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Research Article

# The Role of Psychological and Social Well-being on Physical Function Trajectories in Older Adults

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## Abstract

**Background:** Psychological and social well-being are emerging as major determinants in preserving health in old age. We aimed to explore the association between these factors and the rate of decline in physical function over time in older adults.
**Methods:** Data were gathered from the Swedish National study on Aging and Care in Kungsholmen (SNAC-K). The study population consisted of 1,153 non-demented, community-dwelling men and women free from multimorbidity or impairments in basic or instrumental activities of daily living at baseline. They were followed over 12 years to capture the rate of decline in physical function, which was measured by combining data on walking speed, balance, and chair stands. The association between baseline psychological and social well-being and decline in physical function was estimated through linear mixed models, after multiple adjustments including personality and depressive symptoms.
**Results:** Higher levels of psychological (β = .007; $p$ = .037) and social (β = .008; $p$ = .043) well-being were significantly associated with a decreased rate of decline in physical function over the follow-up. There was a significant three-way interaction between psychological well-being*time*sex (female vs male) (β = .015; $p$ = .047), showing that a slower decline in physical function was observed only among women and not in men. The association was strongest for individuals with high levels of both psychological and social well-being (β = .012; $p$ = .019).
**Conclusion:** High levels of psychological and social well-being may slow down the age-related decline in physical function, which confirms the complexity of older adults' health, but also points towards new preventative strategies.

**Keywords:** Functional decline, Mobility, Psychosocial, Well-being

During the last few decades, the model of successful aging suggested by Rowe and Kahn in 1997 (1) has been largely contested (2–4). It is now considered a multidimensional construct including not only physiological but also psychological and social domains (3).

There is a clear positive association between psychological well-being and short- and long-term health outcomes and quality of life (5). Individuals with higher positive affect show lower morbidity, fewer symptoms, and less self-reported pain in old age (6). Similarly, high life satisfaction is associated with longer survival (7–9), and has been suggested as an indicator of successful aging on its own (10). On the other hand, negative affect has been linked with a lower engagement in healthy behaviors and a weaker adjustment and coping capacity in the face of ill-health and disease (11). Thus, individuals with higher reported psychological well-being not only live longer but also healthier than those with lower psychological well-being (12).

Furthermore, as people age, social connections, participation, and the sense of belonging to a community become critical (13). Individuals who are socially connected are more likely to adopt healthy behaviors including participation in physically and mentally stimulating activities, adherence to medical treatments, and to report better health (14). Social support, and especially the subjective perception of availability and adequacy of support, has been found to have beneficial effects on the cardiovascular, endocrine, and immune systems (15). Also, individuals with high levels of participation in social activities have higher self-esteem, lower scores of depressive

symptoms, and better physiological and self-reported physical functioning (16,17).

Despite the growing amount of literature on psychological and social well-being and health, very few studies have looked at their combined effect. Moreover, provided the limited access to longitudinal data, previous research has rarely examined the rate of decline in physical function, an acknowledged proxy of biological aging (18) as it is associated with major health end points including disability, hospitalization, and death (19–21). The aim of our study was therefore to explore the association between factors related to psychological and social well-being and the rate of decline in physical function. Our hypothesis was that, given their complementary nature, the combination of high levels of both psychological and social well-being leads to the slowest decline in physical function over time in older adults.

## Materials and Methods

### Study Population

This research is based on data from the Swedish National study on Aging and Care in Kungsholmen (SNAC-K; http://www.snac-k.se). This is a community-based longitudinal study of randomly selected adults aged 60 years or older living at home or in institutions in the Kungsholmen district of Stockholm between 2001 and 2004. The sample was selected from 11 age cohorts (ages 60, 66, 72, 78, 81, 84, 87, 90, 93, 96, and ≥99 years) and the baseline population included 3,363 (73.3% participation rate) individuals that have been followed up regularly: every 6 years for the young-old cohorts (<78 years) and every 3 years for the older cohorts (≥78 years). Participants underwent extensive clinical examinations, interviews, and assessments by physicians, nurses, and psychologists following the same protocols in all study waves. Data on medical history and vital status were also obtained by linking SNAC-K data with the National Patient Register and the Swedish Cause of Death Register. This study included data from baseline and four follow-ups over 12 years, as shown in the population flow chart displayed in Supplementary Figure 1.

