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Short communication

Enhancement of daily physical activity increases physical fitness of outclinic COPD patients: Results of an exercise counseling program

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ABSTRACT

Objective: To investigate whether a 12-week pedometer-based exercise counseling strategy is feasible and effectively enhances daily physical activity in outclinic Chronic Obstructive Pulmonary Disease (COPD) patients who do not participate in a rehabilitation program in a controlled way.
Methods: 35 outclinic COPD patients (21 males, mean age 62 years, GOLD I–III, mean FEV_1% predicted 64.7) were randomized for a 12-week individual pedometer-based exercise counseling program promoting daily physical activities or usual care. Daily physical activity (DigiWalker SW-200), physical fitness, health-related quality of life, self-efficacy, fatigue, depression and motivation to be physically active were assessed before and after the intervention.
Results: After the intervention, COPD patients in the exercise counseling group showed a significant increase in their mean number of steps/day (from 7087 to 7872), whereas the usual care group showed a decrease (from 7539 to 6172). Significant differences favoring the exercise counseling group were demonstrated in arm strength, leg strength, health-related quality of life and intrinsic motivation to be physically active.
Conclusion: Our study shows that a 12-week pedometer-based exercise counseling strategy is feasible and effectively enhances daily physical activity, physical fitness, health-related quality of life and intrinsic motivation in outclinic COPD patients who do not participate in a rehabilitation program.
Practice implications: The feasibility of our exercise counseling strategy is good and patients were motivated to participate.

1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) is characterized by cough, phlegm, dyspnea, decreased exercise tolerance and exacerbations. COPD patients may enter a downward spiral of symptom-induced inactivity leading to lack of fitness and a reduced quality of life. It has been demonstrated that during 1 day, COPD patients spend more time sitting and lying down and less standing and walking than age-matched healthy controls [1]. To reverse this vicious circle of inactivity it is important to prevent the decrease in daily physical activity or even to enhance it.

Enhancement of low-to-moderate-intensity daily physical activity has proven to be effective in strengthening health-related fitness and quality of life in healthy older adults [2,3]. Because COPD patients frequently suffer from ventilatory limitations and oxygen uptake problems, low-to-moderate-intensity physical activities seem an appropriate level to enhance their physical fitness [4]. To monitor enhancement of daily physical activity pedometers have shown to be effective in healthy people as well as in various patients groups [5–8]. Pedometers are also key in triggering enhancement of daily physical activity [9–12]. In addition, exercise counseling has shown to be effective in tailoring the needs and circumstances of individual patients in the process of behavioral modification [13,14].

In this study, we investigated whether a 12-week pedometer-based exercise counseling strategy is feasible and effectively enhances daily physical activity in COPD patients who do not participate in a rehabilitation program.

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2. Methods

2.1. Participants and recruitment

Patients with stable COPD visiting the outpatient clinic of the pulmonary department of Wilhelmina Hospital in Assen were approached to participate in this study. Inclusion criteria were diagnosis of COPD and age between 45 and 75 years. Exclusion criterion was significant comorbidity interfering with physical activity. The study was approved by the local medical ethical committee of University Medical Centre Groningen and all patients signed a written informed consent.

2.2. Measurements

All measurements were taken at baseline and following the intervention period.

- Daily physical activity was measured with a pedometer (Digiwalker SW-2000 (Yamax; Tokyo, Japan)) [10].
- Pulmonary function was measured using a spirometer (Jaeger MS-IOS) according to standardized guidelines [15].
- Physical fitness: leg strength was measured by the chair-stand-test [16,17], arm strength by the arm-curl-test [16,17], grip force by a handheld dynamometer and cardiorespiratory endurance by the 6-min walking test [18].
- Health-related quality of life was measured by the Clinical COPD Questionnaire and the St. George Respiratory Questionnaire [19,20]. Health status was measured by the SF-36 [21].
- Fatigue was measured by the Dutch Exertion Fatigue Scale [22].
- Depression was measured by the Beck Depression Inventory [23].
- Self-efficacy was measured by the LIVAS [24,25].
- Motivation to be physically active was measured by the Exercise Self-Regulation Questionnaire.

