

1 **A randomized controlled trial on the effects of a 6-month home-based physical activity**
2 **program with individual goal-setting and volunteer mentors on physical activity, adherence**
3 **and physical fitness in inactive older adults at risk of cognitive decline: The INDIGO Study**

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18

1 **Abstract**

2 **Background:**

3 Increasing physical activity (PA) in those who have memory concerns requires innovative
4 approaches.

5 **Objective:**

6 To compare in this randomized controlled trial (RCT) the effects on PA, adherence and fitness of
7 two approaches to deliver a 6-month home-based PA program in older, inactive individuals at risk
8 of cognitive decline.

9 **Methods:**

10 Individuals (n = 52) aged 60-85 years, inactive with mild cognitive impairment or subjective
11 cognitive decline were recruited from the community and memory clinics. Randomization was to 6-
12 months of 150 minutes/week moderate intensity PA with either: goal-setting with mentor support;
13 or education and peer contact. A subset of participants (n = 36) continued for a further 6 months.
14 PA , moderate and vigorous PA and secondary outcomes, fitness, goal performance/satisfaction
15 and self-efficacy were assessed at baseline, 6 and 12 months. Modelling of primary and
16 secondary outcomes was conducted with linear mixed models.

17 **Results:**

18 Participants were mean age (\pm sd) 70.1 (6.4) years. Six-month retention was 88.5% (n = 46). No
19 significant between-group differences were observed for PA or fitness. Post-hoc combined group
20 data showed a significant, moderate-large effect size increase in PA with time. PA increased by a
21 mean 1,662 (943, 2383) steps/day (95% CI) and 1,320 (603, 2037) steps/day at 6 and 12 months
22 ($p < 0.001$).

23 Median (quartiles Q1-Q3) 6 and 6-12 month combined group adherence was 88.9 (74.4 - 95.7)%
24 and 84.6 (73.9 – 95.4)% respectively.

25 **Conclusion:**

1 In this target group, no differences were detected between groups both intervention strategies
2 were highly effective in increasing PA and fitness.

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4 **WORD COUNT:250**

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1 BACKGROUND

2 Even though the benefits of regular physical activity (PA) are well known and supported by a
3 growing body of evidence that PA is beneficial for cognitive health [1], finding effective strategies to
4 increase the adoption and maintenance of PA for older and inactive individuals is an ongoing
5 significant challenge. Much more complex challenges are present when older people have
6 difficulties with memory loss or declining cognitive function that may limit understanding of
7 instructions and execution of tasks, [2, 3] as well as motivation and capacity to change behaviour,
8 while often experiencing decline in physical function such as poor fitness, strength and balance [4,
9 5].. In our previous work we have been successful in achieving excellent adherence to home-
10 based PA over 6 months [6, 7] and 24 months [8] for older adults with mild cognitive impairment
11 (MCI) or subjective cognitive decline (SCD) at increased risk of Alzheimer's disease (AD).
12 However, these studies included participants who were already undertaking regular moderate
13 intensity PA. In the current study, we explore whether a modified PA program can lead to the
14 uptake and the adoption of PA in physically inactive individuals in this target group.

15 Goal-setting is an effective strategy to increase PA in older adults [9, 10]. Personalized goal-
16 setting was rated as a highly positive intervention strategy by participants who were successful in
17 improving their PA profile [11]. The efficacy of an individual goal-oriented approach to behavior
18 change has been demonstrated in community living older adults and in those with mild dementia,
19 with improved goal performance and satisfaction, increased physical and cognitive activity,
20 feasibility and acceptability by older adults [12, 13, 14]. Further, individual goal-oriented cognitive
21 rehabilitation (CR) improved everyday functioning in relation to individual goals targeted in the
22 therapy for people with mild-to-moderate dementia [14]. When mentoring was added to this goal
23 orientation approach there were further benefits in PA, global cognition, memory and body
24 composition compared to goal-setting alone [13]. Mentorship motivated people to work on goals
25 and was well received [15].

26 Peer mentoring in older adults is as effective in achieving retention, participation and increases in
27 fitness as a similar program delivered by young professionals [16]. When peer mentors are

1 volunteers this approach has the potential to be a cost-effective delivery model to increase PA
2 among older adults [16]. Significantly greater long-term increases in moderate and vigorous PA
3 were achieved with peer-delivered PA compared to community delivered PA programs [17]. In a
4 systematic review of 10 studies on peer-delivered interventions the authors concluded that
5 compared to other programs peer delivery was just as effective as professional delivery and more
6 effective than control programs in increasing PA [18].

7 Combining the strategies of an individual goal-oriented approach developed by Clare and
8 colleagues [12,14], modified to target PA and physical function (PF) goals, with support from
9 physically active peers to promote increased PA in inactive older adults at risk of cognitive decline
10 is a novel approach. To our knowledge, this is the first study to utilize peer mentoring to promote
11 PA in this target group. The primary aim of this randomized controlled trial (RCT) was to determine
12 if a 6-month home-based PA intervention with individual goal-setting and peer mentors
13 (intervention group) would result in a significantly greater increase in PA compared to the same PA
14 program delivered with standard education and peer contact only (control group) after 6 (short-
15 term) and 12 months (long-term). The long-term effects of this intervention were assessed from a
16 sub-group of participants after 12 months. Secondary aims included evaluation of functional
17 fitness, goal performance, goal satisfaction and program factors at 6 and 12 months. Further, to
18 explore the factors that influence the change in the primary and secondary outcomes.

19

20 **METHODS**

21 ***Study Design***

22 The protocol for this parallel group single-blind RCT based on CONSORT guidelines (Figure 1) has
23 been previously published [19]. The study was registered with the Australia New Zealand Clinical
24 Trials Registry registration number ACTRN12613001181796. The trial had two components;
25 mentoring/peer contact training and implementation, and a PA intervention. The main outcomes of
26 the intervention were the change in PA and adherence to the PA program for participants in the PA
27 intervention. Secondary outcomes included functional fitness components, goal performance, goal

1 satisfaction, self-efficacy and program evaluation. The original protocol was for a 6-month PA
2 intervention with a further 6-months follow-up. Due to recruitment challenges and funding
3 restrictions, the protocol was amended with the trial period limited to 6 months after the first 36
4 participants. Another 16 participants were recruited for the 6-month intervention period only (the 6-
5 month cohort). Hence a total of 52, participated in the 6-month intervention with a subset (n = 36)
6 following the original protocol with a further 6-month follow-up (the 12-month cohort). These
7 participants were asked to continue with their PA program during the 6-12 month period recording
8 sessions in their PA diaries but without any of the support given in the first 6 months such as
9 workshops or phone calls. Table 1 outlines the components of the intervention and control group
10 programs and highlights the similarities and differences. The methods relevant to this paper are
11 described briefly below.

12 ***Participants***

13 Participants were independent-living older adults aged 60-85 years with memory concerns
14 (without diagnosed dementia) and inactive (doing <60 minutes of moderate or vigorous
15 intensity leisure activity a week) [20] with total minutes calculated from screening
16 questions that asked about PA type, duration, frequency and intensity.. Screening was
17 completed via telephone and also included: the Telephone Interview for Cognitive Status –
18 Modified (TICS-M) [21], Geriatric Depression Scale 15 (GDS-15) [22] and Revised
19 Physical Activity Readiness Questionnaire (PAR-Q) [23]. Participants were included if they
20 answered “Yes” to the question “Do you have any difficulty with your memory?” They were
21 considered to have subjective cognitive decline (SCD) if they scored in the range of normal
22 control group scores for their age and sex on the Cognitive Battery of the Consortium to
23 Establish a Registry for Alzheimer’s Disease (CERAD) [24]. In addition to a “Yes”
24 response to the above question participants who scored below the normal range on the
25 cognitive measure (CERAD) were defined as having MCI.

1 Exclusion criteria were: scoring less than 19 out of 50 on the TICS-M [21]; more than 5 on the
2 GDS-15; diagnosis of dementia; a Mini-Mental State Examination score (MMSE) < 24 [25];
3 unstable or life-threatening medical condition; medical condition contra-indicating moderate PA;
4 Body Mass Index (BMI) > 37; severe visual or hearing impairment; history of chronic alcohol abuse
5 within the past five years; not fluent in English and inability to attend follow-up visits. Classification
6 of dementia reflected a score of <24 on the SMMSE or a TICS-M score of <19. Classification was
7 overseen by a diagnostic group led by a psychiatrist that considered functioning in addition to
8 cognition. The participant's primary care doctor was asked to approve participation.

9 Participants were recruited from the Melbourne metropolitan area via web sites and newsletters,
10 memory clinics, seniors' groups and the media. The participants gave informed written consent to
11 participate and the Melbourne Health Human Research Ethics Committee approved the trial. The
12 study took place at the National Ageing Research Institute, Parkville, Australia.

