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RESEARCH PAPER

Psychological correlates of multimorbidity and disability accumulation in older adults

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Abstract

Background/Objectives: attitudes toward life and health are emerging as important psychological contributors to health heterogeneity in ageing. We aimed to explore whether different psychological factors were associated with the rate of chronic disease and disability accumulation over time.
Design: population-based cohort study between 2001 and 2010.
Setting: Swedish National study on aging and care in Kungsholmen.
Subjects: adults aged 60 and older ($N = 2293$).
Methods: linear mixed models were employed to study the association of life satisfaction, health outlook, resistance to illness, sickness orientation, and health worry with the rate of accumulation of chronic diseases and impaired basic and instrumental activities of daily living. Models were adjusted for demographic, clinical, social, personality and lifestyle factors. Analyses were repeated after excluding individuals with multimorbidity or disability at baseline.
Results: high life satisfaction and positive health outlook were consistently associated with a lower rate of accumulation and progression of multimorbidity (β −0.064 95% confidence interval [CI] −0.116, −0.011; β −0.065 95% CI −0.121, −0.008, respectively) and disability (β −0.063 95% CI −0.098, −0.028; β −0.042 95% CI −0.079, −0.004, respectively) over time. This was true even for people without multimorbidity or disability at baseline and after adjusting for all covariates.
Conclusions: positive attitudes toward life in general and health in particular may be especially important in old age, when the cumulative effects of biological and environmental deficits lead to accelerated health decline. These findings should encourage researchers to use measures of psychological well-being to better understand the multifactorial and diverse process of ageing.

Keywords: *psychological well-being*, *multimorbidity*, *disability*, *older people*

Key points

- Perceptions of life and health are emerging as important components in the multifactorial view of successful ageing.
- Limited access to health status data over multiple time points has precluded looking at the speed of health deterioration.
- Better attitudes toward life and health are associated with a lower speed of multimorbidity and disability accumulation.

Introduction

The dynamic interplay between biological, behavioural, psychosocial, and environmental factors that unfolds over the entire life course shapes health in old age. Psychological factors that describe attitudes toward life in general, and health in particular, are emerging as important components in the multifactorial view of successful ageing [1]. For instance, those with positive self-perceptions of ageing practice more preventive health behaviours and have better health and survival outcomes, according to a meta-analysis of longitudinal data [2]. The tendency to expect positive outcomes across a variety of life domains, termed dispositional optimism, has also been associated with a better adjustment, prognosis and quality of life for a number of chronic diseases, as reported in a recent mini-review [3]. One possibility is that by mobilizing effective coping adaptations, people with positive psychological profiles experience enhanced physical and psychological resilience, the ability to thrive in the face of daily stressors [4], severe disease [5] or functional impairment [6]. High psychological well-being might also directly influence immune response and neuroendocrine system modulation [7].

Multimorbidity, the coexistence of multiple chronic conditions, has been implicated in a variety of adverse outcomes, including psychological distress, lower quality of life and mortality [8]. Maintaining physical function is another key component of healthy ageing [9]. Thus, measuring both the burden of chronic diseases and the capacity to undertake the tasks of daily living (i.e. physical function) may be a good way to capture how older adults experience their lives and health [10]. Furthermore, the speed of development of multimorbidity and disability has been interpreted as a clinical manifestation of homeostatic multisystem dys regulation and is gaining increasing attention as a potential indicator of biological ageing [11–14].

Researchers have generally had limited access to data on health status over multiple time points, which has precluded looking at the speed or rate of health deterioration. The study of trajectories, charted by a series of transitions, offers a more complete understanding of the disablement process [15]. In this study, we aimed to explore whether different measures of psychological well-being were associated with the rate of chronic disease and disability accumulation over time in a prospective population-based cohort of older adults.

Methods

Data from the Swedish National study on Aging and Care-Kungsholmen (SNAC-K) study were used for this study. SNAC-K is an ongoing longitudinal population-based study targeting people 60 years or older living at home or in institutions in central Stockholm. The SNAC-K baseline population included a sample of 3363 people (73.3% of those invited to participate) who underwent a clinical examination between May 2001 and June 2004. The sample was randomly selected from 11 age cohorts (ages 60, 66, 72, 78, 81, 84, 87, 90, 93, 96 and ≥99 years); the younger cohorts (aged 60–78 at baseline) are examined every 6 years, and the older cohorts (aged ≥78 at baseline) are seen every 3 years. 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.