Because of the limited reliability of self-reported psychological measures in people with dementia, 207 (6.2%) subjects with a definite or questionable dementia diagnosis according to the Diagnostic and Statistical Manual of Mental Disorders (4th edition) or with a Mini-Mental State Examination (MMSE) score <24 at baseline were excluded from the study. In order to minimize reverse causality, 1,953 (61.9% of the remaining sample) individuals with multimorbidity (ie, two or more chronic diseases), 47 (3.9% of the remaining sample) with disability (ie, one or more impairments in basic or instrumental activities of daily living [ADL]), and 3 (0.3% of the remaining sample) individuals living in nursing homes at baseline were also excluded from the study.

After applying the exclusion criteria, data on psychological and social variables were available for 947 (82.13 %) and 1,099 (95.32%) of the 1,153 participants remaining in the study, respectively. SNAC-K was approved by the Regional Ethical Review Board in Stockholm, and written informed consent was obtained from participants or their next of kin in those with cognitive impairment.

### Psychological Well-being

The self-reported Life Satisfaction Index A (LSI-A) was specifically developed for older adults and captures five components of life satisfaction: zest versus apathy, resolution and fortitude, congruence between desired and achieved goals, positive self-concept, and mood tone (22). The LSI-A consists of 20 items with an "agree," "disagree," or "uncertain" response. A high score indicates that the person takes pleasure from the round of activities that constitutes his or her everyday life, regards life as meaningful and resolutely accepts life as it has been, feels he or she has succeeded in achieving his or her major goals, holds a positive self-image, and maintains happy and optimistic attitudes and mood (23).

The Positive and Negative Affect Schedule (PANAS) assesses the positive and negative affective components of psychological well-being (24). Positive affect considers the following affective features: active, inspired, determined, alert, and enthusiastic. Negative affect reflects the extent to which a person feels guilt, anger, or fear, and it considers the following features: distressed, upset, scared, nervous, and afraid. Respondents were asked to report whether and to what extent they had felt in the above-mentioned affective states during the last 4 weeks. The response options were "not at all," "a little," "somewhat," "quite a bit," and "very much." Negative affect scores were reversed to enable their interpretation in the same direction as the rest of the factors. Life Satisfaction, PANAS positive, and PANAS negative were transformed into *z*-scores and a psychological well-being index was computed by averaging all three standardized measures. The index was finally dichotomized according to the median as low (≤.13) and high (≥.14).

### Social Well-being

Social connections were assessed by asking participants about their marital status, cohabitation status, parenthood, friendships, and the frequency of direct or remote contacts with parents, children, relatives, neighbors, and friends (25). Social support was measured by asking participants about their satisfaction with the aforementioned contacts, perceived material and psychological support, sense of affinity with association members, relatives, and residence area, and being part of a group of friends. Social participation was quantified based on participants' frequency of attending the theatre, concerts, or art exhibitions; traveling; playing cards/games; or participating in social groups or a pension organization (25). All three variables were standardized based on the baseline mean and standard deviation (*z*-scores), and a social well-being index was computed subsequently by averaging these three measures. The index was finally dichotomized according to the median as low (≤.32) and high (≥.33).

### Assessment of Physical Function

Walking speed was assessed over 6 or 2.4 m, if the participant reported walking slowly, at a self-selected speed and using a walking aid if needed. It was reported as meters per seconds (m/s) reflecting the time for whichever length walked. The one-leg-balance stand was measured by asking the participant to stand as long as possible, up to 60 seconds, with eyes open. Each leg was tested twice, and the best overall score was used and reported in seconds. Finally, chair stand was tested by asking participants to fold their arms across their chest and stand up from a seated position five times consecutively as quickly as possible and the results were expressed in seconds. Participants with severe physical limitations and unable to perform any of the lower extremity tests received the worst possible score; that is, 0 seconds balance time, a walking speed of 0 m/s, or a 75-second chair stand time. Chair stand scores were reversed to enable their interpretation in the same direction as the rest of the tests. All three tests are considered reliable measures of physical function and have shown to be strong predictors of several health outcomes (26). A global physical function score was computed by

averaging the standardized measures (*z*-scores) of the three physical function measures. The *z*-scores for each physical function measure at follow-up waves were calculated based on the baseline mean and standard deviation.