13 ***The Physical Activity Intervention***

14 Both groups received the same program of 150 minutes of moderate intensity PA per week
15 completed as 3 x 50-minute sessions or 5 x 30-minute sessions to allow for preference and
16 flexibility to fit in with the participant's routine. The program was progressive, taking up to 8 weeks
17 to reach the full duration of the sessions and moderate intensity (55-65% heart rate reserve).
18 Intensity was monitored using the Borg Perceived Rate of Exertion scale (RPE 10-12) [26]. All
19 participants were given a manual containing the same information about progressive walking,
20 water walking, swimming and cycling programs and exercise safety. The manual also included an
21 individualized PA program with standardized diaries to record their PA. Diaries were returned
22 monthly by prepaid post. The program was home-based and unsupervised with monitoring via the
23 phone calls and diaries. Details of the program and demonstration of the PA including the
24 frequency, intensity and recording details of the PA in the diaries was outlined in the first face to
25 face workshop session by the same PA facilitator. The manual for the intervention group also
26 included information on the goal setting. The control group were given copies of the
27 workshop slide presentations on the standard education topics.

1 ***Goal-Orientated PA and Mentoring Intervention Group***

2 The objective of the Goal oriented PA program was to enhance PA self-efficacy and increase PA.
3 The Bangor Goal-Setting Interview (BGSi) [27] modified for use in INDIGO to focus specifically
4 on PA was employed for individual goal identification and goal setting. The interview conducted
5 by the same experienced PA facilitator focused on the 5 individual goals from the PA and PF
6 areas identified in the baseline BGSi. Participants selected 3 personal goals to operationalize and
7 work on during the intervention period. The intervention group's resource manual also included
8 information on setting SMART goals, the development of strategies to achieve behavior change,
9 practical aids and action plans to facilitate goal performance.

10 *Intervention Group Workshops*

11 The program content was delivered over the first 6 months via 3 face to face workshops
12 conducted by the PA facilitator and supported by the mentoring program.

13 The first workshop also attended by mentors was for 2 hours, with the content of the first hour
14 outlining the PA program, and a demonstration walk session. In the second hour, the intervention
15 group focused on identifying and prioritizing more specific PA goals, operationalizing goals and
16 strategies for goal performance. The 2 remaining 1-hour workshops were conducted at 8-weekly
17 intervals. Topics included setting SMART goals; evaluating progress; feedback; getting the most
18 out of the mentoring process; identifying barriers to goal performance; developing practical aids to
19 overcome specific barriers; reassessment of goals; identification of effective and ineffective
20 strategies and review of the action plan. These topics were followed up during the mentor calls in
21 between the workshop sessions.

22 *Mentor Telephone Contact Protocol*

23 Each intervention group participant received 6 calls from their mentor at 4-weekly intervals starting
24 at week 2, then weeks 6, 10, 14, 18 and 22 over the 6-month period. Participants were asked
25 about their PA program progress, prompted to complete and return their PA diaries. Mentors used
26 a semi-structured script and employed the techniques of reflective listening and spontaneous

1 discussion to engage participants in working on their relevant goals, gave feedback and discussed
2 strategies to on how to keep on track. They recorded the number and time spent on calls.

3 ***Control Group***

4 *Standard Education Program Workshops*

5 The control group received a standard education program conducted over 3 workshops scheduled
6 at the same intervals but on separate occasions to the intervention group. The first workshop was
7 for 2 hours, also attended by the peer volunteers (PALS), with the content of the first hour outlining
8 the PA program and a demonstration walk session. In the second hour the research staff gave a
9 generic presentation on 'Healthy Ageing'. The other 2 workshop sessions were conducted as direct
10 information giving sessions with no motivational content for PA and included topics such 'stress
11 and depression' or 'enjoying retirement'.

12 *PAL Telephone Contact Protocol*

13 Participants received 6 scripted telephone calls from their peer volunteer (PAL) with the same
14 scheduling as the intervention group. PALS recorded number of calls, asked direct questions about
15 PA progress and prompted return of the PA diaries but did not give any feedback or motivational
16 advice.

17 ***The Peer Volunteer Program***

18 Thirty-two physically active (meeting the PA guidelines of at least 150 minutes/week of moderate
19 intensity PA [28]) adults aged 50-85 years were recruited from the community via volunteer support
20 groups for seniors and the media in the Melbourne Metropolitan area. Assessments of PA and PA
21 mentoring self-efficacy were completed at baseline, 6 and 12 months after each peer support
22 period [19]. Post baseline peer volunteers were randomly allocated to be trained as either mentors
23 or Physical Activity Liaisons (PALS).

24 Mentors attended an 8-hour face to face training course developed for the trial that focused
25 specifically on the content of the participant intervention program and skills training for the
26 development a motivational interviewing style of counseling. The PALS attended a 3-hour face to

1 face training course on the content of the control program only and how to deliver the standard
2 telephone contact to the control group without engaging the participants in any 'motivational talk'.

3 Over the period of the trial mentors and PALS were assigned to their respective
4 intervention/control participants via a systematic approach of sequenced lists of mentors/PALS and
5 participants. Both mentors and PALS were assigned to a research team member as a 'senior
6 mentor' who provided support via scheduled phone calls during the intervention.

7 ***Baseline Assessments***

8 Following provision of written consent, baseline assessment covered health (height, weight, BMI),
9 a demographic health and lifestyle questionnaire (illness, injury, falls, medications), PA and fitness,
10 a cognitive and clinical test battery and a saliva sample for apolipoprotein E epsilon 4 (APOE)
11 genotyping [19]. A goal-setting interview (the BGSi); [27] was conducted.

12 ***Physical Activity Assessment***

13 *Physical Activity Measurement*

14 Pedometers (Yamax CW-700/701 Digi-walker, Yamax Co., Japan) were worn by participants for 7
15 days to measure their PA. They recorded their daily steps and hours sitting in a diary. Any time
16 during the waking hours that the pedometer was not worn was noted by the participant in a daily
17 diary with the type of activity, time spent in and the intensity of any non-step activity, (eg water-
18 based activity) recorded. A step count for this activity was estimated based on 100 steps/minute for
19 low moderate intensity (3 MET) and 200 steps/minute for moderate intensity activity e.g. swimming
20 [29].

21 *Physical Activity Questionnaires*

22 The CHAMPS PA questionnaire recorded the frequency and duration of activities, with the caloric
23 expenditure (kcal), and minutes per week spent in all, low, moderate, hard and very hard intensity
24 PA calculated [30]. Moderate and vigorous PA (MVPA) from the CHAMPS questionnaire was
25 determined as the sum of the moderate, hard and very hard PA.

1 *Self-efficacy Questionnaires: PA* Self-efficacy under adverse events (SEQ) was assessed on a 5-
2 item questionnaire using a 5-point Likert scale [31]. Participant's rating on a scale of 0-100% of
3 their confidence to complete a specific PA task (150minutes/week of moderate intensity PA) was
4 defined as program specific self-efficacy [32].

5 ***Fitness Assessment***

6 Components of functional fitness were assessed using the following tests [33, 19].

7 *Cardiovascular Fitness:* the 6-minute Walk Test [34].

8 *Lower Leg Strength:* the Sit-to-Stand Test [35].

9 *Mobility and Agility:* the Timed Up and Go Test (TUG) [36].

10 *Dynamic Balance Step Test:* stepping one foot at a time on and off a 7.5 cm high step as many
11 times as possible in 15 seconds. [37].

12 *Grip strength:* measured with a Smedleys hand dynamometer on the dominant and non-dominant
13 hand [38].

14 ***PA Adherence***

15 Adherence to the prescribed PA was determined from the return of self-reported PA diaries that
16 recorded the type, frequency, duration and intensity of the PA. Adherence to the prescribed study
17 PA program was defined as the number of minutes of moderate intensity PA completed relative to
18 the prescribed 150 minutes/week expressed as a percentage (ADH). Adherence to the prescribed
19 PA and any additional moderate intensity PA that the participants were already doing at baseline
20 was defined as total adherence (TotADH). This variable was included to determine if the
21 prescribed PA replaced previous habitual PA.

22 ***Retention***

23 Retention rate was determined as the number of participants assessed at 6 and 12 months,
24 expressed as a percentage of the number of participants randomized.

1 **Goal Performance and Goal Satisfaction Scores**

2 The modified BGSi was also used as an outcome measure of goal performance and goal
3 satisfaction. In a face to face interview all participants discussed the areas of physical health (PH),
4 (PA), physical function (PF) and every-day function (EDF) identifying issues to form the basis of
5 goals. They identified 3-5 goals in the area of PF (e.g., strength, agility, fitness etc.) and/or PA
6 (type, frequency, duration etc.) and rated their current performance and satisfaction for each goal
7 on a scale of 1-10 (1=not able to do it/not satisfied at all and 10=able to do it extremely
8 well/extremely satisfied). A mean score for goal performance was calculated from the sum of the
9 individual goal ratings divided by number of goals set. The mean goal satisfaction score was
10 determined in the same way.

11 Only the intervention group operationalized their goals and continued to work on these during the
12 intervention.

13 **Importance and Readiness to Change Behavior Scores**

14 Self-rating on a scale of 1-10 of the importance and readiness to change behavior in the PF and
15 PA areas was determined at baseline only.

16 **Cognitive and Psychological Assessment**

17 A battery of cognitive, psychometric and neuropsychological tests was administered at baseline, 6
18 and 12 months by an observer blinded to the participant's group allocation [19]. The Mini-Mental
19 State Examination (SMMSE), a measure of global cognition [25] and the Alzheimer's Disease
20 Assessment Scale 13 – cognitive section (ADAS-cog 13) [39] were used in the modelling in this
21 report to determine if baseline cognitive status influenced the PA results.