This study included data from baseline and the first 3 follow-ups of SNAC-K (an average of 9 years of follow-up). People with a definite or questionable dementia diagnosis or with missing data in all psychological variables were excluded from the study sample (N = 2293) (Supplementary Figure 1 available in *Age and Ageing* online).

Assessment of life satisfaction and health perceptions

Life satisfaction was measured at baseline using the Life Satisfaction Index A (LSI-A) developed by Neugarten et al. [16] (Supplementary Text I available in *Age and Ageing* online). This validated self-report index was specifically developed for older adults and is based on the original five-component framework (i.e. zest vs. apathy, resolution and fortitude, congruence between desired and achieved goals, positive self-concept and mood tone) of the Life Satisfaction Rating Scale developed by the same authors.

SNAC-K participants' health perceptions were assessed at baseline by means of Ware's Health Perceptions Questionnaire (HPQ) [17]. Four of the six original perceptual subscales of the questionnaire are assessed in SNAC-K (Supplementary Text I available in *Age and Ageing* online): health outlook (i.e. perceptions of future health), resistance to illness (i.e. sense of susceptibility or resistance to illness), sickness orientation (i.e. tendency to accept sickness as a part of life) and health worry (i.e. amount of health-related worry or concern).

Assessment of multimorbidity and disability

Diagnoses are made by SNAC-K physicians on the basis of clinical examination, medical history, laboratory data and current drug use, and coded in accordance with the International Classification of Diseases 10th Revision (ICD-10). Linkage to Swedish outpatient and inpatient registers provides additional information on medical events. Multimorbidity was operationalized as the total count of chronic diseases on a comprehensive list of chronic conditions [18]. A threshold of <2 chronic diseases was used to identify people free from multimorbidity at baseline. Chronic conditions deemed cardiovascular risk factors (hypertension, dyslipidemia and obesity) were excluded from the total count of chronic conditions given their controversial role as determinants of older adults' health.

Level of disability was measured as the number of basic activities of daily living (ADL) (bathing, dressing, toileting, continence, transferring and eating) and instrumental activities of daily living (IADL) (grocery shopping, meal preparation, housekeeping, laundry, managing money, using the telephone, taking medications and using public

transportation) a person was unable to perform independently. People living in institutions were assumed to depend on others for grocery shopping, meal preparation, housekeeping and laundry. The number of ADL and IADL limitations was summed in a single scale (range 0–14).

Statistical analysis

We used multivariate logistic regression to explore differences in (i) people with and people without information on the psychological variables and (ii) participants who survived and those who died or dropped out during follow-up, by sociodemographic (age, sex and education) and clinical (number of chronic diseases or disabilities) characteristics.

Linear mixed models were employed to estimate β coefficients and 95% confidence intervals of the association between the baseline level (low vs. high according to the median) of the psychological factors and the number of chronic diseases and disabilities both at baseline and over the 9-year follow-up. To measure the effect of the exposures on the average annual increase in the number of chronic diseases and disabilities, the interaction terms between follow-up time (in years) and levels of the different psychological factors were included as a fixed effect. Random effects were defined for the intercept and for follow-up time and models were fit using restricted maximum likelihood. Models were adjusted for demographic and clinical factors (age, sex, civil status, depressive symptoms and cognitive function), social and personality factors (education, occupation, social network, personality and the rest of psychological factors) and lifestyle factors (smoking, body mass index and alcohol consumption) in a cumulative manner. The operationalization of all covariates included in the models is described in Supplementary Text II available in *Age and Ageing* online.

To explore potential reverse causality, the analyses were repeated excluding participants with two or more chronic diseases or any disability at baseline (i.e. prevalent cases). Only β coefficients for the time-interactions were shown in these cases. Three-way interactions (covariates * psychological exposures * time) were tested. Sensitivity analyses were performed to (i) account for mortality/attrition during follow-up by further adjusting the models for time to death or dropout, (ii) consider subclinical health status by additionally controlling for self-rated health and (iii) check for discrepancies when operationalizing the exposures as continuous standardized (i.e. z-scores) variables. All analyses were performed using Stata version 15 (StataCorp LP, College Station, TX, USA).