2.3. Intervention

Patients were randomly assigned to an exercise counseling or a usual care group. The exercise counseling group participated in a 12-week customized exercise counseling program designed to enhance daily physical activity in COPD patients [26]. Patients started the program in the late summer and finished it in the early winter. The exercise counseling program was given by a trained exercise counselor (the first author) and is predominantly based on the principles of goal setting and implementation of goals [27]. Motivational interviewing technique [28] is used as counseling technique. A pedometer, worn all day during the intervention period, was used to monitor and support motivation to participate. Aim of the exercise counseling was to motivate COPD patients to enhance daily physical activities and to develop a more physically active lifestyle. Five individually tailored exercise counseling sessions took place during 12 weeks (Table 1). Each session lasted approximately 30 min.

Patients in the usual care group received usual care and wore the pedometer for 2 weeks at baseline and 10 weeks after baseline.

2.4. Statistical analysis

All statistical analyses were performed using Scientific Package of Social Sciences (SPSS) version 14.0. The Mann–Whitney *U*-test and the Chi-square test were used to analyze baseline characteristics. A factorial ANOVA (group $\times$ time) was used to examine the effect of the intervention. Effect sizes were computed [32] and a power analysis was calculated [33]. To test the null hypothesis alpha was set at 0.05 and beta at 0.80.

3. Results

The flow of participants through the study is shown in Fig. 1. Descriptive characteristics at baseline are shown in Table 2.

3.1. Primary outcome measure

The exercise counseling group increased its mean number of steps/day by 11% (Table 3). By contrast, the usual care group showed a decrease in their mean steps/day of 18%. In the exercise counseling group about 56% of the participants showed an increase, while in the usual care group 29% showed an increase in mean number of steps/day. This difference was significant.

3.2. Secondary outcome measure

The exercise counseling group, as compared to the usual care group, showed a beneficial significant effect on leg strength and arm strength (Table 3). Moreover, a significant improvement was found on quality of life and changes in intrinsic motivation score. No significant differences were found for fatigue, health status, depression and self-efficacy. Controlled for number of steps/day at baseline, the results of a factorial ANOVA showed a significant increase in only leg strength in the exercise counseling group compared to the usual care group.

4. Discussion and conclusion

4.1. Discussion

Our study shows that a 12-week pedometer-based exercise counseling strategy is feasible and effectively enhances daily

Table 1
Exercise counseling sessions.

Visit	Week	Topic of the counseling session	Behavioral theory
1	0	Motivation for increasing physical activity level by focusing on motives to change behavior and assessing the baseline status of physical activity	The Self-Determination Theory [29] The Stage of Change Theory [30]
2	3	Setting individual goals: SMART (specific, measurable, acceptable, realistic en timed) criteria and implementation protocols are used by the exercise counselor	The Goal-Setting Theory [29] The Relapse Prevention Model [31]
3	6	Seeking personal physical activity limits by shifting boundaries	The Goal-Setting Theory [29]
4	9	Consolidation of physical activity behavior; set a personal goal	The Goal-Setting Theory [29]
5	12	Evaluation The exercise counselor gives information about self regulation principles to cope with laps and relapse	The Relapse Prevention Model [31]