22 **Follow-up Assessments**

23 All baseline measures were re-assessed at 6 and 12 months except for the
24 APOE4 genotyping for those recruited for 12 months. For those recruited for 6-months only
25 assessments were at baseline and 6 months.

26 **Program and Process Evaluation**

1 After 6 and 12 months, participants completed a questionnaire specific to this study to provide
2 feedback on the program. Items were structured so that they answered “yes” or “no” for more
3 general questions and then rated the item on a scale 1-5 with 1 being the least favorable and 5 the
4 most favorable score. Questions asked about enjoyment (eg. “How enjoyable did you find the PA
5 program?”), understanding (eg. “Did you find it easy to follow the program we set out for you?”) and
6 helpfulness (eg. “How helpful did you find.....?”). Similarly, specific program components and
7 resources such as the PA program, the information manual, the goal-setting activities, workshops,
8 mentor/PAL phone calls, perceived “knowledge”, “understanding” and “motivation” shown by
9 mentor/PALS was evaluated. The latter 3 attributes were summed then expressed as a percentage
10 for a mentor/PALS total attributes score.

11 ***Workshop Adherence and Fidelity of the Peer Volunteer Support***

12 Total number of attendances at 3 participant workshops was recorded with workshop adherence
13 calculated as a percentage of workshops attended to workshops scheduled.

14 Peer volunteer support and fidelity of the phone calls was derived from the total number of successful
15 calls (as defined and recorded by the peer volunteer) the total time of the call and the mean call time.

16 Call compliance was defined as the percent of successful calls made compared to the number of
17 scheduled calls.

18 ***Sample Size***

19 We estimated that to detect a mean difference of 1200 steps/day between the groups at 80%
20 power, $\alpha = 0.05$, 76 participants were needed for each group [19].

21 ***Randomization and Blinding of Observers***

22 On completion of the baseline assessments participants were randomized to either a goal oriented
23 and mentoring PA intervention group or control group according to a list of computer-generated
24 random numbers in varying block sizes using the “ralloc” user-written command implemented in
25 Stata 12 statistical software [40] performed by an investigator not involved in the data collection.
26 Randomization was concealed in envelopes and an independent person completed the allocation

1 of participants to the intervention or control group. This was a single blind study where researchers
2 responsible for the cognitive and clinical assessments were blinded to the treatment allocation.

3 ***Statistical Analysis***

4

5 Data were summarized using mean and standard deviation (sd), median and first to third quartiles
6 (Q1, Q3), or counts and proportions as appropriate. Pedometer scores; self-reported PA (all and
7 MVPA); adherence; cardiovascular fitness, balance, mobility (TUG), leg strength, grip strength;
8 goal performance and satisfaction; and self-efficacy were modelled using linear mixed models. All
9 models tested the time by group interaction to determine whether the change over time differed
10 between the two groups. Post hoc, pedometer scores and MVPA analyses assessed potential
11 confounders including (baseline age, sex, APOE4 status, body composition, fitness components,
12 cognition, importance and readiness to change PA, mean total goal performance and satisfaction,
13 self-efficacy, self-efficacy for a walking program, self-efficacy to complete 150minutes/week PA,
14 and 6-months total and mean call time, enjoyment of the PA and phone calls) and the method of
15 backward elimination was used to arrive at an adjusted model. Post hoc marginal linear prediction
16 contrasts are provided for changes over time where no group differences were detected. For
17 fitness measures, only age and sex were assessed as potential confounders

18 Baseline characteristics of the two study duration cohorts were compared and a sensitivity analysis
19 where models were refitted with just the 12 month study cohort were conducted to ensure that
20 conclusions are consistent.

21

22 Given the exploratory nature of this trial, multiple adjustments have not been carried out. However,
23 we acknowledge that a considerable number of hypothesis tests have been conducted and as
24 such, caution should be exercised when interpreting significant (and non-significant)
25 results. Statistical modelling was performed using Stata v.15 (StataCorp LLC, College Station,
26 Texas) and statistical significance was set at a p-value < 0.05.

1 **RESULTS**

2 The participant flow through the study is shown in Figure 1. A total of 52 participants was assessed
3 at baseline and randomized into the 2 study groups. The number of participants was lower than
4 planned and extension of the recruitment period was limited due to funding restrictions. Thirty-six
5 participants were followed for 12 months. A further 16 were recruited with follow-up truncated at 6
6 months. Participants who withdrew during the trial were invited to return for the follow-up
7 assessments to allow for an intention-to-treat analysis.

8 ***Baseline characteristics***

9 Participants' baseline characteristics are reported in Table 2a. Mean age (\pm sd) was 70.1 (6.4)
10 years with 33 (63.5%) of participants being female. The baseline characteristics of the participants
11 recruited for 6 and those recruited for 12 months are shown in Table 2b.

12 ***Mentor and PAL Characteristics***

13 Thirty-two peer volunteers were recruited and trained with 7 (21.9%) withdrawing after randomization
14 but before assignment to a participant, 20 (80%) completed 6 months of support and 19 (76%)
15 completed 12 months. Mean age (\pm sd) ($n = 25$) was 65.8 (6.25) years, 15 (60%) were female. Both
16 the mentors and PALS had excellent and similar telephone call-adherence 81.9 (70.4, 93.5)% and
17 87.2 (77.2, 97.1)% respectively. By design the total call time was higher for the mentors 107 (86.6,
18 127) minutes compared to PALS 56.7 (45.1, 62.3) minutes ($p < 0.001$).

19 ***Retention of Participants***

20 Two participants from the intervention group withdrew before the start of the intervention. A further
21 2 withdrew from the intervention during the first 6 months but returned for assessments. After 6
22 months the overall retention (return for assessment) was 88.5% ($n = 46$) with no significant
23 difference detected between the intervention and control group 84.6% ($n = 22$) vs 92.3% ($n = 24$)
24 respectively. For the participants who were in the sub-group for 12 months and were assessed at
25 12 months ($n = 30$) retention was 83.3% with no observed significant between group difference in
26 long-term retention 77.8% ($n = 14$) versus 88.9% ($n = 16$) for the intervention and control group

1 respectively Figure 1. However, although returning for follow-up 2 participants in the intervention
2 group discontinued the PA intervention during the first 6-months and another discontinued PA
3 during the second 6 months resulting in a total of 3 discontinuing the intervention over 12 months.
4 The main reasons for not continuing with the intervention or participation in the study (n = 9) over
5 12 months were “health” (n=5) (55.6%) and “no longer interested” (22.2%).

6 In the sub-group who were enrolled for 12 months, 9 (17.3%) withdrew from the study completely
7 or withdrew from the PA intervention resulting in a long-term participation rate of (n = 16) 88.9% in
8 the control group compared to (n = 11) 61.1% in the intervention group (p = 0.054).

9 ***Physical activity***

10 ***Pedometer Scores***

11 The pedometer scores of steps/day for both groups at baseline, 6 and 12 months are shown in
12 Table 3. There was no significant difference detected between the control and intervention groups
13 in the pattern of change in steps/day over time (p = 0.129).

14 In the secondary analysis there was a significant increase in mean steps/day (95% CI) for both
15 groups over time at 6 months 1662 (943, 2383) steps/day (p < 0.001) and 1320 (603, 2037)
16 steps/day (p < 0.001) at 12 months. When baseline BMI and fitness (walk distance) were included
17 in a multivariable model, both were associated with a significant change in steps/day over time
18 (Figure 2(a)). On average, 1 metre more of baseline walk distance on the 6-minute walk test was
19 associated with an increase of 14.6 (3.4, 25.7) steps/day (p = 0.010). Conversely, 1 unit increase
20 in baseline BMI was associated with a decrease of 228.7 (41.1, 416) steps/day (p = 0.017). The
21 model explains 34.4% of the variability in steps/day. The effect size for the total group, Cohen’s f²,
22 of 0.31 for time (the intervention) was medium to large. No associations with potential confounders
23 such as age, sex, cognitive status, self-efficacy, study-time or APOE4 status were detected. Figure
24 2 shows the relationship of time and steps/day adjusted for baseline BMI and walk distance for the
25 whole group.

26 ***Self-Reported Physical Activity***

1 The raw scores for minutes/week of time spent on all PA and MVPA for the study period are shown
2 in Table 3. For time spent on all PA no significant difference in change over time was detected
3 between the 2 groups ($p = 0.082$). During the second 6 months of the study the control group
4 continued to increase PA whereas the intervention group had a decline in the rate of change of PA.
5 No significant difference was detected between the 2 groups ($p = 0.051$).

6 For both groups combined however, total time spent in all PA increased significantly on average
7 220.2 (117.4, 323.1) ($p = 0.001$) minutes/week at 6 months and 274.5 (164.9, 383.9) ($p < 0.001$)
8 minutes/week at 12 months.

9 Similarly, for MVPA, no significant difference in change over time was detected between the 2
10 groups ($p = 0.082$). A sensitivity analysis to assess the impact of the study-time, as for steps/day,
11 found conclusions to remain the same ($p = 0.100$).

