Physical activity in hard-to-reach physically disabled people

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Short-term effects of Activity Coach+, a physical activity intervention in hard-to-reach physically disabled people: A feasibility study

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Submitted

7

Abstract

Objectives: Physically disabled people participate less in physical activity compared to healthy people. Existing interventions do not reach a considerable proportion of the targeted physically disabled people. Activity Coach+ stimulates physical activity in hard-to-reach physically disabled people. This study tested feasibility and short-term effects of Activity Coach+.
Setting: Municipality setting.
Participants: 21 physically disabled people.
Intervention: Activity Coach+ based on individual coaching and self-monitoring of behaviour.
Primary and secondary outcome measures: Feasibility of Activity Coach+ was described by reach, dropouts of the intervention, and compliance to the protocol. For testing short-term effects physical activity behaviour (primary outcome measure) was measured objectively (Activ8 accelerometer) and subjectively (adapted SQUASH questionnaire). Secondary outcome measures were health outcomes, evaluated as body mass index, waist circumference, systolic blood pressure, hand grip force, 10 metre walk test, 6 minute walk test and Berg Balance Scale. RAND-36, Exercise Self-Efficacy Scale, Fatigue Severity Scale and IMPACT-S measuring social participation were administered to evaluate bio psychosocial health. Activity Coach+ was evaluated at baseline, 2 and 4 months after baseline. Changes of primary- and secondary outcomes over time were analysed by Friedman tests.
Results: Activity Coach+ reached 29 hard-to-reach physically disabled people during the first four months, of whom two dropped out. Twenty-one participants volunteered in research. Different intervention components were adopted in 18 (86%) to 21 (100%) of the participants. Physical activity behaviour did not change after implementation of Activity Coach+. Body Mass Index (p=.004), 10 metre walk test (p=.001), 6 minute walk test (p=.020), dynamic balance (p=.014) and vitality (p=.049) increased over time after implementation of Activity Coach+. A relevant trend was found for the increase of hand grip force (p=.055).
Conclusion: Activity Coach+ was found feasible in a community setting. First indications for effectiveness of Activity Coach+ in hard-to-reach physically disabled people were provided.
Trial registration: NTR6858.

Strengths and limitations of this study

- Effects of Activity Coach+ were evaluated on bio-, psycho- and social health outcomes, rather than biomedical outcomes only, according to the current health perspective.
- Physical activity behaviour was objectively measured, using an accelerometer.
- Activity Coach+ was feasible for a heterogeneous population of physically disabled people, regarding age and (severity of) disability.
- Due to practical reasons the study design lacked a control group or multiple baseline measurements, whereby results of this study can theoretically not only be assigned to the implementation of Activity Coach+.

Introduction

Physical inactivity has a major burden on health, being the fourth leading cause of death worldwide. It is recently called pandemic[6,18,181]. Being physically active benefits health and functioning, not only in healthy people[8], but also in physically disabled people[23,182]. In physically disabled people, the amount of physical activity (PA) is positively related to bio-, psycho- and social aspects of health related quality of life[150]. However, physically disabled people participate substantially less in PA compared to healthy people[25,182].

Most existing PA-stimulating interventions for physically disabled people reach their participants via intermediate organisations as rehabilitation centres or schools for special education. However, a major part of the physically disabled population is hard-to-reach because they cannot be reached through these intermediate organisations. The limited reach of existing interventions might explain why PA participation did not increase despite the implementation of several interventions targeting the general physically disabled population[20]. Internationally, research on stimulating PA in physically disabled people is shifting from describing barriers and facilitators regarding PA, towards designing interventions to stimulate PA in this target population[29]. Although more than 80 exercise interventions for stimulating PA in physically disabled people exist internationally[24,33,34], most interventions are disease specific, time restricted, and stimulate participants to perform a specific mode of exercise, rather than to participate in PA in general or adopt an active lifestyle. To induce long term behavioural changes, lifestyle PA interventions are preferred rather than exercise interventions in physically disabled people[24]. Literature describes a need for designing and evaluating community interventions to stimulate active lifestyle adoption and PA participation, that serve broader populations, instead of disease specific interventions[24,29,183].

In our earlier studies, Intervention Mapping was used for the systematic development of a new intervention, to stimulate PA in hard-to-reach physically disabled people, that can be applied in a community setting[184]. By following the procedure of Intervention Mapping, both professionals and physically disabled people were involved in intervention development, ensuring co-creation[125,152]. Intervention development resulted in adapting an existing Dutch intervention 'Activity Coach' (Dutch: Beweegcoach) into the new intervention 'Activity Coach+' (Dutch: Beweegcoach+)[164,184]. The current study aims to test the feasibility and short-term effects of Activity Coach+ for stimulating PA in hard-to-reach physically disabled people, on PA behaviour and bio-, psycho- and social health.