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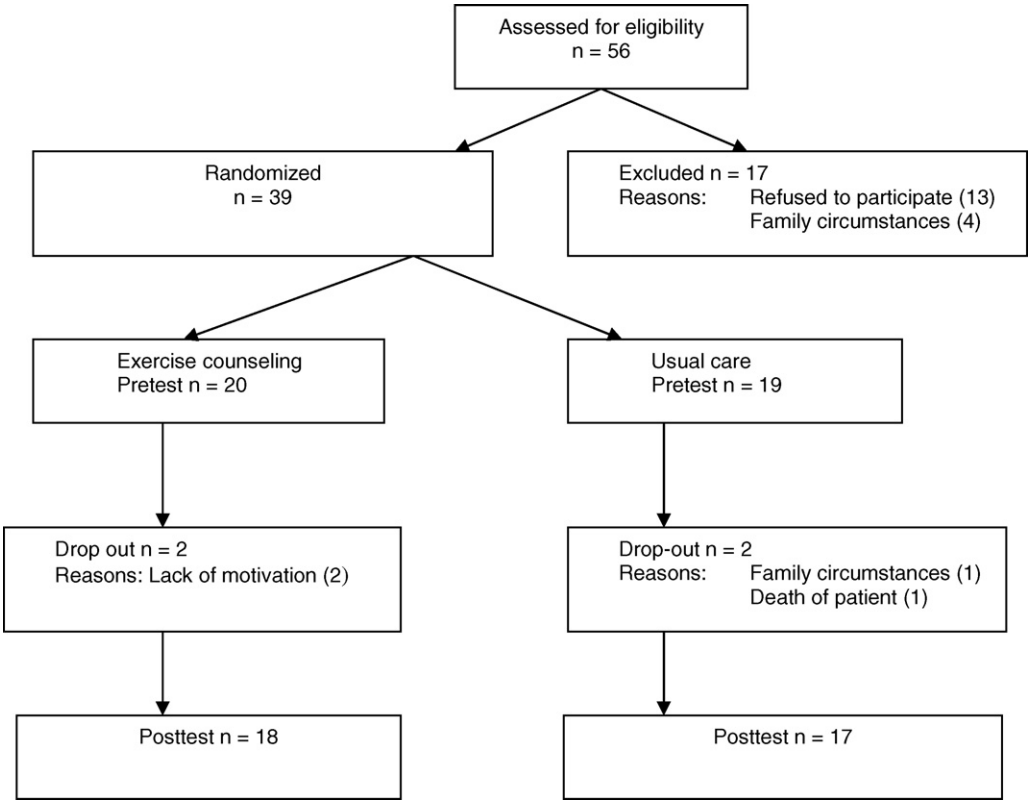

Fig. 1. Flow chart of the study.

physical activity, physical fitness, health-related quality of life and intrinsic motivation in COPD patients who do not participate in a rehabilitation program.

COPD patients in the exercise counseling group increased their number of steps by 11%. COPD patients who took less than 10,000 steps/day at baseline increased their number of steps by about 19%. This corresponds with about 20 min walking per day. Still, a mean number of 6124 steps post-program is far below the arbitrary cut-off point of 10,000 steps/day for healthy adults. For physically active COPD patients (>10,000 steps/day at baseline) who participated in the exercise counseling group the number of steps did consolidate. Contrary, physically active participants in the usual care group demonstrated a dramatic fall in number of steps/day by 21%. One might suggest that this dramatic fall is due to a seasonal effect [34,35]. Patients started the program in the late summer and finished it in the early winter. It is conceivable that physically active COPD patients reduce their outside physical activities in the early winter because of bad weather.

Table 2
Descriptive characteristics at baseline.

	Exercise counseling	Usual care	*P*-value
Number	18	17	
Gender, (M/F)	10/8	11/6	.24
Age (years)	63.1 (8.3)	61.2 (9.1)	.41
BMI (kg/m^2)	27.8 (6.8)	26.6 (3.5)	.80
FEV (L)	1.9 (0.7)	1.8 (0.5)	.90
FEV (%) predicted	67.4 (17.5)	61.8 (14.4)	.42
TLC (%) predicted	112.0 (19.8)	114.3 (13.6)	.87
RV (%) predicted	136.6 (30.5)	146.0 (29.3)	.40
ITGV (%) predicted	128.8 (30.8)	131.3 (27.0)	.96
GOLD			
Stage I	4 (22)	1 (6)	
Stage II	11 (61)	12 (71)	.35
Stage III	3 (17)	4 (23)	

Units are means (S.D.) or numbers (%). No significant differences between the two groups.