Results

Participants with a higher number of ADL + IADL disabilities (odds ratio [OR] 1.31 95% confidence interval [CI] 1.22; 1.41) and lower MMSE scores (OR 0.87 95% CI 0.82; 0.93) had a higher probability of missing information on the psychological variables, but there were no significant differences by sex, age, education or number of chronic diseases after adjusting for the rest of the variables. Those who died during follow-up also had a higher number of ADL + IADL disabilities (OR 1.33 95% CI 1.24; 1.42) and lower MMSE scores (OR 0.80 95% CI 0.76–0.84). Participants who dropped out during follow-up were older (OR 1.03 95% CI 1.01; 1.04), more likely to be women (OR 1.40 95% CI 1.07; 1.81) and had fewer ADL + IADL disabilities (OR 0.86 95% CI 0.75; 0.99).

The strength of the pairwise correlations amongst the different psychological exposures ranged between very weak ($r = 0.09$ for health worry and sickness orientation) and moderate ($r = 0.47$ for resistance to illness and health outlook) (Supplementary Table 1 available in *Age and Ageing* online). For most psychological variables, significantly higher (better) scores were observed for those who were younger, men and married, had a lower burden of depressive symptoms and had better cognitive status, a high level of education, a non-manual occupation, a richer social network, higher levels of extraversion, lower levels of neuroticism, higher levels of openness, higher body mass index but no obesity and some level of alcohol consumption (Supplementary Table 2 available in *Age and Ageing* online). However, only high extraversion and low neuroticism were significantly and independently associated with most psychological factors in multivariate models (Table 1).

Statistically significant differences were observed in the baseline number of chronic diseases and ADL + IADL disabilities in people reporting low vs. high life satisfaction, negative vs. positive health outlook and low vs. high resistance to illness (Supplementary Figure 2, Supplementary Table 3 available in *Age and Ageing* online).

The fully adjusted linear mixed model that included the total sample showed a significant negative association between the annual accumulation of chronic diseases and reporting high life satisfaction, a positive health outlook and a low sickness orientation (Table 2). However, the association with sickness orientation disappeared when people with multimorbidity at baseline were excluded from the analysis (Table 3). For ADL + IADL disabilities, a significant negative association was observed with high life satisfaction and low sickness orientation (Table 2), as well as with positive health outlook but only when people with prevalent disability were excluded (Table 3, Supplementary Figure 3 available in *Age and Ageing* online). The direction, significance and magnitude of all associations remained similar after further adjusting the models for mortality/attrition and/or self-rated health (Supplementary Table 4a and b available in *Age and Ageing* online). When modelling the exposures as continuous (i.e. z-scores), the statistical significance was lost for the associations between health outlook and chronic diseases and between sickness orientation and ADL + IADL disabilities (Supplementary Table 4c available in *Age and Ageing* online).

Discussion

In this community-based longitudinal study of older adults from an urban area in Stockholm, better attitudes toward

Table 1. Population distribution by demographic, clinical, social and personality variables at baseline and the association between these variables and levels of psychological factors