12
13 The MVPA in the secondary analysis increased from baseline over time in both groups ($p < 0.001$)
14 with the approximated mean increase of 165 (125, 210) minutes/week and 160 (102, 229)
15 minutes/week at 6 and 12 months, respectively, from the univariate model. In a multivariable
16 model, younger age at baseline was associated with the increase in MVPA over time ($p = 0.002$)
17 as were higher baseline cognition (SMMSE) ($p = 0.002$), and higher baseline goal performance (p
18 $= 0.002$). When the total time of the PALS/Mentors calls and the enjoyment rating of the PA
19 program over the first 6 months were entered into the model, there was evidence that the
20 relationship of call time to MVPA varied over time. Relative to 12 months, the call time had a
21 stronger positive effect on MVPA at 6 months ($p = 0.021$) demonstrating that higher total call time
22 in the first 6 months resulted in more MVPA undertaken in the intervention 6 months. Further, the
23 relationship of the enjoyment of the PA program with MVPA varied over time with the enjoyment at
24 6 months having a stronger positive relationship with MVPA at 12 months ($p = 0.033$). That is, the
25 more people enjoyed the PA program during the first 6 months the more MVPA they did in the
26 second 6 months. Figure 2(b) depicts the relationship of time and MVPA adjusted for baseline age,
27 SMMSE, goal performance score, 6 months call time and enjoyment rating for the whole group.

1 **Adherence**

2 Both groups achieved high ADH and TotADH (Table 4). Median (Q1-Q3) adherence rates of 87.4
3 (76.1 - 95.8)% versus 91.1 (71.7 – 95.7)% and 84.6 (78.5 – 92.9)% versus 84.8 (70.1 – 98.9)% for
4 the control and intervention groups during the 0-6 months and 6-12 months respectively with no
5 significant differences detected. Forty participants (81.6%) had greater than 67% ADH for the first
6 6 months with 23 (82.1%) maintaining this level during the 6-12 month period with similar numbers
7 in each group. The results for TotADH were consistent with these results for the ADH. ADH was
8 associated with higher baseline goal satisfaction and total call time during the 0-6 month period.
9 One point on baseline goal satisfaction score was associated with a 6.6% increase in ADH ($p =$
10 0.012) and 10 minutes higher total call time was associated with a 1.9% increase in ADH ($p =$
11 0.004). The PA intensity RPE for both groups was similar 10.8 (10.5, 11.2) versus 10.9 (10.4, 11.4)
12 for 0-6 months and 10.9 (10.3, 11.4) versus 11.0 (9.9, 12.0) for 6-12 months for the control and
13 intervention groups, respectively. The PA of choice was walking $n=48$ (96%).

14 **Fitness**

15 No significant difference in the change over time was detected between the 2 groups for any of the
16 fitness measures (Table 5). However, for both groups combined cardiovascular fitness, mobility,
17 leg strength and balance but not grip strength improved significantly with the intervention ($p <$
18 0.001). These improvements translate to a mean increase in cardiovascular fitness of
19 approximately 7% and 10% after 6 months and 12 months respectively with corresponding
20 improvements in mobility 11% and 16%; leg strength 18% and 19%; balance 18% and 28%.
21 Women on average walked 56 metres less than men on the 6-minute walk test ($p = 0.024$) and
22 older age was associated with lower mobility ($p = 0.006$). Being female and older was associated
23 with poorer grip strength ($p < 0.001$) and ($p = 0.017$). No associations with age and sex were
24 detected with other fitness measures.

25 **Goal Performance and Satisfaction**

26 There were no significant differences detected between groups in the pattern of change in goal
27 performance and goal satisfaction over time. Goal performance scores for both groups combined

1 increased significantly over time with on average increases of 3.80 (3.30, 4.30) and 4.00 (3.24,
2 4.75) ($p < 0.001$) at 6 and 12 months respectively (Table 6). Goal satisfaction scores had a similar
3 pattern of change with increases of 4.12 (3.57, 4.67) at 6 months and 4.44 (3.63, 5.26) ($p < 0.001$)
4 at 12 months.

5 ***PA Self-efficacy***

6 No significant differences were detected between the groups for change over time in PA self-
7 efficacy. For both groups combined PA self-efficacy increased on average by 2.66 (1.26, 4.06)
8 ($p < 0.001$) and 1.83 (0.28, 3.39) ($p = 0.025$) over 6 and 12 months, respectively. PA program
9 specific self-efficacy was high at baseline for both groups 96.6 (94.2, 98.8)% and was maintained
10 over time 97.6 (95.0, 100.1)% and 97.3 (95.1, 99.5)% after 6 and 12 months, respectively.

11 ***Fidelity and Program Evaluation***

12 The delivery, attendance and compliance with aspects of the program was high with similar mean
13 attendance rates for the workshops, 97.4 (92.2, 102)% for the control and 85.9 (73.7, 98.0) for the
14 intervention group. The control group had 96.2% and the intervention group 76.9% participants
15 achieving a 100% attendance at the workshops ($p = 0.074$). Diligence in following up participants
16 for calls (total attempted calls) was 6.69 (5.84, 7.53) calls for the PALS and 5.11 (4.02, 6.20) calls
17 for the mentors.

18 At 6 months 24 control and 21 intervention participants completed the program evaluation
19 questionnaire. All respondents reported that the PA program was easy to follow and 95.6%
20 enjoyed their respective programs. The “enjoyment” rating of the PAL/mentor phone calls was high
21 and similar for both groups mean 3.49 (sd 1.27). Reasons why the calls were enjoyable included
22 ‘positive qualities’ of the PALS/mentors (40%) and that they provided motivation and the
23 opportunity to talk about issues (37%). The control group rated the perceived “understanding”
24 shown by their PAL 4.32 (0.57) which was significantly higher than the intervention group’s rating
25 of 4.00 (0.66) for their mentor ($p = 0.0005$). Further, the “attributes of the PAL” score by the control
26 group was 79.1% and “attributes of the mentor” score by the intervention group was 63.5%.

1 After 12 months in the program, 96.6% (n = 28) enjoyed the second 6-months with similar high
2 enjoyment ratings. Fifteen (93.8%) in the control and 10 (76.9%) in the intervention group
3 continued with their prescribed PA. No longer receiving calls from their PALS/mentors was not
4 seen as affecting their ability to continue with their PA (reported by 93.8% (n = 15) of the control
5 and 91.7% (n = 11) of the intervention groups). Reasons given for why lack of calls did not affect
6 PA was that PA was a routine or habit 50%, (n = 11) and that participants were now self-motivated
7 45.4% (n =5). Having PALS/mentors was still seen as important to promote PA in older adults by
8 82.8% (n = 24) of participants.

9 ***Injury during the PA Program***

10 Bursitis in the hip was reported by 2 women in the control group during the first 6 months of the
11 program. They missed 6 and 11 of their prescribed sessions respectively, but the bursitis resolved
12 and they continued with their PA program for the 12 months.

13 **DISCUSSION**

14 In this target group of inactive, older adults at increased risk for cognitive decline we compared two
15 different approaches, a more intensive approach utilizing goal-setting and an active control, and
16 found both were effective with no significant differences between the groups detected. In this first
17 study in this target group, although we were unable to realise the primary aim of the trial, by
18 combining the data from the two groups we were able to identify key factors salient to future efforts
19 to promote PA in underactive older people at risk for cognitive decline.

20 Not being able to show differences between groups in peer-led PA interventions is not uncommon
21 [18]. In the current study, there were several possible reasons for this, the most evident being a
22 lack of power. Secondly, it is possible that the two approaches used were too similar either in
23 design or implementation. Table 1 highlights the similarities and differences between the programs
24 and some design elements that may have been contributing factors. In terms of design, both
25 groups were asked to rate their goal performance and satisfaction as outcome measures. Also,
26 both groups monitored their PA progress via their diaries and self-monitoring has been shown to
27 be an effective technique to increase PA and MVPA [41, 42]. With respect to potential similarities

1 in study design, we had processes in place to minimize this, for example both the mentors and
2 PALS received training on their respective roles only and they were regularly advised and
3 supported by senior mentors to keep them on task.
4 Irrespective of not being able to discriminate between 2 intervention approaches, by combining the
5 groups and examining the changes over time for the outcomes and the factors that were
6 associated with these changes we were able to determine some relevant and novel findings that
7 are salient to the promotion of PA in this group of older adults.

8 ***Effects of participation on physical activity***

9 Across the groups as a whole, participation in the intervention increased PA as determined from
10 pedometer steps over time. This change in steps/day exceeded the 1,000 steps/day that has been
11 associated with a lower risk all-cause mortality cardiovascular disease morbidity and mortality [43]
12 and frailty [44]. The magnitude of the change equates to 13-16 minutes/day or 92-117
13 minutes/week of brisk walking [45] and has important health implications. The PA levels in our
14 study reached more than 8,000 steps/day which exceeds the 7,100 steps/day as the minimal
15 amount recommended to achieve health benefits for older adults [46]. Further, in an earlier study
16 in participants with MCI or SCD using the same 6-month PA program we demonstrated a
17 difference of approximately 1,285 steps/day that was associated with improved cognition when
18 compared to usual care after 6 and 18 months [6]. The association of higher baseline aerobic
19 fitness measured by the 6-minute walk and an increase in PA is not surprising [47] nor is the
20 association of higher BMI and lower levels of PA [48]. However, these results suggest that
21 modifiable risk factors, such as low fitness and overweight rather than age, sex, cognitive and
22 APOE4 status maybe the more relevant barriers to increasing PA in this target group. This
23 highlights the need to identify those who are less fit and overweight and at risk of not achieving
24 increases in PA and to consider additional strategies to overcome these barriers in PA programs.
25 The medium to large effect size of the intervention to increase PA demonstrates that these
26 participants were not only able to adopt a more active lifestyle and maintain this in the long-term
27 but that the magnitude of the change has potential health benefits.