Methods

Intervention

Activity Coach+ aimed to stimulate organised PA, non-organised PA and PA during activities of daily living. Within Activity Coach+, participants were recruited via a network of various intermediate organisations from social, medical and sports background. Moreover, flyers and local newspapers were used for recruiting participants (figure 1). An activity coach individually coached participants towards adoption of a more active lifestyle. First participants had a physiotherapeutic intake at a local physiotherapist. The intake included history taking and physical assessment. The intake aimed to improve confidence of the participant, and to let the activity coach get an idea about activities that are suitable for the participant. Second, in a consultation between the participant and the activity coach, barriers regarding PA participation were discussed. The activity coach guided the participant to either participation in organised PA by informing about local opportunities for PA, participation in non-organised PA by matching participants, or improved PA during activities of daily living by monitoring daily PA using an activity tracker (Fitbit Zip). Participants were counselled by the activity coach after 2 (phone call), 4 (physical meeting), 6 (phone call), and 12 months (physical meeting) (figure 1)[184].

Participants

Activity Coach+ targeted adults with a physical disability or chronic disease that impairs movement. Participants of the intervention were at least one year post-rehabilitation, or not familiar with rehabilitation, in order to prevent overlap with an existing intervention during and directly after inpatient rehabilitation[36]. Participants of Activity Coach+ were asked to voluntarily participate in research by the activity coach during the first phone contact.

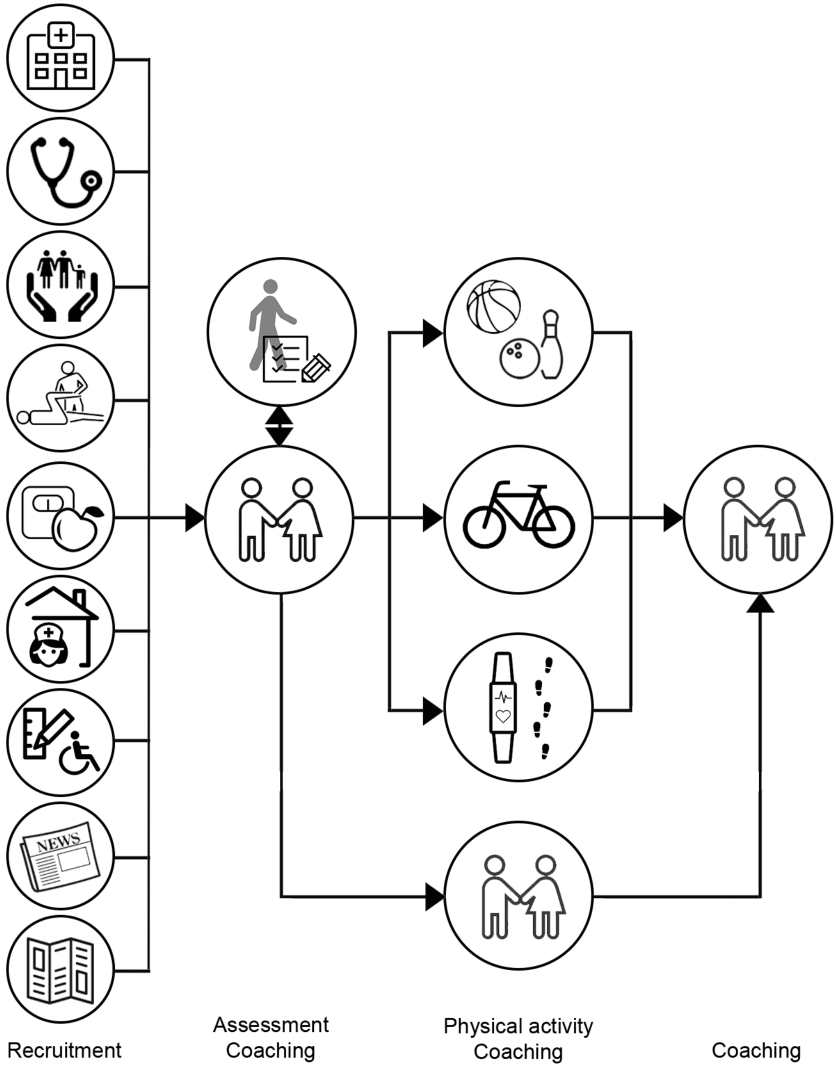

Figure 1: Schematic overview of Activity Coach+

Data collection

Feasibility of Activity Coach+ was operationalised as number of participants, number of dropouts and compliance with the protocol. Activity coaches were asked to report their contact moments for each participant. Per participant it was reported whether the physiotherapeutic assessment, face-to-face intake with the activity coach, and phone-based counselling sessions at 2 and 4 months took place, whether the activity tracker was used, and eventually whether additional contacts took place.

In this study effects of Activity Coach+ on PA behaviour and health outcomes were investigated using a longitudinal study design with three measurement occasions, without a control group. Measurements were performed at baseline (during physiotherapeutic intake, T0), 2 (T1) and 4 (T2) months after physiotherapeutic intake, which was considered as the start of the intervention. Measurements after 2 and 4 months were performed at participants' homes. For practical reasons, maximum two weeks of deviation were allowed between the measurement and scheduled date. During each measurement occasion, three types of measurements were performed; objective measurement of PA, physical assessment, and questionnaires. Measurement procedures for all tests have been described in detail[184].

