Running head: NEED-SUPPORT AND WELL-BEING IN OLDER ADULTS

Effects of need-supportive physical activity counseling on well-being: A two-year follow-up among
sedentary older adults

Manuscript type: original research

Keywords: aging, mental health, exercise, evidence-based research, community-based research

Abstract word count: 200

Date of manuscript submission to *Journal of Physical Activity & Health*: May 17th, 2013

Authors: Van Hoecke, A.S., Delecluse, C., Bogaerts, A., & Boen, F.

ABSTRACT

Background: This study evaluated the long-term effectiveness of multiple physical activity counseling strategies on subjective health among older adults.

Methods: Sedentary older adults (n = 442) were randomized to three programs: (1) a one-contact referral to locally-organized physical activities, (2) a one-contact provision of a walking program, (3) a ten-week multiple-contact physical activity coaching based on the Self-Determination Theory. Self-reports on well-being, trait anxiety and physical activity were completed at baseline (pre-test), and ten weeks after (ten-week follow-up), one year after (one-year follow-up) and two years after (two-year follow-up) pre-tests.

Results: All three programs yielded improvements in well-being and trait anxiety from pre-test to ten-week follow-up and to one-year follow-up. From pre-test to two-year follow-up, no changes emerged in well-being whereas trait anxiety increased significantly. Changes over time in well-being and anxiety were not significantly different between the programs. Changes in physical activity contributed significantly to the prediction of changes in well-being and trait anxiety.

Conclusions: The findings demonstrate the year-round effectiveness of physical activity counseling on subjective health among older adults, irrespective of counseling strategy. However, a relapse to baseline level occurred two years after the intervention. Physical activity appears to be an important determinant of older adults' well-being.

INTRODUCTION

The increasing life expectancy in Western societies yields a continuously growing proportion of older adults.¹ Given that advanced age is associated with a higher risk of chronic diseases, the aging population results in a substantial health and economic burden.^{2,3} Regular physical activity (PA) has been recognized as a key strategy to prevent older adults from diseases and to improve their health, quality of life and well-being.^{4,5} In particular, PA has been shown to produce increases in physical fitness and functional performance. Moreover, quantitative and qualitative research has demonstrated beneficial effects of PA on various indicators of subjective well-being and mental health such as vitality, mood, anxiety, cognitive functions, and self-esteem.^{4, 6-10}

Despite the numerous positive outcomes, several studies have failed to find a positive association between PA and subjective well-being.¹¹⁻¹⁶ For example, results of the Better Ageing Project¹⁵ in which healthy older adults were randomized to a PA condition and a control condition showed only minor psychological benefits of a six-month structured PA program including aerobic exercises, strength training, tai chi and flexibility exercises. Moreover, longitudinal research of Perrig-Chiello and colleagues¹⁶ found that an eight-week resistance training program is not effective in improving subjective health, well-being or memory among normally active adults aged between 65 and 95 years. Furthermore, based on a randomized controlled trial among older adults living in long-term care facilities but without progressive or terminal illness, Chin A Paw et al.¹⁴ concluded that neither strength training nor all-round functional training of moderate intensity yields improvements in quality of life, vitality or depression in this population group.

The following three reasons might explain the inconsistent findings on the association between PA and well-being. First, longitudinal research on the effects of PA on subjective health varies largely with respect to the intervention procedures (e.g., counseling method, program duration, PA type and intensity). The majority of the studies have focused on the effects of aerobic forms of PA on well-being. However, well-being has not only been shown to be improved by aerobic training but also by other types of PA such as strength training, functional training or flexibility.¹⁷⁻¹⁹ For example, McAuley et al.¹⁸ demonstrated that both a six-month aerobic (walking) program and a six-month PA program based on stretching and toning are effective in improving happiness, life satisfaction and

1 loneliness among healthy sedentary adults. Even though endurance training including walking appears
2 to be most effective^{7-8, 10, 14, 20-23}, it remains unclear which type of PA intervention is most valuable for
3 enhancing well-being among older adults.

4 Second, well-being is a subjective and wide-ranging construct for which a diversity of operational
5 definitions exist.^{9, 12, 24} According to Diener et al.,²⁵ the applied definition of well-being is often not
6 made explicit, but is rather implied by the specific measurement that is used. Moreover, the concept of
7 subjective health and well-being comprises both positive (e.g., vitality, life satisfaction and happiness)
8 and negative components (e.g., anxiety, depression and loneliness), which can be influenced
9 differently.²⁶ In this respect, [REDACTED] (submitted) found improvements in physical well-
10 being but not in psychological well-being after a four-month PA program among sedentary
11 employees. Furthermore, Opdenacker and colleagues²⁷ showed a significant decrease in anxiety but
12 no changes in well-being after a six-month PA intervention in rural older women. The contrasting
13 results of PA programs on different indicators of subjective health highlight the importance of
14 approaching well-being as a multidimensional construct.

15 Third, previous research has underscored the importance of a theoretical foundation in health
16 promoting strategies.²⁸ However, many of the PA interventions studying the effects on subjective
17 health and well-being lack an underlying theory.¹² Given that aging may involve reduced feelings of
18 personal control and competence, the Self-Determination Theory²⁹ (SDT) has been postulated as an
19 appropriate framework for health behavior changes and optimal psychological functioning among
20 older adults.³⁰⁻³³ SDT assumes that an individual's motivation for behavioral actions can vary from
21 controlling (i.e. behavior regulated by external demands) to autonomous (i.e. behavior regulated by
22 personal values). Due to its volitional character, autonomous motivation is assumed to produce long-
23 term behavior. This form of motivation can be facilitated by a social environment providing support
24 for the three basic psychological needs, i.e. the need for autonomy, the need for competence and the
25 need for relatedness. Autonomy refers to the performance of a behavior with a sense of choice and
26 personal control; Competence implies the pursuit of mastering a behavior within a challenging
27 environment; Relatedness reflects the experience of belongingness with meaningful others.

SDT-based counseling has repeatedly been shown to be effective in facilitating health-promoting behavior such as PA.³⁴ In addition to the beneficial effect of need-supportive counseling on behavioral change, the satisfaction of the three basic psychological needs across the life span is assumed to be essential to experience an ongoing sense of integrity and well-being.^{30, 35-37} More specifically, the pursuit and attainment of one's personal goals is expected to produce feelings of need-satisfaction and consequently to enhance subjective health and well-being.