1 This increase in PA was also supported by the increase in minutes/week of all intensities of PA as
2 well as the MVPA for both groups. The significant increase in MVPA for both groups over 6 months
3 of 164 minutes/week and 188 minutes/week for 12 months exceeds the recommended level of 150
4 minutes/week [28] and the target amount of PA for the PA intervention further supporting the
5 efficacy and acceptability of the PA program.

6 It is possible that factors other than the intervention, may have played a part and been more potent
7 in determining the increase in PA and MVPA as seen with the association of conventional factors
8 such as age, cognition as well as program factors and MVPA in the multivariate model. The
9 observation that younger age, better cognition and higher goal performance at baseline were
10 associated with higher levels of MVPA is not unexpected as these characteristics would not only
11 support a greater capacity to follow and perform the PA but also to accurately recall the PA for self-
12 reports. Program factors were also associated with increases in MVPA namely more peer support
13 call time over the 6-month intervention associated with greater increases in MVPA over 6 months
14 but not 12 months. As we reported significantly higher call time in the intervention group compared
15 to the control group it is possible that when the calls were ceased in the second 6 months this had
16 more impact on the intervention group than the control resulting in the declining rate of change in
17 MVPA for the intervention group and increasing MVPA for the control group over the second 6
18 months. Enjoying the initial 6 months of the program was important for the maintaining MVPA
19 during the second 6 months of this study. Both of these findings highlight the importance of
20 providing a positive experience for inactive older people when initiating a PA program to support
21 ongoing behavior change. This finding supports the emerging concept that enjoyment rather self-
22 efficacy is a stronger predictor of increased PA [49, 50]. The results of our program evaluation
23 showing high ratings of enjoyment of the PA program and the peer support calls demonstrate a
24 positive experience for both study groups with the enjoyment attributed to the PALS/Mentor
25 qualities and the motivation providing by being able to talk about issues. It is possible that these
26 qualities, rather than differences in the content (education versus goal orientation) and delivery
27 style may have had a more potent effect on participation thus demonstrating that different
28 strategies can achieve good results.

1 Other interventions using peer-led delivery did not establish a difference between groups in PA in
2 the short term. In a 4-months PA intervention utilising a group-mediated behavioral intervention
3 with goal-setting with peer advice and support versus a standard community PA promotion and
4 education both groups had similar increases in PA. However, after 18 months follow-up the peer-
5 led group had better PA results compared to the standard group [17, 51]. Our study differed from
6 that of Floegel and colleagues [51] in that it was home-based, the peer support was via telephone
7 contact and the follow-up was at 12 months. Our mentors may not have been as interactive thus
8 not achieving the same levels of social connectedness and social support that may partly explain
9 the difference in the long-term results.

10 ***Adherence to the Physical Activity Program***

11 The 79% mean adherence rate for the whole group was similar to that observed in our previous
12 studies with similar target groups [7, 8]. The observation that adherence did not change with time is
13 also similar to our previous study where adherence to the same home-based program was
14 consistent over 24-months demonstrating that this type of program is acceptable and sustainable
15 in the long-term for this target group. The current study results are even more remarkable given
16 that the participants were inactive at baseline. These results are also comparable to other PA
17 interventions in those with MCI as a recent meta-analysis reported a 70% mean adherence rate
18 [52]. Only one study in this review reported adherence after the end of the intervention with only
19 25% continuing exercise after the end of the intervention [53] whereas in the current study over
20 82% of participants achieved more than a 67% adherence rate underscoring the success of the
21 study to motivate participation. The similar RPE scores for both groups within the range of
22 moderate intensity and the high retention and adherence rates provide further evidence that this
23 level of moderate intensity PA is both feasible and acceptable for this target group. Evidence that
24 the program was adequately resourced and aimed at the appropriate level was demonstrated by
25 the response of 100% of participants that it was easy to follow and high ratings of enjoyment and
26 program components. This finding supports the suggestion from recent research that factors such

1 as enjoyment may be more relevant than traditional factors such as self-efficacy [Lewis et al 2015]
2 in motivating an increase in PA.

3 The program was also shown to be safe for this target group. Low-level bursitis was reported by
4 two participants, but was resolved and these participants continued with the program without
5 further incident.

6 During the initiation stage of the intervention, that is the first 6 months, having a higher baseline
7 goal satisfaction score was associated with higher adherence. Identifying participants with low goal
8 satisfaction scores and targeting these specific goals at baseline may be a potential strategy to
9 enhance adherence and increase PA. As noted there was a significant difference in total call time,
10 with the intervention group having a significantly higher total call time than the control group.
11 However, the association of call time with adherence was independent of the group assignment.
12 This further supports the notion that contact time rather than the content of the contact may be a
13 more influential factor in increasing adherence at least in the initiation of PA. The belief of 92% of
14 participants that no calls during the second 6-month period would not affect their adherence, that
15 they were in a routine and were self-motivated was borne out by the maintenance of the adherence
16 during the second 6 months. This suggests that peer-support is more critical in the adoption phase
17 of a PA intervention.

18 ***Effects on Functional Fitness***

19 As the adherence to the program was similar in both groups this was reflected in similar gains in
20 fitness for both groups. Apart from grip strength we demonstrated significant and substantial short
21 and long-term changes in cardiovascular fitness, leg strength, mobility and balance which are
22 consistent with improvements of 7-46% in functional fitness reported in a review of health benefits
23 of aerobic PA in aged adults [1]. The magnitude of the change seen in the current study was
24 greater than the improvements in cardiovascular fitness (10% versus 4% and leg strength (19%
25 versus 10%) in our previous study after 12 months in a more active group using the same PA
26 program [8]. Further, the improvement seen in mobility measured with the TUG score was within
27 the range considered clinically significant (0.8-1.4 seconds) [54] This finding of improvements in

1 functional fitness is contrary to the conclusion from a meta-analysis that peer-led PA interventions
2 in older adults may not be as effective in gaining improvements in functional fitness [55]. From the
3 meta-analysis in 13 out of 18 studies the peers led the PA sessions and 5 studies delivered
4 support in a similar manner to our program. In our study the PA program was set by the research
5 staff for both groups and the peer support was mainly for delivery of the behavior change aspects
6 of the intervention that is the goal orientation or education program. This may partly explain why in
7 this specific target group we were able to demonstrate meaningful changes in functional fitness.

8 ***Goal Performance and Goal Satisfaction***

9 Study participants increased their goal performance and goal satisfaction scores significantly over
10 the course of the study with both groups showing similar improvements. The magnitude of the
11 mean change in goal performance of 4.00 and 4.44 for goal satisfaction over 12 months was
12 consistent with results achieved with cognitive rehabilitation in early dementia [56] and higher than
13 the goal performance scores seen when individual goals are targeted in therapy [14]. Further,
14 when mentoring was added to goal setting additional benefits in PA, body composition, global
15 cognition and memory were achieved compared to goal setting alone in healthy individuals at risk
16 of dementia [13].

17 Although we were able to demonstrate these significant gains in goal scores we were unable to
18 demonstrate a superior effect of the goal orientated intervention. As both groups completed the
19 BGSi and selected specific goals related to PA and PF and both then completed the same PA
20 program, it is possible that this exposure for the control group with peer contact was sufficient to
21 promote an increase in goal performance and satisfaction scores of similar magnitude in both
22 groups. The similar results for PA, adherence and fitness scores for both groups supports this
23 notion. A further reason for lack of discrimination in these results could be that the PALS were
24 more engaging with the participants than the mentors. The PALS were trained to only ask direct
25 questions about PA progress, not engage in any motivational talk and their calls times were lower
26 than the mentors. It is possible that the participants may have found this approach just as engaging
27 and more preferable as the control group seemed to relate more positively to the PALS rating them

1 higher on understanding and positive support for the program than did the intervention group for
2 their mentors. The control group also found their program information more helpful and were more
3 engaged in the education with better attendance at the workshops. Further both groups were
4 asked to record their PA sessions in PA diaries and self-monitoring is a strong motivator for PA
5 behavior change [57; 10]. Thus, similarities between the approaches and program factors may
6 have contributed to our inability to discriminate between the approaches.

7 ***Strengths and Limitations***

8 A major strength of this study is that we targeted an under-researched at-risk group of inactive
9 older adults to increase PA with an established PA program and a validated goal orientation
10 program. The modifications to the goal orientation program where the goals targeted specific
11 elements of PA allowed the participants to be more focused in their goal setting and actions was a
12 further strength. The use of the pedometer to objectively quantify the total daily amount of
13 ambulatory PA [46] was a strength but also a limitation as it may not have detected very low or
14 slow PA nor did it not provide a measure of the PA intensity. While the CHAMPS questionnaire
15 enabled us to record PA and estimate the PA intensity, the reliance on self-reported PA in this
16 target group may potentially have been a limitation. The inclusion of program evaluation questions
17 allowed for exploration of program factors that may have influenced behavior change and the
18 outcomes of interest. The similarity between the approaches discussed above was a limitation of
19 the study. This together with slow recruitment, resulting in low numbers of participants in the trial
20 and thus reduced power, were limitations in enabling us to demonstrate between-group
21 differences. The further restriction in numbers with only a sub-group continuing for 12 months
22 limited our ability to demonstrate long-term changes.