Objective measurement of PA

Daily PA was objectively measured using the Activ8 (2M Engineering, Valkenswaard, The Netherlands), a tri-axis accelerometer[175]. The Activ8 was attached to the ventral side of the thigh (at 10 cm from proximal). Activ8 determines the time spend on lying, standing, walking, running and cycling based on the orientation (horizontal or vertical) and movement intensity (vector magnitude, expressed in counts) of the thigh. Activity classification was done at 2.56Hz and output was summed and stored over a 15 seconds interval (Epoch length).

The Activ8 was worn for 7 consecutive days, except when swimming. Participants recorded bed- and wake-up time in a diary. The Activ8 output files and digitalised diaries were analysed using Matlab (R2016b, The Mathworks Inc., Natrick, MA, USA). Wear time per day was defined as minutes that the device was worn, and was retrieved from the diary. Time per activity per day was calculated as absolute time (minutes) and as percentage time (absolute time divided by total wear time * 100%). Daily PA was expressed as percentage of time spend active, intensity of behaviour, average number of active bouts, and mean duration of active bouts.

Percentage of time spend active was calculated by summing percentage of time spend walking, running and cycling. Intensity of behaviour was expressed in counts/min, and calculated as the sum of counts divided by total wear time (min). One minute intervals (sum of four 15 seconds intervals) were identified as either active (≥80% of time spend on walking, running or cycling), sedentary (≥90% of time spend on sitting or lying), or neutral (time intervals that were neither active nor sedentary). Periods of active intervals, interrupted by neutral intervals of maximum 1 minute, of which at least 70% of the total bout duration consisted of walking, running or cycling were defined as active bouts. For each participant, outcomes were averaged over the number of analysed days.

Physical assessment

Body Mass Index (BMI) and waist circumference were measured as indicators of body composition. Blood pressure was measured using an Omron M3 automatic blood pressure system (Omron Healthcare, Kyoto, Japan). Hand grip force was measured using a dynamometer and E-link software (Biometrics Ltd, Gwent, United Kingdom). Contrary to what we described earlier[184], hand grip force was presented as the maximum of the strongest hand, to allow comparison with values for clinical relevance, as found in earlier research[185]. Walking ability was measured using the 10 metre walk test, and exercise capacity was measured using the 6 minute walk test[170,171,186]. Walking aids were used when needed during both walking tests. Dynamic balance was measured using the Berg Balance Scale[173].

Questionnaires

A set of questionnaires was completed in the same week as the physical assessment, and returned by post. Health Related Quality of Life was measured using the RAND-36[50]. Fatigue was measured using the Fatigue Severity Scale[165]. Self-efficacy towards PA was measured using the Exercise Self-Efficacy Scale (ESES)[166]. Social participation was measured using the ICF Measure of Participation and ACTivities Screener (IMPACT-S)[167]. Daily PA and sedentary behaviour were measured using the adapted Short Questionnaire to Assess Health enhancing physical activity (SQUASH)[168]. The abovementioned tests and questionnaires were found reliable and valid for specific sub populations of the physically disabled population, in earlier research (appendix 2)[166–168,171,174,186–188].

Data analyses

Data of objective PA monitoring were only used for analyses if the device had been worn for at least 11 hours a day, for at least four days. Since data was non-normally distributed, boxplots were made to present data at three measurement occasions. Longitudinal progression of the outcome parameters over time was analysed using non-parametric Friedman tests (SPSS 20.1, IBM, New York, NY, USA). For all tests of significance, α was set at 5%.

Results

Within the first four months after implementation of Activity Coach+ (March 30, 2017), 29 physically disabled people enrolled. Twenty-three participants of the intervention participated in this study (6 participants on the intervention declined to participate in research), but two participants stopped the intervention within four months, because of a severe progression of arthritis and psychosocial problems respectively. Characteristics of the 21 participants included for analyses, suffering from various physical disabilities or chronic diseases, are presented in table 1. Participants had been recruited via local newspapers (n=5), general practitioners (n=6), domestic care (n=6), physiotherapists (n=2) and social work (n=2).

All 21 participants underwent physiotherapeutic assessment and face-to-face intake with the activity coach. Twenty participants received counselling session at 2 months, of whom 6 by phone and 14 face-to-face. Nineteen participants received counselling session at 4 months, of whom 8 by phone and 11 face-to-face. Eighteen participants used the activity tracker, whereas 3 did not. Fifteen participants had additional contacts with the coach (1 – 7 contacts including phone calls).