### Covariates

Several covariates were considered as possible confounders and measured at baseline: age (continuous), sex (male/female), highest level of formal education (elementary school, high school, or university and above), presence of a chronic condition (yes/no) (27), alcohol consumption (never/occasional, light/moderate, or heavy consumption), smoking (never, former, or current smoker), and time to death and time to dropout (as two separate variables). In SNAC-K, personality traits (extraversion, neuroticism, and openness to experience) were assessed with a short version of the self-reported NEO Five-Factor Inventory (NEO-FFI) questionnaire (28). The MMSE 30-point screening test was used to account for participants' overall cognitive status (29) and the 10-item Montgomery-Åsberg Depression Rating Scale (MADRS) to consider depressive symptoms (30). MMSE scores ≤26 indicate higher likelihood of dementia (31) and MADRS scores >9 indicate higher likelihood of depression (32).

### Statistical Analysis

Linear mixed models were employed to estimate β coefficients (95% confidence interval) for the association between baseline levels of the psychological and social well-being scores and annual changes in physical function over the 12-year follow-up. To that end, the interaction term between follow-up time and the variables related to psychological and social well-being were included as a fixed effect. A positive β coefficient for the interaction indicates that an increase in well-being scores is associated with a slower decline in physical function over time. Models were first adjusted for sex, age, education level, and time to death/dropout (Model I), and additionally for presence of a chronic disease, alcohol consumption, smoking (Model II), MMSE, MADRS, and personality traits (Model III). The exposures were operationalized both as continuous variables and dichotomized according to medians in order to address potential non-linearity in their association with the outcome and to facilitate the interpretation of the findings. The association between each exposure and changes in physical function were first tested separately. Then, three-way interactions between both exposures*time and between covariates and each exposure*time were also tested. Last, we created an indicator variable with four mutually exclusive categories by cross-classifying individuals' levels of psychological and social well-being in order to further explore the combined effect of both exposures.

We rerun the models excluding participants with less than two measures of physical function over the whole follow-up, in order to examine the impact of longitudinal attrition. The analyses were performed using Stata version 15 with the level of statistical significance set at $p < .05$.

## Results

The baseline study population consisted of 1,153 individuals, 58% female, with a mean (*SD*) age of 67 (7.7) years, and with almost half of the sample (45.4%) holding a high school level education. This was a purposefully selected healthy sample, as shown by the low proportion of people with MADRS scores >9 (2.3%) or MMSE scores ≤26 (3.2%) (Supplementary Table 1).

The correlation within and between psychological and social well-being scores are shown in Supplementary Table 2: while psychological and social well-being scores were weakly correlated ($R = .31$), weak-to-moderate correlations were found within both indexes. As shown in Table 1, among individuals with high psychological and social well-being scores, there was a significantly lower proportion of people with elementary school education, current smokers, and with high levels of neuroticism, and a significantly higher proportion of people with a moderate alcohol consumption, and with high levels of extraversion and openness.

The baseline unadjusted mean levels of walking speed, balance, chair stands, and global physical function were lower among people with low versus high levels of psychological and social well-being (Figure 1).

In the longitudinal analyses over the 12-year follow-up, increasing levels of psychological (β = .007, $p = .037$) and social (β = .008, $p = .043$) well-being scores showed a significant positive association with the annual change in physical function after adjustment for potential confounders. When dichotomizing exposures according to the median (high vs low), the statistical significance of social well-being was lost (β = .007, $p = .084$) (Table 2). A significant three-way interaction was identified between psychological well-being*time*sex (female vs male): β = .015, $p = .047$ (Figure 2, footnotes). Indeed, when comparing women versus men with a high level of psychological or social well-being, a significantly slower decline in physical function was observed only among women and not in men (Figure 2).