Although SDT appears to be a promising approach to increase individuals' PA level and to improve their well-being, literature on need-supportive counseling involves several limitations. First, previous research on need-supportive PA coaching has rarely studied the direct and indirect effects on well-being, especially among older adults.^{18, 22, 34, 37-39} Given that well-being is considered as a crucial factor of successful aging^{9, 12}, research on the effects of SDT-based PA programs on subjective health in older adults may be valuable. Second, even though well-being is associated with PA on the one hand and with need-satisfaction on the other hand, the extent to which (one of) those constructs contribute to the prediction of well-being is less clear.^{12, 13, 24, 37, 40-41} An understanding of the primary factors that results in improved levels of well-being may advance the development and implementation of effective public health promoting strategies. Third, PA studies among clinical populations have mainly examined the effects on negative components of subjective health (e.g., anxiety). By contrast, PA interventions among non-clinical samples have mostly focused on positive health outcomes (e.g., mood).¹¹ Given that PA engagement has been demonstrated to be an effective treatment for anxiety and depression^{6, 19, 42-43}, and that advanced age is associated with an increased risk of depression^{44, 45}, it may be valuable to evaluate the potential of PA engagement in the prevention of psychological health problems among non-clinical healthy (older) adults.¹² Fourth, most research on the association between PA and subjective health has been cross-sectional.²⁴ Moreover, only a limited number of the studies that involve a longitudinal design have focused on the long-term effects of PA on well-being, i.e. one year or more after the PA program.^{4, 7, 15, 18} Knowledge on the duration of the effects may be helpful to determine which aspects are needed in a PA intervention to improve indicators of subjective health in the long term. Fifth and finally, to our knowledge, no studies have compared the effectiveness on well-being of one-contact PA counseling and more time-

1 consuming PA coaching. In order to implement the most optimal strategy, comparing the (cost-)
2 effectiveness of different health promoting procedures may be valuable.

3 Based on the abovementioned reasoning, the main purpose of this study was to examine whether
4 different PA promoting strategies varying in counseling method and counseling intensity among
5 healthy sedentary older adults yield improvements in different indicators of subjective health in the
6 short term (i.e. ten weeks after the beginning of the intervention) as well as in the long term (i.e. one
7 year and two years after the beginning of the intervention). More specifically, we evaluated the effects
8 of PA counseling on well-being (i.e. a positive indicator of subjective health; closely related to
9 physical fitness and PA because of its physical component) and on trait anxiety (i.e. a negative
10 indicator of subjective health; characterizing individuals' personality). The following three PA
11 interventions were compared: (1) a one-contact PA referral in which a Health Fitness Specialist
12 explained existing locally-organized PA opportunities (i.e. REFER); (2) a one-contact advice session
13 in which a Health Fitness Specialist provided a structured walking program in addition to the referral
14 (i.e. WALK). Due to the structured format and the gradually increasing difficulty of the walking
15 program, WALK was assumed to implicitly support participants' need for competence; and (3) a ten-
16 week multiple-contact individually-tailored PA coaching in which a Health Fitness Specialist
17 explicitly fostered the need for autonomy, the need for competence and the need for relatedness (i.e.
18 COACH). The secondary purpose of the study was to examine the extent to which older adults'
19 changes in PA on the one hand and their perceived need-support of the coach on the other hand
20 contribute to the changes in well-being and trait anxiety.

21 The year-round effects of the three intervention conditions on total number of daily steps and on self-
22 reported PA are described in detail in Van Hoecke and colleagues.⁴⁶ Compared with baseline,
23 REFER, WALK and COACH have been shown to yield increases in PA ten weeks after the beginning
24 of the intervention as well as one year after the beginning of the intervention. However, larger PA
25 increases have been found in WALK and COACH than in REFER. The associations between
26 perceived need-support and PA were mediated by autonomous motivation, irrespective of counseling
27 strategy. Because of the demonstrated PA increases in the three conditions⁴⁶ and the positive
28 association between PA and health in literature, we hypothesized that all PA programs would yield

improved levels of subjective well-being and trait anxiety immediately after, one year after and two years after the intervention. Furthermore, because previous research has indicated that fulfilling the basic psychological needs enhances vitality and well-being^{30, 37}, we expected that the improvements in well-being and anxiety would be larger in WALK and COACH compared with REFER. Moreover, because need-support was provided more explicitly in COACH than in WALK, it was hypothesized that COACH would produce larger increases in subjective health than WALK. Finally, given the abovementioned positive influence of PA and perceived need-support on health, both constructs were expected to contribute significantly to the variance in well-being and anxiety in all three interventions.

METHODS

Recruitment

The flowchart of the participants' recruitment is presented in figure 1. Flemish adults aged 60 years or older were invited to an information session on PA health benefits and PA recommendations by a Health Fitness Specialist (MSc) (i.e. participants' PA coach during the intervention). Additionally, information on study participation was provided. Recruitment took place in different regions across Flanders and occurred via local newspapers, internet-based announcements, physicians and socio-cultural organizations. Older adults who volunteered to participate in the PA program but already attained the PA health norm,⁴⁷ were excluded from the study (n = 229).

Procedure

Study purpose and procedures were explained and participants (n = 442) gave their written consent. After pre-tests, participants were randomly assigned to three PA programs, i.e. (1) a one-contact PA referral, (2) a one-contact walking program, and (3) a ten-week multiple-contact individually-tailored need-supportive PA program. In order to avoid contamination between conditions, partners and close friends who were engaged in the same socio-cultural organization were assigned to the same intervention condition. Measurements were completed before the intervention (i.e. pre-test), as well as ten weeks after (i.e. ten-week follow-up; 10-WK FU), one year after (i.e. one-year follow-up-test; 1-YR FU) and two years after the beginning of the intervention (i.e. two-year follow-up-test; 2-YR FU). Before their study participation, participants were informed on the occurrence of 10-WK FU measurements but not on the occurrence of 1-YR FU and 2-YR FU measurements. Approximately

four weeks before 1-YR FU or 2-YR FU, participants were sent a letter in which they were informed on the re-occurrence of measurements. In order to avoid dropout, non-responders were sent a reminder and were contacted by phone by a bachelor in kinesiology. The study was approved by the Ethics Committee of the KU Leuven.

Intervention conditions

PA referral condition

REFER consisted of a single 15-minute face-to-face advice session in which the coach explained and referred the older adults to locally-organized PA such as yoga, dancing, swimming, tennis, and cycling. Participants received a booklet with practical information (e.g., location, hour, contact details) on the PA opportunities in their community. In addition, the booklet included information on the sport infrastructure in the community, on the recommended PA level of 30 minutes of moderate intensity PA a day⁴⁷, and on how individuals can integrate more PA into their daily routines (e.g., by climbing stairs instead of using the elevator). Given that the coach's role was only to explain and refer, his/her role was similar to the role of a sport promoter in Flemish communities. Neither a structured PA program nor individually-tailored coaching was provided. Therefore, REFER can be considered as a minimal intervention condition.

Walking condition

In addition to the referral and the provision of the self-help booklet, participants of WALK were explained a structured walking program during the single 15-minute face-to-face contact with their coach. The walking program comprised weekly schedules of uninterrupted walks with progressively increasing volume and intensity on most days of the week. Participants were encouraged to progress through the different levels of the walking program according to their individual abilities. The structured format and the gradually increasing difficulty of the program were assumed to foster individuals' need for competence. Therefore, WALK was considered to be partially need-supportive.