Table 1: Characteristics of the participants (*n*=21)

Age (years; mean ± SD)	60.3 ± 13.1
Gender (male / female)	8 / 13
Diagnosis (n) [a]	
Cerebral Vascular Accident	2
Other brain injury	3
Multiple Sclerosis	1
Diabetes	2
Cardiopulmonary diseases	5
Oncology (chronic)	1
Orthopaedic injury	2
Chronic pain	3
Rheumatoid Arthritis	2

[a] If participants suffered from more than one diagnosis, the diagnosis that influenced daily activities most was reported.

On average, 13.2% of all measurements were missing. Measurements were missing because of inability to complete the questionnaires due to cognitive decline (2.2%), physical status (0.8%), holidays (1.6%), incorrect measurements (1.8%), weather conditions (measurements took place at home, and walk tests were performed outside because of space needed and walk tests could not be performed during heavy rainfall) (0.2%), refraining from wearing the objective PA monitoring during one week (1.5%), and unknown reasons (5.1%). Since too many diaries were incomplete, outcomes of objective measurement of PA were reported per 24 hours, instead of per waking time. On average 1425 minutes (23 hours and 45 minutes) were analysed per day. Measurements included 6.8 days on average.

7

PA behaviour did not change significantly over time (figure 2). BMI (x^2=11.217 (2), *p*=.004), 10 metre walk test (x^2=13.119 (2), *p*=.001), 6 minute walk test (x^2=7.860 (2), *p*=.020) and dynamic balance (x^2=8.600 (2), *p*=.014) significantly increased over time (figure 3). Vitality (RAND-36) significantly increased over time (x^2=6.035 (2), *p*=.049) (figure 4)

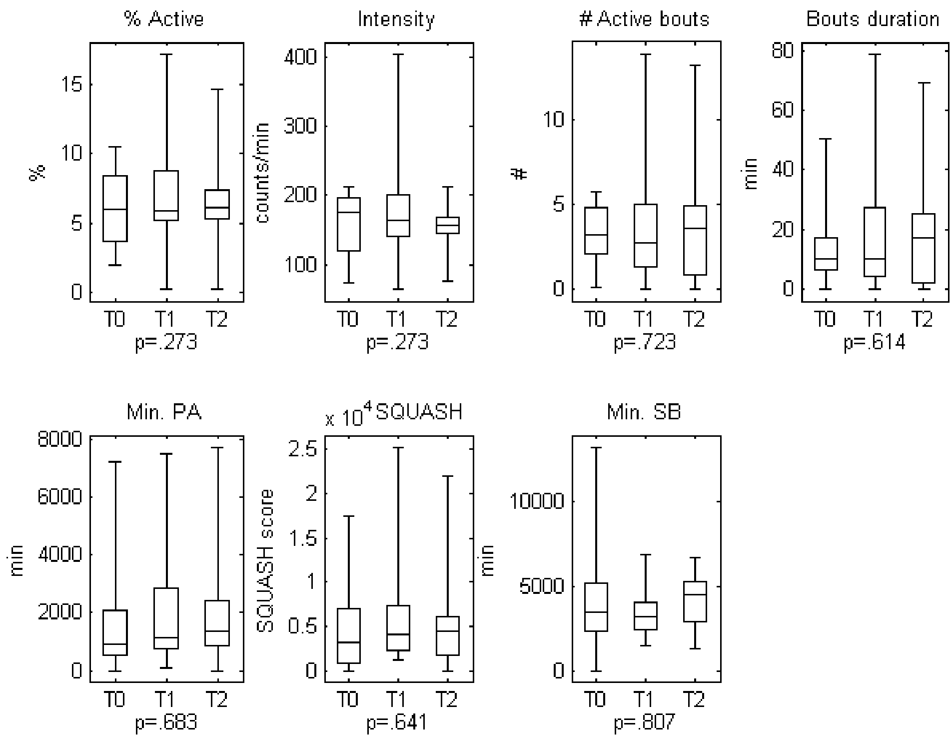

Figure 2: Boxplots showing median value, range and interquartile range of outcomes on physical activity behaviour at T0, T1 and T2. % Active = percentage of the day spend active; Intensity = average intensity of activities throughout the day (counts/min); # Active bouts = average number of active bouts per day; Bouts duration = total duration of active bouts per day; Min. PA = self-reported minutes of physical activity per week; SQUASH = physical activity score reported by the SQUASH questionnaire; Min. SB = self-reported minutes of sedentary behaviour per week; *p* = *p*-value from Friedman test. This figure reports all available cases, statistical analyses are performed on complete cases only.