The increase in daily physical activity level of COPD patients in the exercise counseling group is supported by a systematic review study of Bravata et al. [14], who show pedometer users significantly increased their physical activity by 2491 more steps/day than control participants (95% confidence interval 1098–3885 steps/day, $P = .001$). In our study the difference between the exercise counseling and usual care group is 2152 steps/day.

Sedentary COPD patients in the exercise counseling group show significant improvement of leg strength and arm strength. Apparently, enhancing daily activities provide an adequate training stimulus, at least in COPD patients with a decreased active lifestyle. The 6-min walking test improved by 26 m in the exercise counseling group, compared to 10 m in the usual care group. Both changes are below the minimal clinically relevant change. Nevertheless, we hypothesize that for the exercise counseling group the 6-min walking test will further improve if patients stick to their new lifestyle.

The question arises whether pedometer-based counseling programs should be used as an alternative to regular pulmonary rehabilitation programs, especially for COPD patients who cannot benefit from regular pulmonary rehabilitation due to budgetary restrictions. In our opinion, the benefits of an exercise counseling strategy are evident: it is our experience, also in other settings, that patients can incorporate the daily physical activities into their regular life; and different caregivers can be trained to give exercise counseling. Nevertheless, we realize that specific COPD patients, like those severely deconditioned, really need the multidisciplinary approach of a pulmonary rehabilitation program. We previously published a study in which we enhanced daily physical activity in COPD patients in pulmonary rehabilitation, using the same exercise counseling strategy. We showed that our exercise counseling strategy was feasible next to pulmonary rehabilitation

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Table 3
Daily physical activity (steps/day), physical fitness, health-related quality of life, fatigue, depression, self-efficacy and motivation to be physically active.