23 In summary, in this inactive target group who are particularly difficult to engage we have provided
24 clear evidence that PA levels and functional fitness can improve and that after an initial stage with
25 peer support the PA can become habitual if it is enjoyable. These improvements were
26 commensurate with health benefits and this increase was achieved even with a less intensive
27 intervention. If these results are substantiated in future studies this has implications for PA

1 promotion in that fewer community resources may be needed which may lead to more cost-
2 effective programs. Also, this less intense approach provides another option that researchers and
3 practitioners can utilize in research or implementation programs where some individuals may do
4 better with one approach or another. Hence, having a range of effective options and providing
5 individuals with a choice to select what suits them best may potentially enhance the uptake of PA.
6 Further, community peer volunteers successfully delivered and provided acceptable, effective
7 support for this target group and as such their value as a resource and delivery strategy should be
8 economically evaluated. Barriers to participation identified in this study such as being overweight or
9 having low fitness levels should be a focus of future programs with the development of strategies
10 to overcome or minimize these. We have also highlighted novel theoretical constructs in the
11 promotion of PA uptake and adherence such as enjoyment particularly in the initial stages and
12 program factors including social support provided by the peer volunteers. This support was
13 provided predominantly via phone but other forms of communication deserve exploration such as
14 emails and online social media. These findings have implications for translation into the community
15 and should be explored further to ensure that intervention strategies are relevant to this target
16 group. Due to the limitations outlined above these results are somewhat tentative until confirmed
17 in a larger adequately powered intervention study. Recruitment is challenging for such studies and
18 innovative strategies may be required to attract participants. We further recommend that future
19 studies be conducted where the intervention is distinctly different from the control condition and
20 avoids or minimizes any overlapping methods.

21

22 **CONCLUSION**

23 In this inactive target group at risk of cognitive decline, no differences were detected between
24 groups in PA uptake hence we were unable to confirm our hypothesis that the novel PA
25 intervention utilizing individual goal-setting and peer mentors was superior to the control program.
26 Instead, both approaches were highly effective in increasing PA and fitness in the short and long-
27 term. Our study demonstrates that programs supported by peer volunteers are acceptable and

1 effective and the findings suggest the less intensive peer contact maybe sufficient to improve PA
2 levels. This approach should be explored in larger targeted implementation studies.

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12 **CONFLICT OF INTERESTS /DISCLOSURE STATEMENT**

13 The following authors have no conflict of interest to report (KC, EC, KE, LC, CE-B, LF, OA, DA, DL,
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15

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1 **Table 1.** A comparison of the similarities and differences between the program
 2 components of the 2 study groups in the INDIGO study conducted in Melbourne, Australia.

Component	Control Group	Intervention Group	Comparison
Assessment of PA and Fitness	Pedometer. CHAMPS Q Fitness test battery	Pedometer. CHAMPS Q Fitness test battery	Same
Training course for Peer Volunteers	3 hours PALS Program content Skills training in direct questions	8 hours Mentors Program content Skills training in goal orientation program and MI delivery	Different
Physical activity program	150 mins/week moderate intensity PA	150 mins/week moderate intensity PA	Same
Hard copy of Manual with Program	PA Program information and instruction	PA Program information and instruction	Same
Hard copy of Manual Group specific information	Presentation slides on 'Healthy Ageing'	Goal orientation information and worksheets	Different
Number of Face-to face workshops	3	3	Same
Workshop 1 Content & Delivery	Part 1 Instruction on PA program & Trial walk	Part 1 Instruction on PA program & Trial walk	Same
	Part 2 'Healthy Ageing' Lecture	Part 2 Identifying and refining PA Goals Interactive	Different
Workshop 2 & 3 Content & Delivery	'Stress and depression' 'Retirement' Lectures	Goal-setting operationalization and skills Interactive	Different

Workshop Facilitator	Different facilitator for each topic	Same facilitator for all workshops	Different
Telephone calls number	6 Weeks 2, 6, 10, 14, 18 and 22	6 Weeks 2, 6, 10, 14, 18 and 22	Same
Telephone calls Content and delivery	Report PA Direct questions from PAL	Report PA Goal orientation MI style interactive by mentor	Different
Recording of PA Adherence	Self-report of PA Diaries	Self-report of PA Diaries	Same
PA Goals Assessment	BGSI at baseline, 6 & 12 months Same interviewer	BGSI at baseline, 6 & 12 months Same interviewer	Same
Identification and Operationalizing PA Goals	None	3 out of 5 Goals identified, prioritized, developed, actioned and reviewed at workshops and calls	Different

1 CHAMPS Q - Community Healthy Activities Model Program for Seniors Questionnaire, MI denotes
2 Motivational Interviewing, BGSI - Bangor Goal-Setting Interview.

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1 **Table 2a.** Baseline demographic, health and PA characteristics of participants in the 2
 2 study groups in the INDIGO study conducted in Melbourne, Australia.

	Control Group	Intervention Group
	(n = 26)	(n = 26)
Age (Years)	68.5 (6.5)	71.9 (5.9)
Sex (n, % Females)	19 (73.1)	14 (53.8)
Education (Years)	14.7 (3.6)	15.3 (3.4)
Married/co-habit (n, % of group)	18 (69.2)	18 (69.2)
Retired (n, % of group)	20 (76.9)	21 (84.0)
SMMSE (range 24-30)	28.8 (1.6)	28.7 (1.7)
ApoE4 carrier (n, % of group)	6 (23.1)	12 (46.2)
Body Mass Index (kg·m ⁻²)	28.8 (4.6)	26.9 (4.4)
Overweight/Obese (n, % of group)	20 (76.9)	14 (53.8)
Ever smokers (n, % of group)	8 (30.8)	10 (38.5)
Pedometer score (steps/day)	6304 (2452)	7693 (3595)
MVPA (mins/week) Median (Q1-Q3)	15 (0 - 60)	30 (0 - 105)
Low Active (n, % of group)	25 (96.2)	23 (88.5)
Barrier Self-efficacy	15.1 (4.9)	16.6 (5.6)
Importance of PA change	8.7 (1.1)	8.6 (1.3)
Readiness to change PA	8.6 (1.4)	7.7 (1.7)
Falls history last 6 months (n (%))	7(26.9)	8 (30.8)

3 Values are mean and (sd), unless described otherwise. SMMSE denotes Standardized Mini-Mental
 4 State Examination score. 'Low active' is the number of participants completing less than 150
 5 minutes moderate or vigorous PA (MVPA) /week on the CHAMPS score. Overweight/Obese is
 6 defined as BMI >25

1 **Table 2b.** Baseline characteristics of participants in the cohorts recruited for 6 and 12
 2 months for the INDIGO study conducted in Melbourne, Australia.

	6 Month Cohort	12 Month Cohort
	(n = 16)	(n = 36)
Control Group (n, % of group)	8 (50)	18 (50)
Intervention Group (n, % of group)	8 (50)	18 (50)
Age (Years)	73.2 (74.5)	68.9 (5.1)
Sex (n, % Females)	9 (56.3)	24 (66.7)
Education (Years)	14.7 (3.9)	15.2 (3.3)
SMMSE (range 24-30)	28.8 (1.6)	28.8 (1.7)
ADAS-cog 13	11.7 (6.8)	10.5 (5.8)
Body Mass Index (kg·m ⁻²)	28.2 (4.3)	27.7 (4.7)
Pedometer score (steps/day)	7283 (3260)	6893 (3123)
All PA (mins/week) Median (Q1-Q3)	442 (337-622)	442 (300-750)
MVPA (mins/week) Median (Q1-Q3)	0 (0-45)	30 (0-105)
Walk Distance (m)	465 (106)	457 (71.4)
Timed Up and Go (secs)	7.2 (1.9)	6.6 (1.3)
Self-efficacy for the walking program (%)	41.6 (20.2)	42 (18.2)

3 Values are mean and (sd), unless described otherwise. SMMSE denotes Standardized Mini-Mental
 4 State Examination score. section (ADAS-cog 13) denotes Alzheimer's Disease Assessment Scale
 5 13 – cognitive. MVPA is defined as Moderate and vigorous intensity PA
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1 **Table 3.** PA levels at baseline, 6 and 12 months for the two groups in the INDIGO study conducted in Melbourne, Australia.