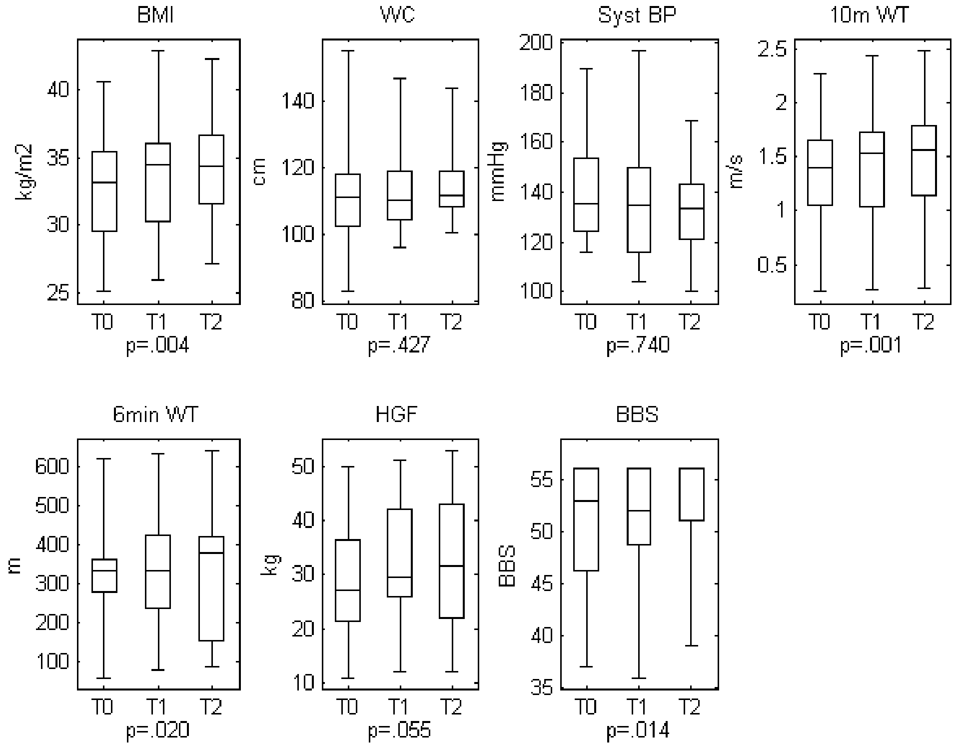

Figure 3: Boxplots showing median value, range and interquartile range of outcomes on field tests at T0, T1 and T2. BMI = body mass index (kg/m^2); WC = waist circumference (cm); Syst BP = systolic blood pressure (mmHg); 10m WT = walking ability measured using the 10 metre walk test; 6min WT = exercise capacity measured using the 6 minute walk test; HGF = hand grip force of the strongest hand (kg); BBS = dynamic balance measured using the Berg Balance Scale; *p* = *p*-value from Friedman test. This figure reports all available cases, statistical analyses are performed on complete cases only.

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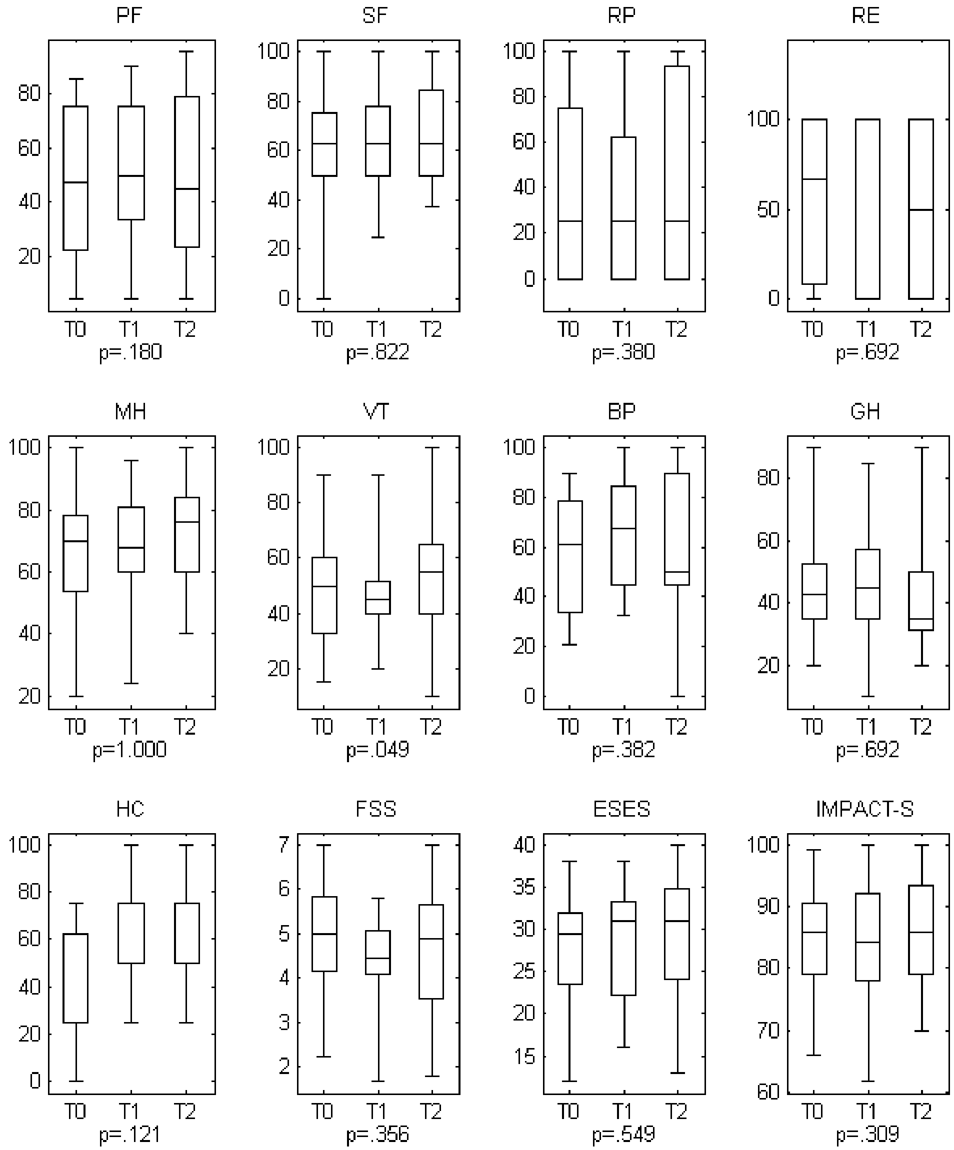

