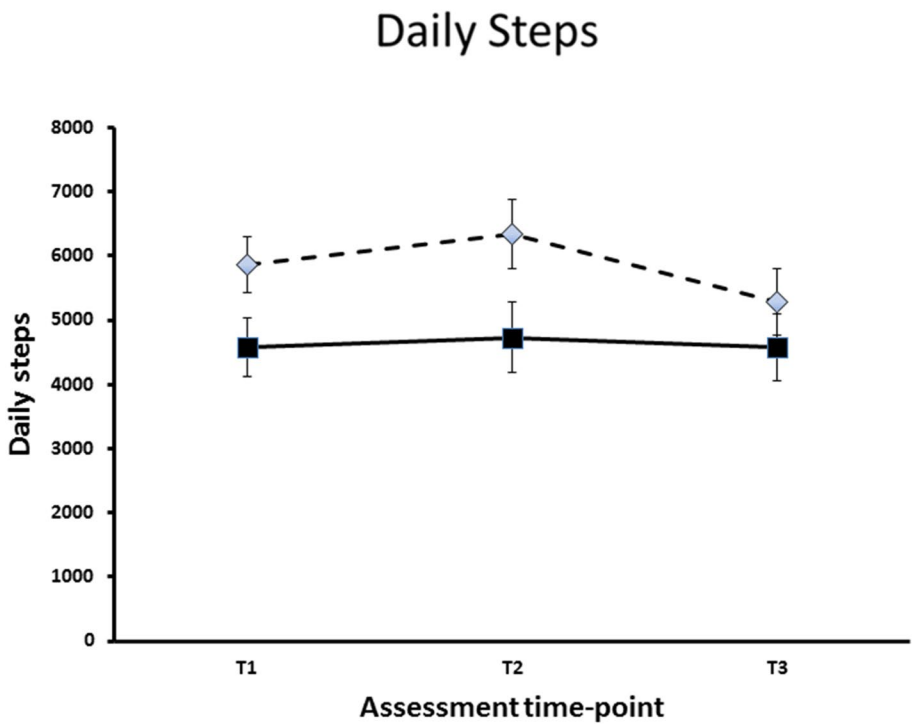

Fig. 1 Daily steps. Data are presented as adjusted mean values from linear mixed models with error bars representing standard errors. Filled square: IG; diamond: UCG. T1: baseline assessment; T2: 2-month assessment; T3: end of 12-month maintenance period

Discussion

This study is one of only a few rigorous RCTs that have investigated the effects of a maintenance exercise training program on PA in COPD. We hypothesised that although short-term supervised GBWT did not result in an immediate change in PA [12] it may have taken longer for changes in PA to occur. In standard clinical practice, it is costly to provide ongoing supervision following completion of short-term supervised exercise training programs. In this study, it was hypothesised that a telephone intervention providing ongoing feedback (biofeedback via pedometer and progressive goal setting) would result in improvements in PA as previous literature has demonstrated that with the addition of biofeedback strategies to telephone support, maintenance of effects of short-term programs on HRQoL and exercise capacity have been shown [15, 16]. Since both groups had the capability to do more, as evidenced by improved exercise capacity at the end of the 2-month supervised walking training [10], improvements in PA might have been expected, especially in the IG. This study has not confirmed our hypothesis. The lack of effect on PA in the IG may be attributed to the fact that the participants were only instructed to wear the pedometers during their walking training sessions and not instructed to use them to monitor participation in daily PA. Consequently, the ongoing feedback provided by the pedometer was to encourage participants in the IG to walk at an appropriate intensity during their regular exercise sessions rather than specifically to walk more in daily life.

The main limitation in this study was the lack of available PA data at the T3 time point which was attributed to both a 21% loss to follow-up in the maintenance study and only 43 participants having available SWA data at T3. Although this lack of data creates uncertainty around the accuracy of the results, a power calculation of our final sample demonstrated that 43 participants at T3 would have been sufficient to detect a larger between-group difference in average daily step count of 1700 steps.

In conclusion, this study investigated the effects of ongoing feedback on PA during a 12-month unsupervised maintenance walking program compared to no feedback. Despite the hypothesis that ongoing feedback would improve PA levels during a maintenance program, there were no between-group differences in any PA variables from T1 to T3 or from T2 to T3. Further studies are required to determine effective methods of facilitating improvements in PA levels to take advantage of improvements in exercise capacity that are evident after a supervised exercise program in people with COPD.

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Compliance with Ethical Standards

Conflict of interest Peter R. Eastwood was funded by a National Health and Medical Research Council of Australia (NHMRC) Senior Research Fellowship (1042341). All other authors declare that they have no conflict of interest.

Ethical Approval The study was approved by the ethics committees of Sydney South West Area Health Service, The University of Sydney, Curtin University, Sir Charles Gairdner Hospital and Bentley Hospital.

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