Physical Activity	Control Group	Intervention Group	Total	Time x Group
				Interaction p value
Pedometer PA (steps/day)				
Baseline	(n = 24)	(n = 25)	(n = 49)	0.129
	6304 (2452)	7693 (3595)	7012 (3136)	
6 Months	(n = 23)	(n = 20)	(n = 43)	
	7954 (2868)	9305 (3190)	8582 (3062)	
12 months	(n = 16)	(n = 14)	(n = 30)	
	8517 (3170.6)	7670 (2995)	8122 (3067)	
Self-reported All PA (mins/week)				
Baseline	(n = 26)	(n = 26)	(n = 52)	0.051

(Median, Q1-Q3)	368 (225 - 675)	458 (375 - 750)	443 (308 - 698)
Mean (SD)	491 (346)	569 (275)	530 (312)
6 Months	(n = 23)	(n = 22)	(n = 45)
(Median, Q1-Q3)	720 (450 - 990)	743 (465 - 1140)	720 (465 - 1020)
Mean (SD)	698 (310)	793 (391)	744 (351)
12 Months	(n = 16)	(n = 14)	(n = 30)
(Median, Q1-Q3)	923 (623 - 1133)	593 (405 - 915)	818 (495 - 1110)
Mean (SD)	888 (328)	687 (375)	794 (359)

Self-reported MVPA (mins/week)

Baseline	(n = 26)	(n = 26)	(n = 52)	0.082
(Median, Q1-Q3)	15 (0 - 60)	30 (0 - 105)	30 (0 - 105)	
Mean (SD)	39.2 (57.2)	59.4 (77.9)	49.3 (68.4)	

6 Months	(n = 23)	(n = 22)	(n = 45)
(Median, Q1-Q3)	210 (105 – 240)	210 (105 - 255)	210 (105 – 240)
Mean (SD)	2134 (132)	212 (31.7)	213 (130)
12 Months	(n = 16)	(n = 14)	(n = 30)
(Median, Q1-Q3)	218 (105 - 428)	203 (105 - 240)	210 (105 - 255)
Mean (SD)	286 (243)	183 (107)	238 (196)

2 MVPA denotes (moderate and vigorous intensity PA). Values are raw scores of mean and (\pm sd) or median scores and (Q1-Q3) where noted.

3 The p value is from the univariable model and reflects the Time x Group interaction p value that tests for a difference over time for the 2 groups.

- 1 **Table 4.** Results for ADH and TotADH for the two 6-months periods and the overall 12-month period for the two groups in the INDIGO study
- 2 conducted in Melbourne, Australia.

Adherence	Control Group	Intervention Group	Total	Time x Group Interaction p value
Adherence to prescribed PA (ADH)				
0-6 months	(n = 26)	(n = 23)	(n = 49)	
Mean (± SD)	79.1 (26.4)	79.4 (26.8)	79.3 (26.3)	0.798
(Median, Q1-Q3)	87.4 (75.1- 95.8)	91.1 (71.7 – 95.7)	88.88 (74.4 - 95.7)	
6-12 months	(n = 16)	(n = 12)	(n = 28)	
Mean (± SD)	81.7 (16.0)	82.8 (16.5)	82.2 (15.9)	
(Median, Q1-Q3)	84.6 (78.5 – 92.9)	84.8 (70.8 – 99.0)	84.6 (73.9 - 95.4)	
0-12 months	(n = 18)	(n = 15)	(n = 33)	
Mean (± SD)	82.1 (17.7)	76.2 (21.0)	79.4 (19.2)	

(Median, Q1-Q3)	87.8 (78.6 - 93.1)	85.0 (64.2 – 91.7)	85.8 (69.9 – 92.1)	
Adherence to prescribed & usual PA				
(TotADH)				
0-6 months	(n = 26)	(n = 23)	(n = 49)	0.909
Mean (± SD)	77.7 (26.8)	78.9 (27.1)	78.2 (26.6)	
(Median, Q1-Q3)	85.8 (72.3 – 96.0)	91.1 (69.5- 95.7)	85.8 (74.2 – 95.7)	
6-12 months	(n = 16)	(n = 12)	(n = 28)	
Mean (± SD)	80.8 (15.7)	82.0 (17.0)	81.4 (16.0)	
(Median, Q1-Q3)	84.2 (69.6 -92.9)	84.4 (69.3- 99.0)	84.2 (69.8 – 95.4)	
0-12 months	(n = 18)	(n = 15)	(n = 33)	
Mean (± SD)	80.9 (18.3)	75.5 (21.3)	78.5 (19.6)	
(Median, Q1-Q3)	87.8 (67.6 – 93.1)	84.7 (60.6 – 91.7)	85.6 (64.2 – 92.1)	

3 ADH denotes (% Adherence to prescribed program), TotADH denotes, (%Total PA adherence). Values are unadjusted mean (\pm sd), median
4 scores and (Q1-Q3). The p value from the univariable model and reflects the Time x Group interaction p value that tests for a difference over
5 time for the 2 groups.

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- 1 **Table 5.** Cardiovascular fitness, mobility, leg strength, balance and grip strength results over the intervention period for the control and
- 2 intervention groups in the INDIGO study conducted in Melbourne, Australia.

Fitness Component	Control Group	Intervention Group	Time x Group Interaction p value
6-minute walk distance (m)			
Baseline	(n = 26) 454 (422, 486)	(n = 26) 469 (436, 501)	0.732
6 Months	(n = 23) 492 (456, 528)	(n = 20) 499 (463, 536)	
12 months	(n = 16) 507 (471, 543)	(n = 14) 510 (468, 552)	
Timed Up and Go (TUG) (secs)			
Baseline	(n = 26) 6.97 (6.35, 7.59)	(n = 26) 6.66 (6.15, 7.16)	0.581
6 Months	(n = 23) 6.06 (5.64, 6.49)	(n = 22) 6.00 (5.55, 6.45)	
12 Months	(n = 16)	(n = 14)	

	5.79 (5.29, 6.29)	5.55 (5.03, 6.07)	
Sit to Stand (strength) (secs)			
Baseline	(n = 26)	(n = 26)	0.338
	10.9 (9.55, 12.3)	10.5 (9.44, 11.5)	
6 Months	(n = 23)	(n = 22)	
	8.70 (7.74, 9.60)	8.92 (7.91, 9.92)	
12 Months	(n = 16)	(n = 14)	
	8.84 (7.66, 10.0)	8.28 (7.37, 9.19)	
Balance Step Test (steps)			
Baseline	(n = 26)	(n = 26)	0.714
	14.2 (12.7)	14.4 (13.1, 15.8)	
6 Months	(n = 23)	(n = 22)	
	17.1 (15.6, 18.6)	16.7 (15.4, 17.8)	
12 Months	(n = 16)	(n = 14)	
	18.6 (16.9, 20.4)	17.9 (16.4, 19.3)	
Grip Strength (dominant hand) (kg)			
Baseline	(n = 26)	(n = 26)	0.653

	28.8 (26.7, 31.0)	29.8 (27.5, 32.2)
6 Months	(n = 23)	(n = 22)
	29.4 (26.8, 32.0)	29.9 (27.6, 32.1)
12 Months	(n = 16)	(n = 14)
	29.5 (26.7, 32.2)	29.2 (26.6, 31.9)

3 Values are raw scores of mean and 95% (CI). The p value is from the univariable model and reflects the Time x Group interaction p value
 4 that tests for a difference over time for the 2 groups.

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- 1 **Table 6.** Mean goal performance and goal satisfaction results over the intervention period for the control and intervention groups in
 2 the INDIGO study conducted in Melbourne, Australia.

	Control Group	Intervention Group	Time x Group Interaction p value
Goal Attainment (1-10)			
Baseline	(n = 26) 2.84 (2.35, 3.33)	(n = 26) 2.96 (2.49, 3.44)	0.533
6 Months	(n = 23) 6.52 (5.82, 7.22)	(n = 20) 6.88 (6.31, 7.45)	
12 Months	(n = 16) 7.01 (5.90, 8.11)	(n = 14) 6.78 (5.67, 7.90)	
Goal Satisfaction (1-10)			
Baseline	(n = 26) 2.58 (2.10, 3.05)	(n = 26) 2.61 (2.17, 3.04)	0.914
6 Months	(n = 23) 6.60 (5.76, 7.43)	(n = 20) 6.83 (6.25, 7.41)	
12 Months	(n = 16) 6.98 (5.79, 8.18)	(n = 14) 7.09 (5.97, 8.21)	

- 3 Values are raw scores mean and 95% (CI). The p value is from the univariable model and reflects the Time x Group interaction p value that
 4 tests for a difference over time for the 2 groups.