Figure 4: Boxplots showing median value, range and interquartile range of outcomes on questionnaires at T0, T1 and T2. PF = physical functioning (RAND-36); SF = social functioning (RAND-36); RP = role limitations physical (RAND-36); RE = role limitations emotional (RAND-36); MH = mental health (RAND-36); VT = vitality (RAND-36); BP = bodily pain (RAND-36); GH = general health (RAND-36); HC = health change (RAND-36); FSS = fatigue severity scale; ESES = exercise self-efficacy scale; IMPACT-S = ICF Measure of Participation and ACTivities Screener measuring social participation; *p* = *p*-value from Friedman test. This figure reports all available cases, statistical analyses are performed on complete cases only.

Discussion

The aim of the current study was to test feasibility and short-term effects of Activity Coach+ for stimulating PA in hard-to-reach physically disabled people, on PA behaviour and bio-, psycho- and social aspects of health. Within the first four months, 29 physically disabled people enrolled in Activity Coach+, 23 participated in this study and two dropped out. Different intervention components were applied in 18 (86%) to 21 (100%) of the participants. Significant changes of BMI, walking ability (10m walk test), exercise capacity (6min walk test), dynamic balance (berg balance scale) and vitality (RAND-36) were found over time after implementation of Activity Coach+. No significant change in PA behaviour over time was found.

Activity Coach+ was able to reach a hard-to-reach physically disabled population. Twenty-nine people enrolled and two dropped out, implying that Activity Coach+ is feasible for a heterogeneous population. Adoption of the different intervention components was relatively high but more than half of the coaching sessions after 2 and 4 months were face-to-face, rather than by phone (which was according to intervention design). According to the activity coaches, practical reasons induced this adaptation. Face-to-face sessions might be more time intensive, what should be taken into account for future intervention planning. Since the programme of Activity Coach+ is individually tailored, Activity Coach+ is also feasible when severity of disability changes, for instance due to comorbidities.

After implementation of Activity Coach+, PA behaviour did not change, neither when objectively measured using the Activ8 accelerometer, nor when assessed using the adapted SQUASH questionnaire (figure 2). Although not significant, median percentage of active time increased from 5.0% at the start of the intervention, to 6.1% after 4 months, meaning that median time spend moderate or vigorously active increased by 17 minutes per day. Earlier research has shown that interventions based on behavioural change techniques, and that apply self-monitoring of behaviour, as included in Activity Coach+, are more likely to be effective in improving PA behaviour[189–191].

Results of the current study showed an increase of BMI, walking ability, exercise capacity, dynamic balance and vitality over time after implementation of Activity Coach+. Since lower BMI indicates better health in this population having a too high BMI on average, the increase of BMI was not desired. The increased BMI might be caused by seasonal influences, and by an increase of muscle mass[192]. Since all participants started the intervention between March and August, measurements after four months took place between July and January. Future research will study long-term effects of the intervention, whereby seasonal influences can be further explored. Median value for walking ability, measured using the 10m walk test, increased by .17 m/s, between the start of the intervention and after 4 months. In elderly suffering from Parkinson's disease, an increase of .23 m/s was found clinically relevant, meaning that the increase of walking ability found in this study may not be clinically relevant[193]. Median value for exercise capacity, measured using the 6 minute walk test, increased by 58 metre between the start of the intervention and after 4 months. Minimum clinically important differences for 6 minute walk test ranged from 23.5 metre for chronic obstructive pulmonary disease patients to 82 metres for fibromyalgia patients[63,194]. It can be debated whether the increase found in this study is clinically relevant or not. Median value for dynamic balance, measured using the Berg Balance Scale, increased by 3 points between the start of the intervention and after 4 months. An increase of 2 points was found relevant in outpatients with Multiple Sclerosis[195]. This means that the significant increase of dynamic balance is probably also clinically relevant. Median value for vitality, measured using the RAND-36, increased by 5 points between the start of the intervention and after 4 months. In chronic cardiopulmonary disease patients, clinical important difference for the SF-36 vitality scale was 12.5 points, meaning that the increase of vitality in this study was not clinically relevant[196]. Although not significant, a trend was seen for the increase of hand grip force, which increased by 4.3 kg between the start of the intervention and after 4 months. An increase of 3.4 kg was relevant in chronic kidney disease patients. Compared to this reference value for clinical relevance the increase, seen within the first four months, is clinically relevant[185]. The values for minimum clinically relevant changes are based on specific sub populations of the population of Activity Coach+ and are relatively high compared to the baseline level of the health outcomes. In this relatively inactive target population smaller changes might be relevant at an individual level.