Individually-tailored need-supportive PA condition

In addition to the referral and the provision the self-help booklet and the walking program, participants of COACH received a ten-week individually-tailored PA coaching based on SDT. In an initial face-to-face session with their coach, participants wrote down several PA goals in a personal

weekly schedule. The goals were specified by PA type, location, time frame, and company. Moreover, they were consistent with their preferences and abilities. Every ten days, they were supported by their coach through face-to-face contacts or booster phone calls, according to their preferences and needs. More specifically, the coach explicitly fostered the basic psychological needs outlined by SDT, i.e. the need for autonomy (e.g., by exploring PA options), the need for competence (e.g., by providing positive feedback) and the need for relatedness (e.g., by expressing empathy). In addition, barriers were identified, goals were modified if necessary and participants were stimulated to persist in the program by using behavior change techniques (e.g., suggesting prompts and cues) and applying motivational interviewing.⁴⁸⁻⁴⁹

Measures

Control variables

During pre-tests, participants were asked for their age, gender and marital status. Moreover, self-rated health status (one item) was measured at baseline on a five-point Likert scale ranging from ‘1 = I feel very unhealthy’ to ‘5 = I feel very healthy’.

Criterion variables

Subjective well-being was assessed with the Louvain Well-Being Scale.⁵⁰ This scale comprises items that refer to physical well-being (four items; e.g., ‘I am satisfied with my body’) and items that refer to psychological well-being (four items; e.g., ‘I am happy with the person I am’). Participants indicated how frequently they agreed with the given statement on a seven-point Likert scale ranging from ‘1 = never’ to ‘7 = always’. Cronbach’s α coefficients for pre-test, 10-WK FU, 1-YR FU and 2-YR FU exceeded .86, indicating good internal consistency.

Trait anxiety was measured by 11 items of the Dutch version of the State-Trait Anxiety Inventory.⁵¹ Trait anxiety is described as a relatively stable individual difference in anxiety proneness and refers to a general tendency to respond with anxiety to perceived environmental threats. Participants indicated how frequently they perceived the stated emotions (e.g., ‘I am happy’ or ‘I feel safe’) on a four-point Likert scale ranging from ‘1 = almost never’ to ‘4 = almost always’. Cronbach’s α coefficients exceeded .82 at pre- and follow-up-test measurements, indicating good internal consistency.

Predicting variables

PA was measured by a modified version of the Godin Leisure-Time Exercise Questionnaire⁵² (GLTEQ), for which test-retest reliability and adequate validity have been shown.⁵³⁻⁵⁴ This brief and easy comprehensible questionnaire asks participants to report their frequency of 20-minute bouts of mild, moderate and strenuous PA in a typical week during the previous month. An overall measure of self-reported PA was obtained by summing the frequencies weighted by their metabolic equivalents, i.e. three, five and nine respectively.

Ten weeks after the beginning of the intervention, perceived need-support of the coach was assessed using a modified version of the Teacher As Social Context Questionnaire.⁵⁵ This questionnaire refers to the three dimensions of coaches' behavior postulated by SDT, i.e. autonomy (eight items; e.g., 'My coach listens to my opinion and ideas'), competence (eight items; e.g., 'My coach shows me how to solve problems for myself') and relatedness (eight items; e.g., 'My coach really cares about me'). Participants indicated their agreement with the items on a five-point Likert scale ranging from '1 = completely disagree' to '5 = completely agree'. As suggested by Vansteenkiste et al.⁵⁶, a general measure of perceived need-support, based on the 24 items, was used for analyses. Good internal consistency was shown with a Cronbach's α coefficient of .84.

Statistical analyses

Data analysis was conducted with SPSS 16.0 (SPSS Inc, Chicago, IL, USA). One-way ANOVAs and chi-square tests (χ^2) were used to assess differences between conditions. Changes over time between conditions in general and between separate conditions were determined by linear mixed models with an unstructured covariance structure and by contrast estimates, respectively. Given that mixed model analysis denotes each observation without adjusting for missing values, Lane⁵⁷ indicated this approach as reliable and statistically grounded for handling missing values in a longitudinal design. Hierarchical pairwise regression analyses were conducted to predict changes in well-being and trait anxiety by changes in PA and perceived need-support. Participants who exceeded three standard deviations from the PA mean score at pre- or follow-up-test measurements were excluded from the regression analyses ($n = 32$). Significance level was set at $P < .05$.

RESULTS

Participants

The final sample consisted of 66.7% female older adults. The majority of the participants (64.3%) was married or lived together with their partner. The mean age was 69.48 ± 6.71 years, with a maximum of 93 years; Respectively 60.9%, 31.4% and 7.7% of the participants were aged between 60 and 70 years, between 71 and 80 years, and over 80 years. The average number of years of education was 12.09 ± 2.76 years; Respectively 31.0%, 36.4% and 32.6% of the participants had a primary educational level (i.e. at least nine years of education), a secondary educational level (i.e. at least 12 years of education) and a high educational level (i.e. 15 or more years of education). Gender, age and years of education were not significantly different between the three conditions. A significantly larger proportion of the participants of COACH (i.e. 73.3%) was married compared with REFER (i.e. 56.8%) ($\chi^2 = 10.399$, $P = .006$).

Dropout

Dropout rates are shown in figure 1. Respectively 4.5%, 21.7% and 22.2% of the participants dropped out at 10-WK FU, 1-YR FU and 2-YR FU. Health problems (e.g., low back pain, cancer) and a lack of interest were the most frequently reported reasons. The dropout rates were not significantly different between REFER, WALK and COACH (10-WK FU: $\chi^2 = 5.265$, $P = .072$; 1-YR FU: $\chi^2 = 2.425$, $P = .297$; 2-YR FU: $\chi^2 = 1.791$, $P = .408$). No significant differences emerged between dropouts and non-dropouts with respect to gender and baseline levels of well-being, trait anxiety and PA. However, self-rated health at baseline was significantly lower in dropouts compared with non-dropouts at 10-WK FU ($F = 16.881$, $P = .000$), at 1-YR FU ($F = 5.761$, $P = .017$) and at 2-YR FU ($F = 15.338$, $P = .000$). Moreover, dropouts were significantly older than non-dropouts at 1-YR FU ($F = 6.994$, $P = .008$) and at 2-YR FU ($F = 10.709$, $P = .001$). At 2-YR FU, a smaller proportion of dropouts was married or lived together with their partner compared with non-dropouts ($\chi^2 = 5.188$, $P = .023$).

Intervention effects

Multivariate analyses indicated that overall changes in well-being and trait anxiety were (borderline) significantly different between REFER, WALK and COACH (Roy's largest root: $F = 2.054$, $P = .129$). More specifically, changes in well-being and trait anxiety between the intervention conditions

were (borderline) significantly different from pre- to 10-WK FU-test (Roy's largest root: $F = 2.188$, $P = .114$), from pre- to 1-YR FU-test (Roy's largest root: $F = 3.172$, $P = .043$), and from pre- to 2-YR FU-test (Roy's largest root: $F = 2.825$, $P = .061$).

Well-being

Well-being was not significantly different between REFER, WALK and COACH at pre-test ($F = 0.143$, $P = .866$), 10-WK FU ($F = 0.119$, $P = .887$), 1-YR FU ($F = 0.662$, $p = .516$) and 2-YR FU ($F = 0.134$, $P = .874$). An overall change over time emerged ($P = .000$) but no differences in overall changes were found between the conditions ($P = .895$) (table 1). With respect to changes in well-being between REFER, WALK and COACH separately, no significant differences were found from pre-test to 10-WK FU, from pre-test to 1-YR FU and from pre-test to 2-YR FU.