Concerning the combined psychosocial indicator variable, those with high levels in both psychological and social exposures showed the strongest positive association (β = .012, $p = .019$) compared to people with low levels in both exposures (Figure 3). Participants with less than two measures of physical function were older, with lower levels of psychological and social well-being, and worse physical function at baseline ($p < .001$). However, results remained similar after excluding them from the analyses (Supplementary Table 3).

## Discussion

In this community-based study of older adults living in Kungsholmen, an urban area of Stockholm (Sweden), higher psychological and social well-being were significantly associated with a slower decline in physical function over a 12-year follow-up, independent of potential confounders. We also found that having high levels in both dimensions was associated with optimum physical function maintenance. Despite the great burden that age-related decline in physical function imposes on both individuals and societies (33), older people with positive psychosocial profiles seem to resist such decline preserving their independence for longer.

Most previous literature on well-being has focused on health outcomes other than physical function (eg, survival, chronic conditions, etc.) and has mainly looked at the inverse association (ie, from health to well-being). However, the existing evidence on the association between well-being and physical capability supports our hypothesis that greater psychological and social well-being might positively affect trajectories of physical function. For instance, in a national sample of U.S. young adults, those with persistently high psychological well-being reported less limitations in ADL over a period of 9 years compared to those with persistently low well-being (34,35). Subjects with high positive affect were half as likely to suffer ADL disabilities and two-thirds as likely to have a slow walking speed compared to those with lower positive affect

**Table 1.** Baseline Sociodemographic, Clinical, and Lifestyle Characteristics of the Study Samples by Levels of Psychological and Social Well-being

| | Psychological Well-being ($n$ = 947) | | | Social Well-being ($n$ =1,099) | | |
|---|---|---|---|---|---|---|
| | Low | High | $p$ Value[a] | Low | High | $p$ Value[a] |
| Age (%) | | | | | | |
| <78 years | 390 (48.2) | 420 (51.9) | .111 | 443 (48.0) | 480 (52.0) | .467 |
| ≥78 years | 84 (61.3) | 53 (38.7) | | 107 (60.8) | 69 (39.2) | |
| Sex (%) | | | | | | |
| Men | 190 (47.5) | 210 (52.5) | .234 | 237 (51.2) | 226 (48.8) | .826 |
| Women | 284 (51.9) | 263 (48.1) | | 313 (49.2) | 323 (50.8) | |
| Education (%) | | | | | | |
| Elementary | 50 (60.2) | 33 (39.7) | .033 | 68 (62.4) | 41 (37.6) | .007 |
| High school | 235 (54.2) | 199 (45.9) | | 276 (55.3) | 223 (44.7) | |
| University | 189 (44.0) | 214 (56.1) | | 206 (42.0) | 285 (58.0) | |
| Smoking (%) | | | | | | |
| Never | 179 (46.4) | 207 (53.6) | <.001 | 213 (46.2) | 248 (53.8) | .003 |
| Former | 187 (47.0) | 203 (52.1) | | 218 (49.2) | 225 (50.8) | |
| Current | 105 (63.3) | 61 (36.8) | | 114 (60.0) | 76 (40.0) | |
| Alcohol consumption (%) | | | | | | |
| Never/occasionally | 100 (58.5) | 71 (41.5) | .470 | 144 (67.0) | 71 (33.0) | .028 |
| Light/moderate | 279 (47.4) | 310 (52.6) | | 302 (45.1) | 367 (54.9) | |
| Heavy | 95 (50.8) | 92 (49.2) | | 104 (48.4) | 111 (51.6) | |
| Depressive symptoms (%) | | | | | | |
| MADRS ≤ 9 | 442 (48.8) | 464 (51.2) | .138 | 512 (49.0) | 532 (51.0) | .314 |
| MADRS > 9 | 18 (94.7) | 1 (5.3) | | 18 (72.0) | 7 (28.0) | |
| Cognitive function (%) | | | | | | |
| MMSE ≤ 26 | 17 (68.0) | 8 (32.0) | .594 | 24 (75.0) | 8 (25.0) | .702 |
| MMSE > 26 | 452 (49.7) | 458 (50.3) | | 511 (48.9) | 534 (51.1) | |
| Personality: extraversion (%) | | | | | | |
| Low | 182 (75.2) | 60 (24.8) | <.001 | 162 (66.9) | 80 (33.1) | <.001 |
| Average | 194 (52.0) | 179 (48.0) | | 176 (47.3) | 196 (52.7) | |
| High | 93 (28.4) | 234 (71.6) | | 111 (34.2) | 214 (65.9) | |
| Personality: neuroticism (%) | | | | | | |
| Low | 147 (32.6) | 304 (67.4) | <.001 | 181 (40.5) | 266 (59.5) | .006 |
| Average | 165 (55.7) | 131 (44.3) | | 148 (49.8) | 149 (50.2) | |
| High | 157 (80.5) | 38 (19.5) | | 120 (61.5) | 75 (38.5) | |
| Personality: openness (%) | | | | | | |
| Low | 164 (59.2) | 113 (40.8) | .030 | 163 (58.8) | 114 (41.2) | .048 |
| Average | 144 (52.9) | 128 (47.1) | | 125 (46.3) | 145 (53.7) | |
| High | 161 (41.0) | 232 (59.0) | | 161 (41.1) | 231 (58.9) | |