The finding that participants' PA did not improve, but functional outcomes did improve, may be caused by the curvilinear relationship between the amount of PA and health. In inactive people, a small increase of PA can lead to substantial health benefit[8]. Moreover, PA was only measured as total PA. Several participants started to participate in activities, for instance exercise groups for elderly, mainly focussed on improving balance and muscle strength. The finding that total PA did not changed despite participants started participating in new activities, might be caused by a decrease of transport-related PA or household-related PA.

In practice it is an advantage, when community interventions can serve broad populations, because of the relatively low number of people having a specific diagnosis, in community. However, for research this heterogeneity of the target population can have its downside, for instance on the choice of outcome measures. For measuring dynamic balance, in the current study the Berg Balance Scale was used because of its discriminative power for people with impaired balance. However, due to the heterogeneity among participants, some participants did not encounter impaired balance causing ceiling effects (figure 3).

The current study design is limited by lack of a control group. Due to the heterogeneity among participants, of whom a lot suffered from multiple diagnoses, it was practically unfeasible to include a control group that was matched on diagnoses and age. Practical reasons did also not allow for multiple baseline measures, as for instance used in an interrupted time series design. The absence of a control group or multiple baseline measures, makes it theoretically impossible to assign changes over time solely to the implementation of the intervention. Median value of the health change outcome of the RAND-36 however showed that the perception on health status compared to one year before, improved by 25 points after implementation of Activity Coach+. At baseline, the majority of participants rated their health status as somewhat worse or equal to one year ago, whereas participants rated their health status as equal or somewhat better than one year ago at four months after starting the intervention. Although not significant, and health change being a subjective measure, this improvement is illustrative, because it is the only measurement that compares the actual situation with that of a longer period ago. The pilot intervention was implemented in a region with relatively low socioeconomic status[197]. People with lower socioeconomic status are at higher risk of having chronic diseases, as diabetes, and being physically inactive[198,199]. It is suggested that results of this study are generalisable to regions with higher socioeconomic status, since Activity Coach+ is based on individual coaching, whereby it can be tailored to the individual.

Objective monitoring of daily PA behaviour was one of the strengths of the current study. The research agenda for PA stimulation in physically disabled people describes a need towards objective PA monitoring for evaluating interventions[24,33]. Moreover, the current study investigated intervention effects on bio-, psycho- and social health outcomes, which complies to the current multidimensional view on health[1]. Finally, the heterogeneity of the study population was one of the strengths of this study, since the current study showed that the intervention Activity Coach+ was feasible for this group.

Future research should focus on studying the effectiveness of Activity Coach+ over a longer time period, in order to study sustainability of the health effects and trends found in this study. Moreover, experiences with the intervention and implementation process should be investigated, in order to further develop Activity Coach+, to enable daily use in the community-setting.

Conclusion

In conclusion, the implementation of Activity Coach+ in a community setting was feasible. Activity Coach+ was able to reach hard-to-reach physically disabled people, only few participants dropped out, and compliance to the protocol was high. The amount of daily PA did not change during the first four months after implementation of Activity Coach. BMI, walking ability, exercise capacity, dynamic balance and vitality increased during the first four months in participants of Activity Coach+. The increase of dynamic balance and hand grip force was clinically relevant, clinical relevance of the increase of exercise capacity was questionable. Although future research considering long term results is needed, the current study provides first indications of the health effects of Activity Coach+ in hard-to-reach physically disabled people.