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1 **Figure 1.** INDIGO study participant flow from recruitment to the end of the 12-month
2 follow-up

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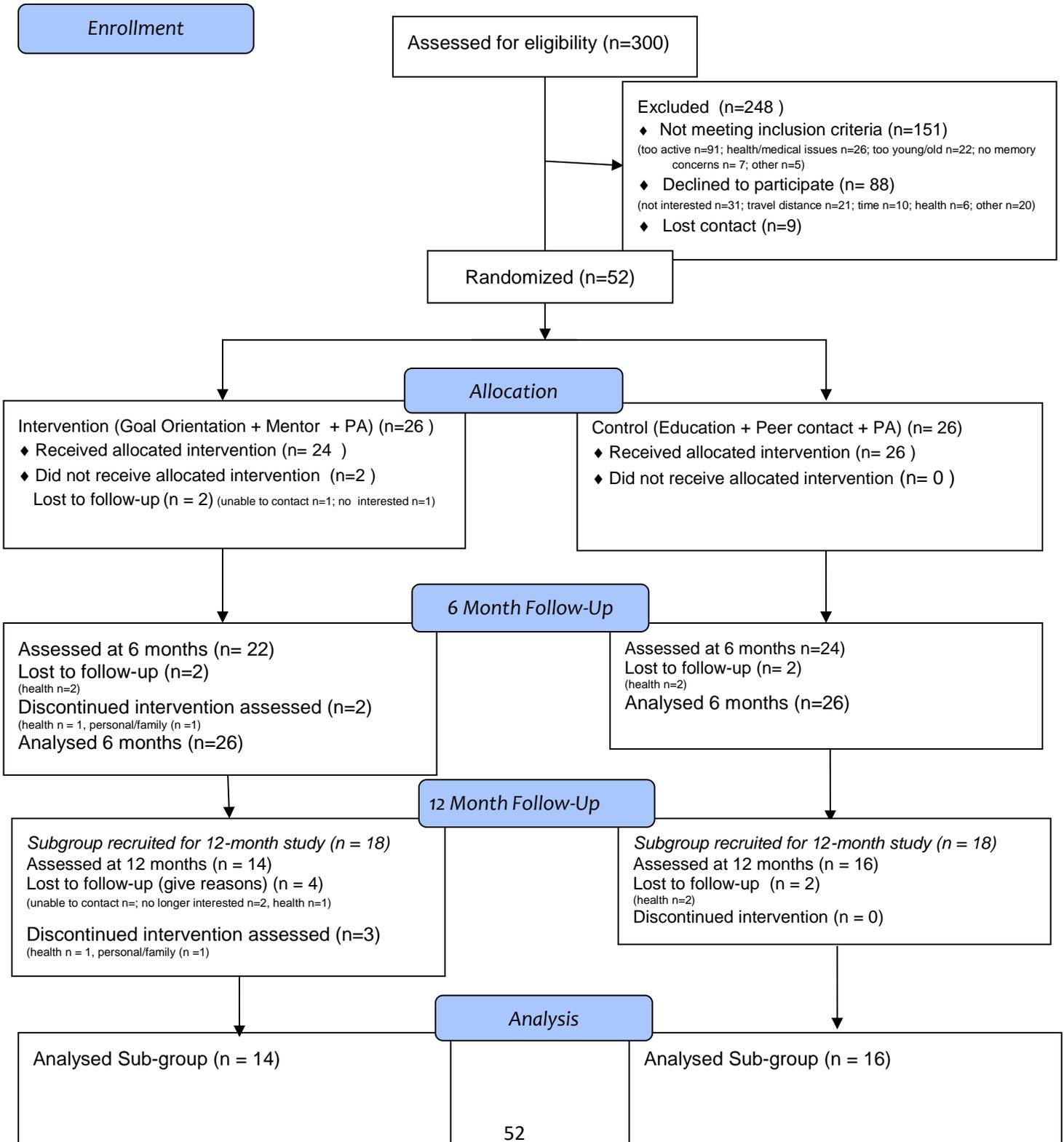
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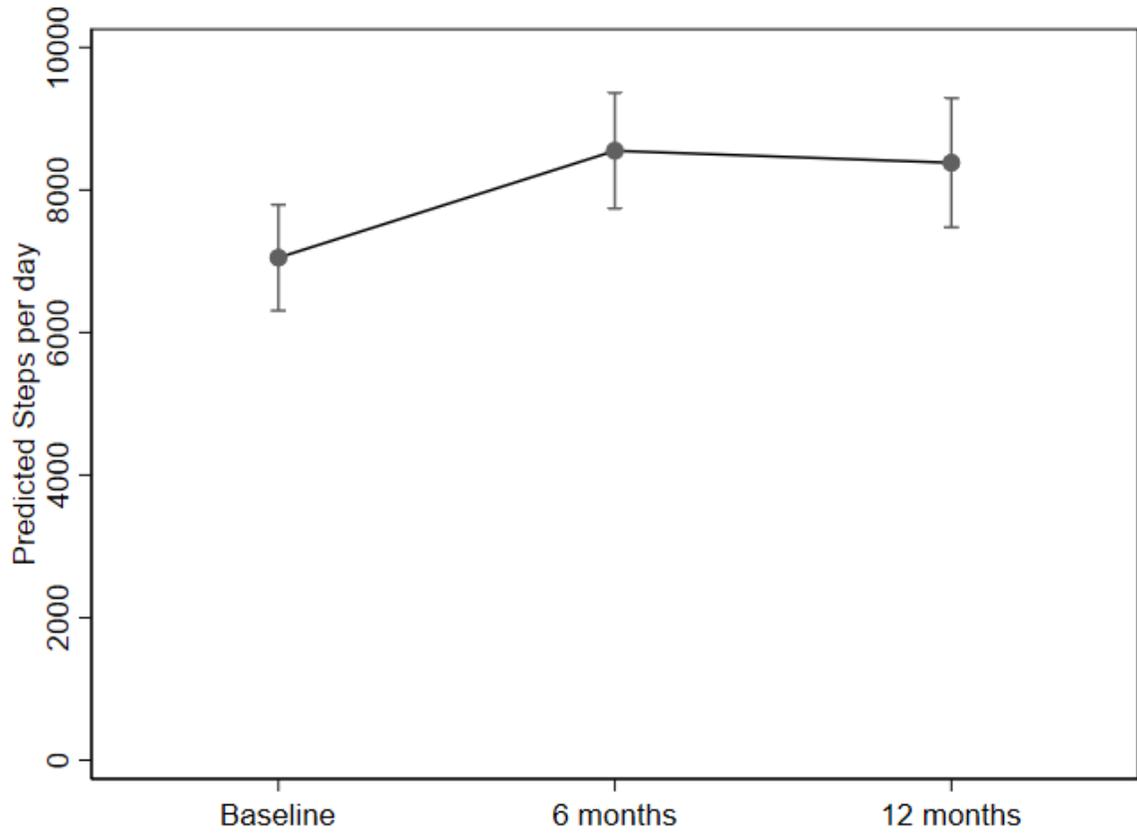
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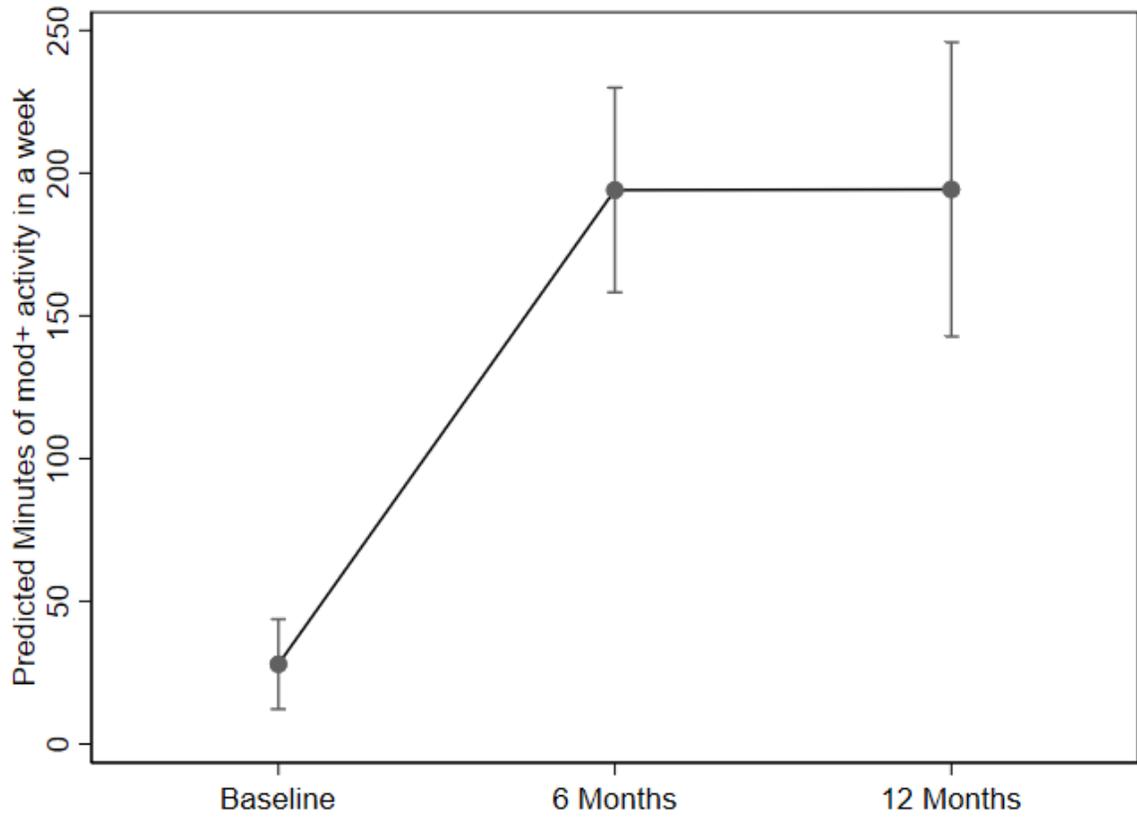
- 1 **Figure 2 a.** Predictions of steps per day for all participants over time adjusted for
- 2 baseline BMI and fitness (walk distance) with 95% CIs.

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1 **Figure 2 b.** Adjusted predictions of Moderate and Vigorous PA (MVPA) minutes a week
2 for all participants over time with 95% CIs. The model was adjusted for baseline age,
3 SMMSE, mean goal performance score, the time interaction and 6-month call time and
4 the time interaction and 6-month enjoyment score.



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