	n (%)[a]	Life satisfaction β (95% CI)	Health outlook β (95% CI)	Resistance to illness β (95% CI)	Sickness orientation β (95% CI)	Health worry β (95% CI)
Age						
<78 years	1425 (62.1)	Ref.	Ref.	Ref.	Ref.	Ref.
≥78 years	868 (37.9)	**−4.823**	**−6.573**	0.877	0.393	**2.141**
		(−6.557; −3.090)	(−8.683; −4.463)	(−0.903; 2.658)	(−1.355; 2.140)	(0.672; 3.609)
Sex						
Male	1411 (61.5)	Ref.	Ref.	Ref.	Ref.	Ref.
Female	883 (38.5)	0.508	−0.847	**−2.348**	−0.894	0.854
		(−1.11; 2.126)	(−2.836; 1.142)	(−4.023; −0.674)	(−2.545; 0.756)	(−0.531; 2.240)
Civil status						
Married	1166 (50.9)	Ref.	Ref.	Ref.	Ref.	Ref.
Unmarried	320 (14.0)	**−5.123**	−0.122	1.086	−0.079	0.193
		(−7.641; −2.604)	(−3.200; 2.955)	(−1.513; 3.685)	(−2.631; 2.473)	(−1.953; 2.338)
Widowed/divorced	805 (35.1)	**−5.007**	−0.499	1.664	−1.226	1.484
		(−6.810; −3.203)	(−2.721; 1.722)	(−0.209; 3.538)	(−3.067; 0.616)	(−0.062; 3.030)
Depressive symptoms						
MADRS ≤9	118 (5.3)	Ref.	Ref.	Ref.	Ref.	Ref.
MADRS >9	2117 (94.7)	**−8.659**	−1.196	−3.938	−2.343	−0.728
		(−12.781; −4.537)	(−6.129; 3.737)	(−8.123; 0.248)	(−6.448; 1.761)	(−4.173; 2.717)
Cognitive function						
MMSE ≥27	2117 (94.7)	Ref.	Ref.	Ref.	Ref.	Ref.
MMSE <27	131 (5.8)	1.693	−2.086	0.703	**−5.294**	−0.091
		(−2.116; 5.501)	(−6.635; 2.464)	(−3.114; 4.52)	(−9.113; −1.476)	(−3.248; 3.066)
Education						
>8 years	304 (13.3)	Ref.	Ref.	Ref.	Ref.	Ref.
≤8 years	1989 (86.7)	−1.845	2.437	−1.822	−2.004	**2.194**
		(−4.182; 0.492)	(−0.417; 5.29)	(−4.225; 0.581)	(−4.388; 0.380)	(0.209; 4.179)
Main occupation						
Manual	461 (20.1)	Ref.	Ref.	Ref.	Ref.	Ref.
Non-manual	1829 (79.9)	1.863	−1.596	0.092	0.739	−0.079
		(−0.089; 3.816)	(−3.968; 0.775)	(−1.900; 2.085)	(−1.232; 2.709)	(−1.725; 1.567)
Social network						
Poor	606 (27.0)	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	788 (35.1)	**6.954**	2.025	1.943	1.646	0.719
		(4.91; 8.997)	(−0.460; 4.509)	(−0.152; 4.038)	(−0.413; 3.704)	(−1.012; 2.450)
Rich	853 (38.0)	**11.249**	2.506	**3.124**	1.864	1.838
		(9.018; 13.480)	(−0.213; 5.224)	(0.830; 5.419)	(−0.386; 4.114)	(−0.054; 3.730)
Extraversion						
Low	634 (28.6)	Ref.	Ref.	Ref.	Ref.	Ref.
Average	898 (40.5)	**7.152**	**4.381**	1.489	0.337	**2.219**
		(5.325; 8.978)	(2.143; 6.619)	(−0.395; 3.374)	(−1.522; 2.195)	(0.661; 3.778)
High	683 (30.8)	**13.056**	**8.67**	**2.156**	0.156	**2.157**
		(10.986; 15.126)	(6.126; 11.215)	(0.012; 4.301)	(−1.957; 2.268)	(0.382; 3.932)
Neuroticism						
Low	888 (40.1)	Ref.	Ref.	Ref.	Ref.	Ref.
Average	676 (30.5)	**−4.961**	**−3.627**	**−2.344**	−1.113	**−4.618**
		(−6.714; −3.209)	(−5.787; −1.467)	(−4.165; −0.523)	(−2.903; 0.678)	(−6.122; −3.115)
High	651 (29.4)	**−15.086**	**−8.194**	**−7.03**	**−3.702**	**−8.975**
		(−16.978; −13.193)	(−10.517; −5.870)	(−8.987; −5.072)	(−5.628; −1.776)	(−10.593; −7.357)
Openness						
Low	766 (34.6)	Ref.	Ref.	Ref.	Ref.	Ref.
Average	655 (29.6)	**2.037**	1.362	−1.896	0.42	**−1.982**
		(0.185; 3.888)	(−0.913; 3.638)	(−3.809; 0.016)	(−1.468; 2.307)	(−3.565; −0.399)
High	794 (35.8)	**3.812**	−0.503	**−2.832**	1.602	−1.068
		(1.983; 5.640)	(−2.751; 1.746)	(−4.724; −0.939)	(−0.263; 3.467)	(−2.633; 0.498)

[a]Divergence between total numbers and the final sample size ($n = 2293$) is due to missing data for some sociodemographic, lifestyle and personality variables. Multivariate linear models adjusted by all covariates in the table plus smoking, body mass index and alcohol consumption. Psychological outcomes are analysed as continuous variables ranging 0–100. Numbers in bold represent a statistically significant association ($P < 0.05$).