Well-being significantly improved from pre-test to 10-WK FU and from pre-test to 1-YR FU (all $P = .000$) (figure 2). More specifically, significant increases were found in all three conditions. Whereas well-being did not change significantly from 10-WK FU to 1-YR FU ($P = .769$), there was a significant decrease from 10-WK FU to 2-YR FU ($P = .000$) and from 1-YR FU to 2-YR FU ($P = .000$). The abovementioned changes resulted in the absence of a significant change in well-being from pre-test to 2-YR FU ($P = .241$), indicating a relapse to baseline level two years after the intervention.

Trait anxiety

Trait anxiety was not significantly different between the conditions at pre-test ($F = 1.332$, $P = .265$), 10-WK FU ($F = 0.106$, $P = .900$), 1-YR FU ($F = 0.595$, $P = .552$) and 2-YR FU ($F = 0.580$, $P = .561$). An overall change over time emerged ($P = .000$) but no differences in overall changes were found between REFER, WALK and COACH ($P = .660$) (table 1). With respect to changes in trait anxiety between REFER, WALK and COACH separately, no significant differences were found from pre-test to 10-WK FU, from pre-test to 1-YR FU and from pre-test to 2-YR FU.

Trait anxiety significantly improved from pre-test to 10-WK FU ($P = .004$), from 10-WK FU to 1-YR FU ($P = .020$) and consequently from pre-test to 1-YR FU ($P = .000$) (figure 2). There was a significant increase in trait anxiety from 1-YR FU to 2-YR FU ($P = .000$) as well as from 10-WK FU to 2-YR FU ($P = .000$). The abovementioned changes resulted in a significant increase in trait anxiety from pre-test to 2-YR FU ($P = .021$).

One-way ANOVAs revealed that participants who improved in well-being and trait anxiety showed respectively lower and higher baseline levels compared with participants who did not improve (pre-test to 10-WK FU: well-being: $F = 44.917$, trait anxiety: $F = 24.124$; pre-test to 1-YR FU: well-being: $F = 40.458$, trait anxiety: $F = 13.451$; pre-test to 2-YR FU: well-being: $F = 33.557$, trait anxiety: $F = 14.875$; all $P = .000$). These results point out that especially participants with worse initial levels of well-being and trait anxiety improved in the short and the long term.

Regression analyses

Regression analyses were conducted to examine the predictability of changes in well-being and trait anxiety by changes in PA, irrespective of condition (table 2). Model 1 displays the abovementioned predictability by adjustment for several control variables, i.e. demographic variables (age, gender and marital status) and self-rated health at baseline. In model 2, perceived need-support of the coach at 10-WK FU was added to the set of predicting variables.

Self-rated health at baseline was 3.637 ± 0.609 , 3.630 ± 0.675 and 3.593 ± 0.656 in REFER, WALK and COACH, respectively. Perceived health at baseline was not significantly different between the conditions ($F = 0.195$, $P = 0.823$). Perceived need-support of the coach after the intervention was 4.500 ± 0.416 , 4.553 ± 0.408 and 4.635 ± 0.306 in REFER, WALK and COACH, respectively. Despite the relatively high score of need-support in each condition, significant differences were found between the conditions ($F = 4.430$, $P = .012$). More specifically, perceived need-support was significantly higher in COACH than in REFER ($P = .003$).

Well-being

The set of variables of model 1 and model 2 significantly predicted changes in well-being. Variance in PA significantly contributed to this predictability, meaning that increased PA contributed to an increased level of well-being from pre- to follow-up-tests. Perceived need-support of the coach after the intervention additionally contributed to changes in well-being from pre-test to 10-WK FU and from pre-test to 1-YR FU. Furthermore, a lower baseline level of self-rated health, being married and being younger significantly contributed to larger improvements in well-being from pre-test to 10-WK FU, from pre-test to 1-YR FU and from pre-test to 2-YR FU, respectively.

Trait anxiety

With respect to trait anxiety, the proposed models significantly predicted changes in trait anxiety from pre-test to 1-YR FU, with changes in PA and perceived need-support at 10-WK FU (significantly) contributing to this predictability. Moreover, participants who were married tended to improve more in trait anxiety from pre-test to 2-YR FU compared with those who were single (model 1: $\beta = -.115$, $P = .058$; model 2: $\beta = -.106$, $P = .082$).

DISCUSSION

This study compared the short- and long-term effects on subjective health of three PA counseling procedures among older adults: (1) a one-contact PA referral, (2) a one-contact provision of a structured walking program, and (3) a multiple-contact individually-tailored PA coaching based on SDT. Despite the inconsistent findings in literature with respect to the effectiveness of PA promotion on indicators of mental health^{6, 10, 14, 16-17}, improvements in well-being and trait anxiety were found shortly (i.e. ten weeks) after the beginning of the intervention in REFER, WALK and COACH. This finding suggests that various PA counseling procedures can be successful in increasing well-being and decreasing trait anxiety among older adults who are motivated to increase their PA. The finding that especially participants with worse initial levels of subjective health improved in well-being and trait anxiety can be explained by the occurrence of a ceiling effect. More specifically, participants who are already happy and satisfied with their life are less likely to further improve in subjective health and well-being.

In addition to the demonstrated effectiveness in the short term and even though PA interventions examining sustained effects on subjective health have produced inconsistent results^{7, 15, 18, 40, 58, 59}, this study indicated positive effects of REFER, WALK and COACH on well-being and trait anxiety in the long term, i.e. one year after the intervention. However, two years after the intervention, the level of well-being and trait anxiety respectively decreased to and exceeded baseline levels. This finding indicates that the applied PA counseling strategies were insufficient to maintain enhanced levels of subjective health over a two-year follow-up period. Consequently, the implementation of booster sessions might be needed in order to maintain improved levels of subjective health. In this respect, sustained PA promotion can be a potential strategy not only to maintain one's enhanced level of well-being but also to counteract the age-related decline in psychological health.^{12, 60} Moreover, other

aspects than PA promotion are possibly essential to maintain satisfactory feelings of well-being and trait anxiety among older adults.

The demonstrated effectiveness on both well-being and trait anxiety is interesting. Even though these two constructs can be considered as indicators of subjective health, they involve diverse characteristics: (1) Whereas well-being emphasizes the positive aspects of subjective health such as happiness, trait anxiety refers to stress-related emotions such as fear. Even though it has been stated that PA is especially effective in producing changes in indicators of a positive affective nature¹², results of this study have not only indicated improvements in well-being but also in trait anxiety; (2) Trait anxiety is a clear indicator of psychological health, whereas the applied measurement of subjective well-being comprises both a psychological and physical component. Given that physical fitness can be influenced directly by PA, we expected that well-being would improve more rapidly than trait anxiety. Moreover, because trait anxiety represents a more stable personality characteristic referring to how people feel ‘in general’, this construct is probably less likely to change shortly after PA has increased. However, the PA interventions did not only yield immediate changes in well-being, but also in trait anxiety. Despite the abovementioned diversity between well-being and trait anxiety, the different PA programs have been found to be successful in increasing positive emotions and decreasing negative emotions in healthy older adults.