	Exercise counseling (n = 18)		Usual care (n = 17)		ANOVA	P	β	D
	Baseline mean (S.D.)	12 weeks mean (S.D.)	Baseline mean (S.D.)	12 weeks mean (S.D.)	F (d.f. 1.33)			
Daily physical activity								
Steps/day	7,087 (4,058)	7,872 (3,962)	7,539 (3,945)	6,172 (3,194)	8.80	.01	.82	.21
≤10.000 steps/day[a]	5,129 (2,537)	6,124 (2,535)	5,501 (2379)	4,684 (2,076)	9.01	.01	.82	.28
≥10.000 steps/day[b]	12,176 (2,416)	12,416 (3,423)	12,429 (2,085)	9,744 (2,520)	2.01	.19	.24	.20
Physical fitness								
Leg strength	11.9 (2.8)	13.3 (2.4)	11.4 (3.4)	10.9 (2.8)	9.35	.01	.81	.22
Arm strength	16.8 (3.8)	18.9 (4.9)	15.1 (3.7)	15.1 (4.4)	5.18	.03	.60	.14
Grip force	35.8 (9.4)	37.5 (10.3)	37.9 (13.1)	39.4 (12.9)	.42	.52	.40	.02
6-MWT	364.9 (45.1)	387.4 (46.6)	351.4 (54.5)	361.4 (66.6)	3.10	.09	.40	.09
Health related quality of life								
St. George's Respiratory Questionnaire								
Symptoms	53.7 (20.5)	43.4 (23.7)	49.8 (22.3)	50.7 (20.9)	3.21	.81	.41	.09
Activity	50.3 (16.0)	47.1 (14.9)	45.7 (28.0)	48.7 (22.5)	1.81	.18	.26	.05
Impacts	25.6 (13.0)	24.0 (14.7)	24.7 (16.4)	28.4 (15.9)	2.07	.16	.29	.06
Total	37.7 (12.4)	34.2 (13.5)	35.2 (18.7)	38.3 (16.8)	4.17	.05	.51	.11
Clinical COPD Questionnaire								
Symptoms	2.2 (1.1)	2.1 (1.4)	2.4 (1.5)	2.7 (1.1)	1.24	.27	.19	.04
Functional state	1.5 (0.6)	1.4 (0.6)	1.7 (1.1)	1.7 (1.1)	.38	.54	.09	.01
Mental state	0.5 (0.8)	0.4 (0.7)	0.8 (1.0)	0.7 (0.9)	.21	.64	.07	.01
Total	1.6 (0.6)	1.5 (0.8)	1.8 (1.2)	1.9 (0.9)	.13	.32	.16	.03
SF-36								
Physical functioning	23.6 (3.2)	24.4 (3.5)	23.1 (4.8)	23.3 (4.7)	.30	.58	.01	.08
Vitality	15.7 (3.9)	16.0 (2.2)	16.0 (4.1)	15.7 (4.5)	.15	.70	.01	.07
Bodily pain	50.9 (13.5)	48.5 (14.5)	5.4 (11.8)	51.8 (11.9)	.26	.61	.08	.01
General health	14.2 (4.3)	13.8 (2.9)	13.7 (4.4)	12.9 (3.0)	.12	.74	.06	.01
Change in health status	2.7 (0.8)	2.7 (0.6)	2.5 (0.7)	2.6 (0.7)	.32	.58	.08	.01
Social functioning	8.8 (1.2)	8.4 (1.8)	8.4 (2.0)	7.8 (1.9)	.37	.54	.09	.01
Physical functioning	6.1 (1.6)	6.8 (1.4)	6.2 (1.5)	6.2 (1.8)	1.84	.18	.26	.05
Emotional problems	5.7 (0.7)	5.5 (0.9)	5.2 (1.1)	5.7 (0.9)	2.76	.10	.37	.08
Mental health	24.9 (3.6)	24.6 (2.8)	24.2 (5.7)	24.7 (4.1)	.47	.50	.10	.02
Fatigue								
Dutch Exertion Fatigue Scale	2.7 (1.9)	1.8 (1.8)	3.4 (3.3)	3.2 (2.2)	1.78	.19	.25	.05
Depression								
Beck Depression Inventory	8.4 (5.2)	7.6 (3.9)	9.1 (8.3)	7.8 (7.2)	.07	.93	.01	.05
Self-efficacy								
LIVAS	29.8 (7.9)	31.0 (8.9)	28.4 (7.9)	28.5 (8.3)	.52	.47	.02	.11
Motivation								
Exercise Self-Regulation Questionnaire								
External regulation	3.4 (1.4)	1.9 (1.0)	1.6 (1.0)	1.5 (0.8)	1.71	.29	.18	.04
Introjected regulation	5.9 (1.0)	3.1 (1.2)	3.2 (1.6)	3.2 (1.3)	.38	.54	.09	.01
Identified regulation	4.8 (1.6)	6.0 (1.3)	5.6 (1.5)	5.8 (1.0)	.18	.67	.07	.01
Intrinsic motivation	1.6 (0.7)	5.5 (1.5)	5.4 (1.5)	5.0 (1.4)	9.21	.01	.83	.24
Relative autonomy index (total score)	8.9 (3.7)	10.3 (3.7)	10.0 (9.8)	5.7 (4.5)	2.61	.12	.35	.08

[a] Exercise counseling; n = 13, usual care; n = 12.
[b] Exercise counseling; n = 5, usual care; n = 5.

[26]. In our opinion, pulmonary rehabilitation and exercise counseling may act complementarily and synergistically.

5. Conclusion

Our study shows that a 12-week pedometer-based exercise counseling strategy is feasible and effectively enhances daily physical activity, physical fitness, health-related quality of life and intrinsic motivation in outclinic COPD patients.

5.1. Practice implications

Pedometers are simple in use, and the feasibility of the counseling program is good. Patients were motivated to participate in this study, and the dropout rate is low. The strengths of the study are the feasibility and effectiveness of the exercise counseling strategy in sedentary COPD patients. Especially the significant increase in daily physical activity and leg strength are amenities of this study. Limitation of the study is the lack of long-term follow-up.

Conflict of interest

Herewith we state that none of the authors had any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within 3 years of beginning the submitted work that could inappropriately influence, or be perceived to influence, their work.

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