*Notes*: MADRS = Montgomery-Åsberg Depression Rating Scale; MMSE = Mini-Mental State Examination. Levels (high/low) of psychological and social well-being according to the median of the distribution. Missing information for the psychological well-being sample: smoking habit = 5; depressive symptoms = 22; cognitive function = 12; personality = 5. Missing information for the social well-being sample: smoking habit = 5; depressive symptoms = 30; cognitive function = 22; personality = 160.

[a]Multiple logistic regression adjusted for the rest of variables included in the left column of the table.

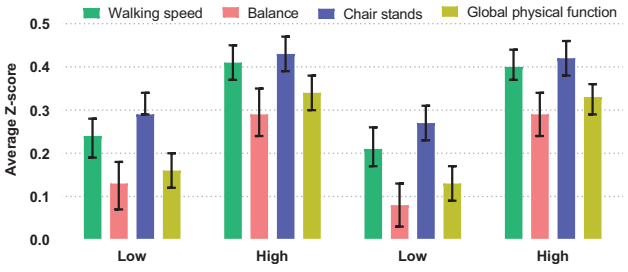


**Figure 1.** Mean and 95% confidence interval of baseline walking speed, balance, chair stands, and global physical function score by levels of psychological and social well-being. *Note:* Levels (high/low) of psychological and social well-being dichotomized according to the median of the distribution.

scores in a population-based sample of older Mexican Americans (35). Life satisfaction was associated with the development of fewer mobility limitations in a population-based study from Taiwan (36), and to a slower accumulation of basic and instrumental ADL disabilities in a Swedish cohort of older adults (23).

In the Rush Memory and Aging project, participation in common social activities was associated with a reduced risk of incident disability in basic and instrumental ADL and mobility, and a faster rate of decline in physical function throughout an average 5-year follow-up (37,38). A prospective U.S. study of elderly people also showed that interacting with people and receiving support from a wide social network can help maintain physical independence in older adults (39). Similarly, a recent longitudinal study of Swedish older adults showed that strong social connections and support