Contrary to our expectations, changes in well-being and trait anxiety were not significantly different between the three intervention conditions. The following two reasons might explain the lack of differences in changes in subjective health between REFER, WALK and COACH: (1) Each of the PA counseling strategies have been found to be effective in increasing PA⁴⁶, which in turn has been shown to yield improvements in subjective health⁹⁻¹⁰; and (2) Given that well-being is assumed to be enhanced by environmental factors facilitating the needs for autonomy, competence and relatedness³⁰, the similar changes in subjective health in all three intervention conditions suggest that not only WALK and COACH but also REFER was perceived as need-supportive. More specifically, in COACH, the Health Fitness Specialist explicitly fostered the three basic psychological needs outlined by SDT. In WALK, participants were explained a walking program with gradually increasing walking volume and intensity. Due to the structured format, the walking program was expected to implicitly

support the need for competence and therefore to evoke feelings of success. Finally, participants were probably appreciative and pleased to take part in a scientific research. In this respect, participants of REFER might have perceived the 15-minute contact with the coach as need-supportive, even though this contact was not aimed to support the basic psychological needs. The abovementioned assumption is in accordance with the high rates of perceived need-support in all three interventions (i.e. 4.50 or more on a five-point Likert scale).

The demonstrated positive effects of need-supportive PA counseling on well-being and trait anxiety in this study are consistent with previous intervention studies that showed psychological benefits due to an autonomy-supportive exercise instructing style among (older) adults.^{22, 37, 39} Similarly, qualitative research of Lloyd and Little³⁸ demonstrated improved well-being through engagement in leisure-time PA in which SDT was supported. In this respect, Stathi et al.³¹ emphasized that PA programs should meet older adults' personal needs, goals and preferences in order to obtain positive effects on well-being. The satisfaction of the basic psychological needs is thus not only associated with behavioral persistence (e.g., PA) but also with higher levels of subjective health and well-being.^{30, 35-36, 61-62}

Even though mental health has been shown to be related to PA and perceived need-support, there is a lack of research studying the contribution of these two constructs to improved subjective health.^{22, 24, 41}

Identifying the determinants of health and well-being can be helpful to develop optimal health promoting strategies among older adults.⁶³ The results of the present study indicate that increases in PA and perceived need-support of the coach after a PA intervention significantly contribute to positive changes in well-being and trait anxiety. Need-supportive PA counseling can therefore be considered as an appropriate strategy to enhance subjective health among older adults. The close association between PA, perceived need-support and subjective health is reinforced by the significant correlations between those constructs. In addition, subsequent one-way ANOVAs underscored the importance of encouraging older adults to attain the PA health norm as prescribed by Haskell et al.⁴⁷ in order to improve their subjective health perception. More specifically, participants scoring 27 or more on the GLTEQ indicated a significantly higher level of well-being and a lower level of trait anxiety compared with those who did not attain a GLTE-score of 27. According to Scheerder et al.⁶⁴,

a score of 27 on the GLTEQ corresponds with the public health recommendation of 20 minutes of strenuous PA three times a week.

Notwithstanding the abovementioned significant contributions of changes in PA and need-support to changes in well-being, three comments should be made. First, consistent with previous findings in the literature, the explained variances were rather small.^{41, 65} This suggests that, in addition to increased PA and perceived need-support, other factors are important to improve older adults' subjective health. Besides demographic variables such as age and marital status, research has identified the following determinants of quality of life and well-being in older adults: perceived health status, social reasons, individuals' personal goals and needs, leisure-time activities in general and activity-related enjoyment.^{7, 13, 18, 60-61, 65-66} According to Everard⁶⁶, the low predictability of changes in well-being can also be attributed to the participants' sample, i.e. a homogenous group of relatively healthy community-dwelling older adults.

Second, the explained variances in well-being were larger than the explained variances in trait anxiety, meaning that changes in PA and perceived need-support contributed to a greater extent to changes in well-being than to changes in trait anxiety. This is in line with Diener et al.²⁶ who indicated that subjective health is a multidimensional construct comprising indicators that can be influenced differently. On the one hand, the applied measurement of well-being involved a psychological as well as a physical component. Physical well-being does not only refer to the avoidance of diseases, but also addresses the experience of a good health, the increase in physical fitness, the satisfaction with one's body and the ability to perform habitual tasks without effort.^{9, 61} These physical aspects of well-being are probably affected relatively easily by changes in PA. This is in accordance with Rejeski et al.⁴⁰ who stated that functional changes are the most direct and salient effects experienced through involvement in PA programs. Similarly, Stathi et al.⁹ indicated the direct effect of PA on physical well-being. On the other hand, trait anxiety refers to a general tendency to respond anxiously to perceived environmental threats, and therefore involves a more stable dimension of subjective health. Therefore, trait anxiety is less likely to be influenced directly and to a large extent by changes in PA.²⁰ Moreover, given that a significant contribution of changes in PA to changes in trait anxiety could only be indicated in the long term, i.e. one year after the intervention, older individuals might need more

1 time to perceive the psychological benefits associated with PA than the physical benefits associated
2 with PA.

3 Third, despite the significant contribution of changes in PA to changes in subjective health from pre-
4 test to 1-YR FU, the prediction is less clear from pre-test to 2-YR FU with respect to well-being and
5 even disappears with respect to trait anxiety. Moreover, after a two-year follow-up period, perceived
6 need-support of the coach does not longer contribute to changes in subjective health. Given that PA
7 further increased from pre-test to 2-YR FU, other factors such as age and changes in participants'
8 social environment might have led to the decreases in well-being and increases in anxiety. Moreover,
9 the current findings suggest that coaches should continue fostering the needs for autonomy,
10 competence and relatedness in order to maintain high levels of subjective health.

11 Notwithstanding the rather low predictability of changes in subjective health by changes in PA and
12 perceived need-support, these results point out the importance of motivating individuals to increase
13 their PA level, of stimulating coaches to facilitate their clients' needs for autonomy, competence and
14 relatedness, and of encouraging policy makers to support the implementation of (SDT-based) PA
15 interventions in order to obtain subjective health benefits at community level.⁴⁰ However, prior to
16 implement health promoting strategies in the wider community, their cost-effectiveness should be
17 considered. In this respect, REFER and WALK are one-contact PA counseling procedures whereas
18 COACH involves a multiple-contact and thus more time-consuming procedure. Moreover, given that
19 the PA counseling associated with REFER and WALK is not individually-tailored, this counseling
20 can take place at group level (e.g., in a socio-cultural organization). Consequently, health promoting
21 strategies such as REFER and WALK might be more beneficial to implement at a large scale than
22 multiple-contact individually-tailored coaching, especially in a context of limited resources. In
23 addition to this lifestyle approach that aims to improve individuals' well-being through an increase of
24 their PA level, structural environmental changes may also increase individuals' PA level and
25 subsequently enhance public health. For example, given the favorable climate in Belgium and more
26 specifically in Flanders, building safe bicycle and footpaths may be helpful to promote active
27 transportation among the Flemish population.