Appendix 1: Overview of test statistics

	T0	T1	T2			
	Median (IQR)	Median (IQR)	Median (IQR)	x^2	df	*p*-value
Physical activity behaviour						
Time active (%)	5.94 (3.60 – 8.44)	5.90 (5.01 – 9.40)	6.13 (5.29 – 7.44)	2.600	2	.273
Intensity of behaviour (counts/min)	176 (117 – 200)	165 (140 – 203)	158 (142 – 175)	2.600	2	.273
Active bouts (#)	3.17 (1.57 – 4.86)	2.71 (1.29 – 5.43)	3.55 (0.72 – 5.25)	.649	2	.723
Duration of active bouts (min)	10.0 (5.5 – 17.7)	10.0 (4.1 – 28.7)	17.2 (1.7 – 26.2)	.974	2	.614
Physical activity (min)	900 (463 – 2106)	1153 (670 – 2894)	1350 (803 – 2399)	.764	2	.683
SQUASH score	3165 (690 – 6900)	4005 (2100 – 7868)	4425 (1729 – 6221)	.899	2	.641
Sedentary behaviour (min) [a]	3450 (2265 – 5150)	3165 (2378 – 4313)	4530 (2625 – 5355)	.429	2	.807
Field tests						
Body mass index (kg/m^2) [a]	33.2 (29.4 – 35.7)	34.5 (30.2 – 36.2)	34.4 (31.5 – 36.8)	11.217	2	.004
Waist circumference (cm) [a]	111.0 (102.0 – 118.5)	110.0 (104.3 – 119.3)	111.5 (107.9 – 119.0)	1.701	2	.427
Systolic blood pressure (mmHg) [a]	136 (124 – 155)	135 (115 – 150)	134 (121 – 145)	.603	2	.740
Walking ability (m/s)	1.40 (1.04 – 1.66)	1.53 (1.04 – 1.76)	1.57 (1.12 – 1.80)	13.119	2	.001
Exercise capacity (m)	335 (248 – 375)	332 (235 – 426)	381 (150 – 426)	7.860	2	.020
Hand grip force (kg)	27.2 (21.3 – 37.3)	29.7 (25.6 – 42.2)	31.5 (21.6 – 45.1)	5.815	2	.055
Dynamic balance	53 (46 – 56)	52 (48 – 56)	56 (51 – 56)	8.600	2	.014

Appendix 1 (continuation)

	T0	T1	T2			
	Median (IQR)	Median (IQR)	Median (IQR)	x^2	df	*p*-value
Questionnaires						
RAND-36 – Physical functioning	47.5 (21.3 – 75.0)	50.0 (32.5 – 75.0)	45.0 (20.0 - 80.0)	3.433	2	.180
RAND-36 – Social functioning	62.5 (50.0 – 75.0)	62.5 (50.0 – 81.3)	62.5 (50.0 – 87.2)	.391	2	.822
RAND-36 – Role limitations physical	25.0 (0.0 – 75.0)	25.0 (0.0 – 75.0)	25.0 (0.0 – 100.0)	1.938	2	.380
RAND-36 – Role limitations emotional	66.7 (0.0 – 100.0)	100.0 (0.0 – 100.0)	50.0 (0.0 – 100.0)	.737	2	.692
RAND-36 – Mental health	70.0 (53.0 – 79.0)	58.0 (60.0 – 82.0)	76.0 (60.0 – 84.0)	.000	2	1.000
RAND-36 – Bodily pain	61.2 (33.2 – 79.1)	67.4 (44.9 – 89.8)	50.0 (44.9 – 89.8)	1.926	2	.382
RAND-36 – General health	42.5 (35.0 – 53.8)	45.0 (35.0 – 60.0)	35.0 (30.0 – 50.0)	.737	2	.692
RAND-36 – Health change	25.0 (25.0 – 68.8)	50.0 (50.0 – 75.0)	50.0 (50.0 – 75.0)	4.227	2	.121
Fatigue Severity Scale [a]	5.0 (4.1 – 5.9)	4.4 (4.1 – 5.1)	4.9 (3.4 – 5.8)	2.066	2	.356
Exercise Self-efficacy Scale	29.5 (23.3 – 32.5)	31.0 (21.5 – 33.5)	31.0 (23.0 – 35.5)	1.200	2	.549
IMPACT-S	85.9 (78.1 – 90.6)	84.4 (77.7 – 92.6)	85.9 (79.0 – 93.8)	2.351	2	.309

Notes: [a] lower score indicates a better score

7

Appendix 2: Reliability and validity of the tests and questionnaires used

	Population	Reliability	Validity
10 metre walk test	Neurological patients [186]	Test-retest: ICC = .81 - .99	Barthel index: *r* = -.78
6 minute walk test	Neurological patients [186]	Test-retest: ICC = .74 - .97	Gait speed: *r* = .89
	Cardiac patients [171]	Test-retest: ICC = .97	Peak oxygen uptake: *r* = .56
Berg Balance Scale	Stroke patients [174]	Test-retest: ICC = .95 - .98	Barthel index: *r* = .80 - .94
RAND-36	Diverse post-rehabilitation patients [187]	Test-retest: ICC = .71 - .88	-
Fatigue Severity Scale	Multiple Sclerosis patients [188]	Internal consistency: Cronbach's α = .95	Multiple Sclerosis Impact Scale: *r* = .69
Exercise Self-Efficacy Scale	Spinal Cord Injury patients [166]	Test-retest: ICC = .81	General self-efficacy scale: *r* = .52 - .66
IMPACT-S	Road accident patients [167]	Test-retest: ICC = .94	WHODAS: *r* = .88
SQUASH (total minutes)	General physically disabled population [168]	Test-retest: ICC = .60	Actiheart accelerometer: *r* = .29