**Table 2.** Association Between Levels of Psychological and Social Well-being and Annual Change in Global Physical Function Score Over the 12-Year Follow-up

| | Model I | | Model II | | Model III | |
|---|---|---|---|---|---|---|
| | β (95% CI) | *p* Value | β (95% CI) | *p* Value | β (95% CI) | *p* Value |
| Continuous (*z*-scores) | | | | | | |
| Psychological well-being | .005 (−0.001; 0.011) | .078 | .006 (−0.0004; 0.011) | .069 | .007 (0.0004; 0.013) | .037 |
| Social well-being | .007 (−0.001; 0.013) | .098 | .006 (−0.001; 0.013) | .093 | .008 (0.0003; 0.016) | .043 |
| Categorical | | | | | | |
| Psychological well-being | | | | | | |
| Low | Ref. | | Ref. | | Ref. | |
| High | .008 (0.0002; 0.015) | .043 | .008 (0.0003; 0.015) | .042 | .009 (0.001; 0.016) | .024 |
| Social well-being | | | | | | |
| Low | Ref. | | Ref. | | Ref. | |
| High | .006 (−0.001; 0.013) | .103 | .006 (−0.001; 0.014) | .086 | .007 (−0.001; 0.014) | .084 |

*Note*: Model I: adjusted by sex, age, education level, and death/dropouts. Model II: adjusted additionally by smoking, alcohol consumption, and presence of one chronic disease. Model III: adjusted additionally by MADRS (Montgomery-Åsberg Depression Rating Scale), MMSE (Mini-Mental State Examination), and personality traits. Levels (high/low) of psychological and social well-being dichotomized according to the median of the distribution. Positive coefficients refer to lower decline in the global physical function score compared to the reference group.

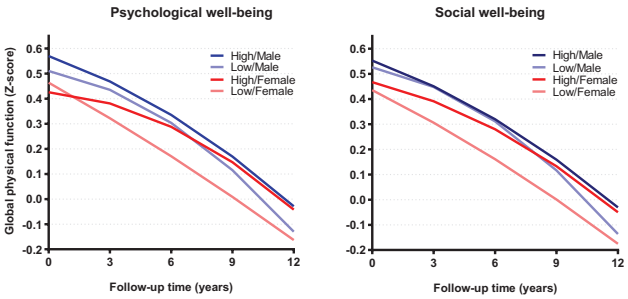


**Figure 2.** Estimated global physical function (*z*-score) over the 12-year follow-up by levels of psychological and social well-being and sex (including a quadratic function of time in the models). *Note:* Fully adjusted models. Levels (high/low) of psychological and social well-being dichotomized according to the median of the distribution. Three-way interaction for psychological well-being (high vs low)*follow-up time*sex (female vs male): β = .015; *p* = .047.

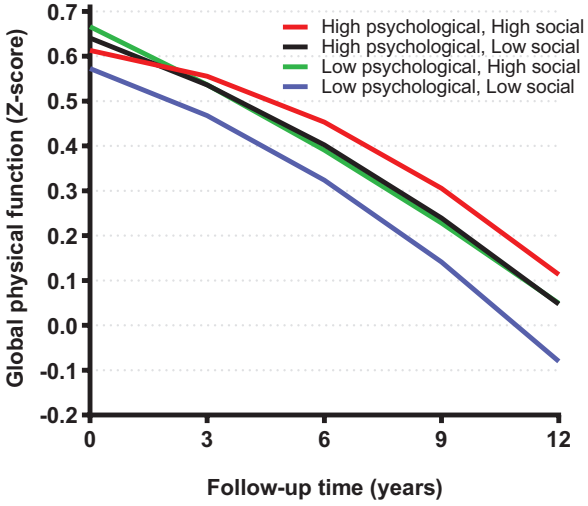


**Figure 3.** Estimated global physical function (*z*-score) over the 12-year follow-up by psychosocial profiles (including a quadratic function of time in the models). *Note:* Levels (high/low) of psychological and social well-being dichotomized according to the median of the distribution. Three-way interaction for psychological well-being (high vs low)*follow-up time*social well-being (high vs low): β = .006; *p* = .449.

may protect against fall risk and fall-related functional decline and mortality (40). Interestingly, in the few studies that looked at the association between baseline psychosocial well-being and changes in physical function in older adults with some degree of disability at baseline, the statistical significance was lost after adjusting for potential confounders (41), suggesting that well-being is a weaker predictor of physical function in samples of people where disabilities are already present.