Before concluding, several strengths and limitations should be noted. The use of a longitudinal study design constitutes a first strength. This allowed us to examine causality rather than merely cross-sectional associations between PA, need-support and psychological responses. Moreover, the assessment of well-being and trait anxiety one year and two years after the intervention provided information on the sustainability of the effects of the different PA programs on mental health. Second, given that well-being is associated with PA on the one hand and with need-support on the other hand, the extent to which both constructs contribute to the prediction of well-being was studied. This enabled us to gain insight in the mechanisms leading to improved psychological health. Third, by studying the PA effects on well-being (i.e. positive indicator of subjective health, comprising physical and psychological well-being) as well as on trait anxiety (i.e. negative indicator of subjective health, considered as a relatively stable individual characteristic), subjective health was approached as a multidimensional construct.

The lack of a strict control condition constitutes a first limitation. This prevented us from drawing strong conclusions on the impact of the PA programs relative to participation effects. However, the demonstrated year-round improvements in well-being and trait anxiety suggest that the PA interventions considerably contributed to the increases in subjective health. Due to the health promoting character of the study and the voluntarily participation of the older adults, we considered it more ethical to include a minimal PA counseling procedure rather than a no-treatment condition. A second limitation refers to the generalization of the study results. Recruitment occurred through media campaigns which involve voluntarily participation to the study. Consequently, the sample consisted of sedentary but relatively healthy and highly educated older adults who were initially already motivated to increase their PA, and thus to improve their health. This self-selection recruitment procedure reduces the generalizability of the findings to (younger) adults who are less motivated, have less education, and are in poorer health. Third, measurements were based on self-reports, which can have led to overestimation and social desirability. However, compared with objective health indices, subjective measures of health have been shown to be more strongly related to outcomes such as life satisfaction.¹³ Finally, given that dropouts were significantly different from non-dropouts with respect to age, marital status and self-rated health at baseline, there might have occurred some attrition bias

on the observed study results. However, neither baseline levels of well-being and trait anxiety (i.e. the criterion variables) nor baseline levels of PA were significantly different between dropouts and non-dropouts.

To conclude, this study provides evidence for the year-round effectiveness of multiple PA programs on well-being and trait anxiety among older adults, especially in those with initially lower levels of mental health. In addition to enjoyment and a meaningful social environment, the results indicate the importance of increased PA and a sufficient level of perceived need-support in order to maintain satisfactory feelings of mental health and well-being among this population over a one-year follow-up period. However, the lack of beneficial effects of the PA counseling procedures on well-being and trait anxiety over a two-year follow-up period points out that the applied PA promoting strategies were inappropriate to maintain enhanced levels of mental health in the long term. The absence of differences in associations between REFER, WALK and COACH and the indicators of mental health suggests that both one-contact PA counseling and more time-consuming need-supportive coaching are valuable health promoting strategies among older adults. Given that a PA referral and the provision of a walking program only involve a single advice session, these counseling strategies entail relatively low costs and are therefore particularly beneficial to implement in a wider community compared with multiple-contact PA coaching. This study constitutes a promising step in the development and implementation of cost-effective health promoting strategies in the wider community.

ACKNOWLEDGEMENTS

- [REDACTED] is a Ph.D. fellow of [REDACTED].
- The study design from pre-test to ten-week follow-up was funded by the Flemish Government.

REFERENCES

- (1) Leon DA. Trends in European life expectancy: A salutary view. *Int J Epidemiol.* 2011;40:271–277.
- (2) Crews DE, Zavotka S. Aging, disability, and frailty: Implications for universal design. *J Physiol Anthropol.* 2006;25:113–118.

- 1 (3) Naughton C, Bennett K, Feely J. Prevalence of chronic disease in the elderly on a national
2 pharmacy claims database. *Age Ageing*. 2006;35:535–536.
- 3 (4) Penedo FJ, Dahn JR. Exercise and well-being: A review of mental and physical health
4 benefits associated with physical activity. *Curr Op Psychiatry*. 2005;18:189–193.
- 5 (5) Biddle SJH, Mutrie N. *Psychology of Physical Activity: Determinants, Well-being and*
6 *Interventions*. New York, NY: Routledge; 2008.
- 7 (6) Fox RF. The influence of physical activity on mental well-being. *Public Health Nutr*.
8 1999;2:411–418.
- 9 (7) DiLorenzo TM, Bargman EP, Stucky-Ropp R, Brassington GS, Frensch PA, LaFontaine T.
10 Long-term effects of aerobic exercise on psychological outcomes. *Prev Med*. 1999;28:75–85.
- 11 (8) Hale BS, Koch KR, Raglin JS. State anxiety responses to 60 minutes of cross training. *Br J*
12 *Sports Med*. 2002;36:105–107.
- 13 (9) Stathi A, Fox KR, McKenna J. Physical activity and dimensions of subjective well-being in
14 older adults. *J Aging Phys Act*. 2002;10:76–92.
- 15 (10) Netz Y, Wu MJ, Becker BJ, Tenenbaum G. Physical activity and psychological well-being in
16 advanced age: A meta-analysis in intervention studies. *Psychol Aging*. 2005;20:272–284.
- 17 (11) Byrne A, Byrne DG. The effect of exercise on depression, anxiety and other mood states: A
18 review. *J Psychosom Res*. 1993;37:565–574.
- 19 (12) McAuley E, Rudolph DL. Physical activity, aging, and psychological well-being. *J Aging*
20 *Phys Act*. 1995;3:67–96.
- 21 (13) Rejeski WJ, Mihalko SL. Physical activity and quality of life in older adults. *J Gerontol*.
22 2001;56A:23–35.
- 23 (14) Chin A Paw MJM, van Poppel MNM, Twisk JWR, van Mechelen W. Effects on resistance
24 and all-round, functional training on quality of life, vitality and depression of older adults
25 living in long-term care facilities: A ‘randomized’ controlled trial. *BMC Geriatrics*. 2004;4:5–
26 13.
- 27 (15) Fox KR, Stathi A, McKenna J. Physical activity and mental well-being in older people
28 participating in the Better Ageing Project. *Eur J Appl Physiol*. 2007;100:591–602.

- 1 (16) Perrig-Chiello P, Perrig WJ, Ehrlam R, Staehelin HB, Krings F. The effects of resistance
2 training on well-being and memory in elderly volunteers. *Age Ageing*. 1998;27:469–475.
- 3 (17) Tsutsumi T, Don BM, Zaichkowsky LD, Delizonna LL. Physical fitness and psychological
4 benefits of strength training in community dwelling older adults. *J Physiol Anthropol*.
5 1997;16:257–266.
- 6 (18) McAuley E, Blissmer B, Marquez DX, Jerome GJ, Kramer AF, Katula J. Social relations,
7 physical activity, and well-being in older adults. *Prev Med*. 2000;31:608–617.
- 8 (19) Stathopoulou G, Powers MB, Berry AC, Smits JAJ, Otto MW. Exercise interventions for
9 mental health: A quantitative and qualitative review. *Clin Psychol Sci Prac*. 2006;13:179–
10 193.
- 11 (20) Petruzzello SJ, Landers DM, Hatfield BD, Kubitz KA, Salazar W. A meta-analysis on the
12 anxiety-reducing effects of acute and chronic exercise. *Sports Med*. 1991;11:143–182.
- 13 (21) Hui E, Chiu BT, Woo J. Effects of dance on physical and psychological well-being in older
14 adults. *Arch Gerontol Geriatrics*. 2009;49:45–50.
- 15 (22) Solberg PA, Hopkins WG, Ommundsen Y, Halvari H. Effects of three training types on
16 vitality among older adults: A self-determination theory approach. *Psychol Sport Exerc*.
17 2012;13:407–417.
- 18 (23) Morgan AL, Tobar D, Snyder L. Walking toward a new me: The impact of prescribed
19 walking 10 000 steps/day on physical and psychological well-being. *J Phys Act Health*.
20 2012;7:299–307.
- 21 (24) Lampinen P, Heikkinen RL, Kauppinen M, Heikkinen E. Activity as predictor of mental well-
22 being among older adults. *Aging Mental Health*. 2006;10:454–466.
- 23 (25) Diener ED. Assessing subjective well-being: Progress and opportunities. *Soc Indic Res*.
24 1994;31:103–157.
- 25 (26) Diener ED, Suh EM, Lucas RE, Smith HL. Subjective well-being: Three decades of progress.
26 *Psychol Bull*. 1999;125:276–302.

- 1 (27) Opdenacker J, Boen F, De Bourdeaudhuij I, Vanden Auweele Y. Explaining the
2 psychological effects of a sustainable lifestyle physical activity intervention among rural
3 women. *Mental Health Phys Act.* 2008;1:74–81.
- 4 (28) Glanz K, Bishop DB. The role of behavioral science theory in development and
5 implementation of public health interventions. *Annu Rev Public Health.* 2010;31:399–418.
- 6 (29) Deci EL, Ryan RM. *Intrinsic Motivation and Self-Determination in Human Behavior.* New
7 York, NY: Plenum; 1985.
- 8 (30) Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation,
9 social development, and well-being. *Am Psychol.* 2000;55:68–78.
- 10 (31) Stathi A, McKenna J, Fox KR. The experiences of older people participating in exercise
11 referral schemes. *J R Soc Prom Health.* 2003;124:18–23.
- 12 (32) Dacey ML. A client-centered counselling approach for motivating older adults towards
13 physical activity. *Top Geriatric Rehabil.* 2005;21:194–205.
- 14 (33) Fortier MS, Duda JL, Guerin E, Teixeira PJ. Promoting physical activity: Development and
15 testing of self-determination theory-based interventions. *Int J Behav Nutr Phys Act.*
16 2012;9:20–33.
- 17 (34) Teixeira PJ, Carraça EV, Markland D, Silva MN, Ryan RM. Exercise, physical activity, and
18 self-determination theory: A systematic review. *Int J Behav Nutr Phys Act.* 2012;9:78–107.
- 19 (35) Ryan RM, LaGuardia JG. *What is being optimized?: Self-determination theory and basic*
20 *psychological needs.* In: Honn S, Norman A, eds. *Psychology and the Aging Revolution: How*
21 *we Adapt to Longer Life.* Washington DC, US: American Psychological Association;
22 2000:145–172.
- 23 (36) Gagné M. Autonomy support and need satisfaction in the motivation and well-being of
24 gymnasts. *J Appl Sport Psychol.* 2003;15:372–390.
- 25 (37) Wilson PM, Longley K, Muon S, Rodgers WM, Murray TC. Examining the contributions of
26 perceived psychological need satisfaction to well-being in exercise. *J Appl Biobehav Res.*
27 2006;11:243–264.

- 1 (38) Lloyd K, Little DE. Self-Determination Theory as a framework for understanding women's
2 psychological well-being outcomes from leisure-time physical activity. *Leisure Sci.*
3 2010;32:369–385.
- 4 (39) Moustaka FC, Vlachopoulos SP, Kabitsis C, Theodorakis Y. Effects of an autonomy-
5 supportive exercise instructing style on exercise motivation, psychological well-being, and
6 exercise attendance in middle-aged women. *J Phys Act Health.* 2012;9:138–150.
- 7 (40) Rejeski WJ, Shelton B, Miller M, Dunn AL, King AC, Sallis JF. Mediators of increased
8 physical activity and change in subjective well-being: results from the Activity Counseling
9 Trial (ACT). *J Health Psychol.* 2001;6:159–168.
- 10 (41) Mewes N, Jekauc D, Woll A. *The influence of physical activity on well-being: A comparison*
11 *of adolescents and adults.* In: Teixeira N, ed. *Sport and Exercise Psychology: Human*
12 *Performance, Well-Being and Health.* Madeira, Portugal: 13th FEPSAC European Congress
13 of Sport Psychology; 2011:402–403.
- 14 (42) Barbour KA, Blumenthal JA. Exercise and depression in older adults. *Neurobiology Aging.*
15 2005;26:119–123.
- 16 (43) Martinsen EW. Physical activity in the prevention and treatment of anxiety and depression.
17 *Nord J Psychiatry.* 2008;62:25–29.
- 18 (44) Beekman ATF, Copeland JR, Prince MJ. Review of community prevalence of depression in
19 later life. *BJ Psychiatry.* 1999;174:307–311.
- 20 (45) Djernes, JK. Prevalence and predictors of depression in population of elderly: A review. *Acta*
21 *Psychiatr Scand.* 2006;113:372–387.
- 22 (46) Van Hoecke AS, Delecluse C, Bogaerts A, Boen F. The long-term effectiveness of need-
23 supportive physical activity counseling compared with a standard referral in sedentary older
24 adults. *J Aging Phys Act.* In press.
- 25 (47) Haskell WL, Lee I, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW,
26 Thompson PD, Bauman A. Physical activity and public health: Updated recommendation for
27 adults from the American College of Sports Medicine and the American Heart Association.
28 *Med Sci Sports Exerc.* 2007;39:1423–1434.