According to our findings, the protective association between psychological and social well-being and functional decline was stronger in women compared to men. Some have found that older women seem to make a better use of positive reappraisal than older males (42), which may in turn help them preserve their physical capability. Even if other studies have also found sex to be a moderator of the connection between psychological well-being and health outcomes (43–45), convincing explanations have still not been provided.

The mechanisms behind these associations remain to be elucidated, but it is likely that both non-biological and biological processes dynamically interact to form the pathways by which psychological and social well-being impact physical function. Individuals with higher psychological well-being tend to have better self-perceptions of aging and therefore practice more preventive health behaviors such as exercising (46), taking vitamins (47), visiting doctors, or screening for diseases (11). High levels of social well-being provide a sense of belonging and self-esteem, as well as better access to resources and material goods, which have also been shown to impact older individuals' values, health behaviors, healthcare utilization, and levels of instrumental and emotional support (39,48). The fact that our results remained unchanged after adjustment for behavioral variables (ie, alcohol consumption and smoking) indicates that there may be other mechanisms related to lifestyle explaining this association. Psychological and social well-being have been linked to changes in cardiovascular, endocrine, immune, and pulmonary functions, mainly through stress-related mechanisms (6,15). People with low subjective well-being and positive affect have, indeed, increased levels of lymphocytes, leukocytes, and immunoglobulins in the blood; increased heart rate, blood pressure, finger temperature,

and skin conductance related to their cardiovascular system; and decreased respiratory function, and more frequent allergic reactions or asthma attacks concerning their respiratory system (5,6). Last, research shows that people with high levels of well-being are more resilient to stress, with the ability to recover more rapidly, both emotionally and physiologically, when faced with a stressor (49).

Preserving the functional ability is a core component of older people's general well-being and a powerful measure to identify and locate older adults across the successful aging continuum (50). In this study, we used a composite measure of muscle strength, speed, and balance to capture several dimensions of physical function needed to maintain the independence in older adults. The psychological and social factors included in this study can be considered modifiable and thus amenable to interventions aimed at preventing or decelerating functional decline in old age. Future research should address psychosocial interventions in healthy community-based samples, focusing on positive rather than negative emotions and on physical function-related outcomes, with the aim not only to enhance older people's quality of life, but also to experimentally test the well-being–physical function connection.

Strengths of this study include the use of a longitudinal population-based study over a large sample of randomly selected older adults with detailed clinical characterization and available data on a number of potential confounders such as personality and depressive symptoms. The objective and comprehensive measurement of physical function reduced the risk of self-reported bias. Moreover, because of the availability of physical function measurements at multiple time points, we were able to reliably investigate its temporal decline, which is rarely the case in previous studies. Individuals with multimorbidity or disability at baseline were excluded from our analyses, which limits the risk of reverse causality. By integrating multiple measures of psychological and social well-being, not only did we minimize measurement error but we were also able to capture the unique information about the subjective quality of an individual's life provided by each of these components. Last, we examined two important components of well-being by combining different psychological and social factors.

Our results are, however, subject to several limitations. The external validity of the study is limited because the study sample included healthy participants that were cognitively capable to complete the self-reported questionnaires. In addition, attrition due to death or dropout most likely led to an underestimation of the association under study, as those who died or dropped out had lower levels of psychosocial well-being and worse physical function. Even if we excluded subjects with disability from our study sample and adjusted our models for several confounders, the possibility of reverse causality or residual confounding cannot be fully discarded given the potential heterogeneity in subclinical health states leading to physical function impairment. The lack of time-varying measurements for psychological and social well-being could be problematic for those factors less likely to maintain within-person stability over time.

In summary, our study provides additional epidemiological insight into the multidimensional definition of successful aging, showing that the psychological and social components importantly contribute to slow down the age-related decline in physical function. These results could be useful to better understand the multifactorial process of aging, and to target older individuals for preventative interventions to reduce physical dependence and healthcare needs in old age.

## Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

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## Conflict of Interest

None reported.

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