- 1 (48) Abraham C, Michie S. A taxonomy of behavior change techniques used in interventions.
2 *Health Psychol.* 2008;27:379–387.
- 3 (49) Miller WR, Rollnick S. *Motivational Interviewing: Preparing People for Change*. New York,
4 NY: Guilford Press; 2002.
- 5 (50) Marcoen A, Van Cotthem K, Billiet K, Beyers W. Dimensies van subjectief welbevinden bij
6 ouderen. *Tijdschr Gerontol Geriatrie.* 2002;33:156–165.
- 7 (51) Van der Ploeg HM. *Handleiding bij de Zelf-beoordelings Vragenlijst: Een Nederlandstalige*
8 *bewerking van de Spielberger State-Trait Anxiety Inventory*. Lisse: Swets & Zeitlinger; 2000.
- 9 (52) Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. *Can J*
10 *Appl Sport Sci.* 1985;10:141–146.
- 11 (53) Gionet NK, Godin G. Self-reported exercise behavior of employees: A validity study. *J*
12 *Occup Med.* 1989;31:969–973.
- 13 (54) Kriska AM, Caspersen CJ. Godin leisure-time exercise questionnaire. *Med Sci Sports Exerc.*
14 1997;29:36–38.
- 15 (55) Belmont M, Skinner E, Wellborn J, Connell J. *Teacher as Social Context: A Measure of*
16 *Student Perceptions of Teacher Provision of Involvement, Structure and Autonomy Support*
17 *(Tech. Rep. No. 102)*. New York, NY: University of Rochester; 1988.
- 18 (56) Vansteenkiste M, Sierens E, Soenens B, Luyckx K, Lens W. Motivational profiles from a
19 self-determination perspective: The quality of motivation matters. *J Educ Psychol.*
20 2009;101:671–688.
- 21 (57) Lane P. Handling drop-out in longitudinal clinical trials: A comparison of the LOF and
22 MMRM approaches. *Pharm Stat.* 2008;7:93–106.
- 23 (58) Penninx BWJH, Rejeski WJ, Pandya J, Miller ME, Di Bari M, Applegate WB, Pahor M.
24 Exercise and depressive symptoms: A comparison of aerobic and resistance exercise effects
25 on emotional and physical education in older persons with high and low depressive
26 symptomatology. *J Gerontol.* 2002;57:124–132.
- 27 (59) Solberg PA, Halvari H, Ommundsen Y, Hopkins WG. One-year follow-up of effects of
28 exercise programs on well-being in older adults. *J Aging Phys. Act.* In press.

- 1 (60) Inder KJ, Lewin TJ, Kelly BJ. Factors impacting on the well-being of older residents in rural
2 communities. *Perspect Public Health*. 2012;132:182–191.
- 3 (61) Reis HT, Sheldon KM, Gable SL, Roscoe J, Ryan RM. Daily well-being: The role of
4 autonomy, competence, and relatedness. *Person Soc Psychol Bull*. 2000;26:419–435.
- 5 (62) Milyavskaya M, Gingras I, Mageau GA, Koestner R, Gagnon H, Fang J, Boiché J. Balance
6 across contexts: Importance of balanced need satisfaction across various life domains. *Pers*
7 *Soc Psychol Bull*. 2009;35:1031–1045.
- 8 (63) Edwards T, Huebner C, Connell F, Patrick D. Adolescent quality of life, part 1: conceptual
9 and measurement model. *J Adolescence*. 2002;25:275–286.
- 10 (64) Scheerder J, Boen F, Vos S, Pelssers J, Thibaut E, Vandermeersch H. *Algemene sport- en*
11 *bewegingsdeelname in ouderen in-actie(f)? Sociaalwetenschappelijk onderzoek naar*
12 *sportdeelname en sportbehoeften van 55-plussers in Vlaanderen*. Gent: Academia Press;
13 2011.
- 14 (65) Everard K. The relationship between reasons for activity and older adult well-being. *J Appl*
15 *Gerontol*. 1999;18:325–340.
- 16 (66) Farquhar M. Elderly people’s definitions of quality of life. *Soc. Sci. Med*. 1995;41:1439–
17 1446.

Table 1. Estimated means (SE) at pre-test, pre- to ten-week follow-up-test, pre- to one-year follow-up-test and pre- to two-year follow-up-test change scores for well-being and trait anxiety in REFER, WALK and COACH, 4 (time) x 3 (conditions) interaction effects and (4) time effects for well-being and trait anxiety.

	REFER	WALK	COACH	4 x 3 interaction	Time
	Mean	Mean	Mean		
	(SE)	(SE)	(SE)	<i>F</i>	<i>F</i>
<u>Well-being</u>					
Pre	5.284	5.305	5.250		
	(.074)	(.074)	(.073)		
Δprefu1	+ 0.167	+ 0.175	+ 0.168		
	(.071)	(.070)	(.070)		
Δprefu2	+ 0.126	+ 0.193	+ 0.160	0.375	21.310 ***
	(.077)	(.078)	(.075)		
Δprefu3	- 0.068	- 0.070	+ 0.008		
	(.077)	(.076)	(.076)		
<u>Trait anxiety</u>					
Pre	1.905	1.816	1.894		
	(.043)	(.041)	(.042)		
Δprefu1	- 0.077	- 0.008	- 0.054		
	(.041)	(.041)	(.039)		
Δprefu2	- 0.130	- 0.045	- 0.088	6.687	15.236 ***
	(.041)	(.047)	(.044)		
Δprefu3	+ 0.024	+ 0.081	+ 0.035		
	(.048)	(.046)	(.46)		

Note. SE, standard error; REFER, physical activity referral condition; WALK, walking condition; COACH, individually-tailored need-supportive condition; Pre, pre-test value; Δprefu1, change score from pre- to ten-week follow-up-test; Δprefu2, change score from pre- to one-year follow-up-test; Δprefu3, change score from pre- to two-year follow-up-test; 4 x 3 interaction, interaction effect over time (4) and between conditions (3); Time, time effect over time (4); *, $P < .05$; **, $P < .01$; ***, $P < .001$.

Table 2. Regression analyses examining the predictability of pre- to ten-week follow-up-test, pre- to one-year follow-up-test and pre- to two-year follow-up-test changes in well-being and trait anxiety by changes in physical activity and need-support.

<u>Well-being</u>	Δprefu1		Δprefu2		Δprefu3	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	β	β	β	β	β	β
PA (GLTE)	.114 *	.106 *	.199 ***	.178 **	.101 #	.096 #
Need-supp.		.143 **		.122 *		.083
<i>F</i>	3.415 **	4.183 ***	4.952 ***	5.139 ***	2.812 *	2.726 *
<i>R</i> ²	.043	.062	.075	.093	.044	.051
<u>Trait anxiety</u>	Δprefu1		Δprefu2		Δprefu3	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	β	β	β	β	β	β
PA (GLTE)	-.069	-.067	-.161 **	-.137 *	-.022	-.020
Need-supp.		-1.357		-.099 #		-.070
<i>F</i>	1.807	1.766	3.043 *	2.958 **	.800	.955
<i>R</i> ²	.023	.027	.047	.056	.013	.018

Note. PA (GLTE), self-reported physical activity score by Godin Leisure-Time Exercise Questionnaire; Need-supp., perceived need-support of the coach at ten-week follow-up-test; Δprefu1 , change score from pre- to ten-week follow-up-test; Δprefu2 , change score from pre- to one-year follow-up-test; Δprefu3 , change score from pre- to two-year follow-up-test; Model 1: adjusted for age, gender, marital status, self-reported health at baseline; Model 2, model 1 plus perceived need-support of the coach at ten-week follow-up-test included as predicting variable; *, $P < .05$; **, $P < .01$; ***, $P < .001$; #, $.05 < P < .092$.

1
2
3
4
5
6

Figure 1. Flowchart of the study.

REFER, physical activity referral condition; WALK, walking condition; COACH, individually-tailored need-supportive physical activity condition.

Figure 2. Changes over time in well-being and trait anxiety.