Table 2. Association between levels of psychological factors and number of (A) chronic diseases and (B) ADL + IADL disabilities at baseline and annual increase over the 9-year follow-up in the total sample

	Model I: demographic and clinical factors		Model II: model I + social and personality factors		Model III: model II + lifestyle factors	
	β	95% CI	β	95% CI	β	95% CI
(A) Chronic diseases						
Life satisfaction (high vs. low)						
At baseline	−0.06	−0.257; 0.138	0.035	−0.181; 0.251	0.002	−0.207; 0.210
Annual change	**−0.132**	−0.173; −0.092	**−0.1**	−0.141; −0.056	**−0.096**	−0.140; −0.053
Health outlook (positive vs. negative)						
At baseline	**−0.781**	−0.957; −0.606	**−0.679**	−0.880; −0.478	**−0.569**	−0.764; −0.374
Annual change	**−0.14**	−0.180; −0.100	**−0.103**	−0.148; −0.057	**−0.104**	−0.150; −0.057
Resistance to illness (high vs. low)						
At baseline	**−0.627**	−0.803; −0.451	**−0.353**	−0.557; −0.148	**−0.374**	−0.572; −0.177
Annual change	**−0.083**	−0.124; −0.042	−0.014	−0.061; 0.034	−0.015	−0.063; 0.033
Sickness orientation (low vs. high)						
At baseline	**−0.395**	−0.568; −0.222	**−0.245**	−0.427; −0.062	**−0.272**	−0.448; −0.096
Annual change	**−0.092**	−0.132; −0.052	**−0.068**	−0.110; −0.026	**−0.065**	−0.107; −0.022
Health worry (low vs. high)						
At baseline	**−0.292**	−0.466; −0.118	−0.092	−0.282; 0.097	−0.106	−0.290; 0.077
Annual change	**−0.053**	−0.093; −0.012	−0.009	−0.053; 0.034	−0.011	−0.054; 0.033
(B) ADL+IADL disabilities						
Life satisfaction (high vs. low)						
At baseline	0.007	−0.086; 0.100	0.044	−0.056; 0.144	0.041	−0.058; 0.139
Annual change	**−0.095**	−0.133; −0.057	**−0.081**	−0.119; −0.043	**−0.081**	−0.119; −0.044
Health outlook (positive vs. negative)						
At baseline	−0.018	−0.108; 0.072	−0.004	−0.099; 0.091	−0.004	−0.098; 0.089
Annual change	**−0.056**	−0.095; −0.017	−0.035	−0.075; 0.006	−0.027	−0.067; 0.014
Resistance to illness (high vs. low)						
At baseline	−0.056	−0.146; 0.035	−0.064	−0.160; 0.032	−0.042	−0.137; 0.052
Annual change	−0.021	−0.061; 0.020	0.003	−0.039; 0.046	−0.002	−0.044; 0.040
Sickness orientation (low vs. high)						
At baseline	0.025	−0.062; 0.112	0.044	−0.042; 0.130	0.056	−0.028; 0.140
Annual change	**−0.07**	−0.108; −0.031	**−0.042**	−0.079; −0.004	**−0.044**	−0.081; −0.007
Health worry (low vs. high)						
At baseline	−0.007	−0.095; 0.081	−0.01	−0.099; 0.079	0	−0.088; 0.088
Annual change	−0.016	−0.055; 0.023	0.013	−0.025; 0.052	0.007	−0.032; 0.045

Model I: adjustment by age, sex, civil status, baseline chronic conditions (only for the model looking at disability), depressive symptoms and Mini-Mental State Examination score.

Model II: adjustment by the same variables as model I plus education, occupation, social network, personality and the rest of the psychological factors.

Model III: adjustment by the same variables as in model II plus smoking, body mass index and alcohol consumption.

Psychological exposures are dichotomized according to the following median values of the 0–100 score range: life satisfaction = 60, health outlook = 62, resistance to illness = 75, sickness orientation = 50, health worry = 56. Numbers in bold represent a statistically significant association ($P < 0.05$).

life and health, assessed through validated questionnaires on life satisfaction and general health perceptions, were associated with a lower speed of multimorbidity and disability accumulation and progression over time. This was true even of people without multimorbidity or disability at baseline, and the effects were independent of demographic, clinical, social, personality and lifestyle factors.

Establishing the direction of the effect in studies on psychological well-being and health outcomes (other than mortality) can be difficult because both measures intertwine over time. Even if the presence of subclinical disorders or severe single diseases cannot be ruled out, our results were corroborated in a subpopulation free from multimorbidity or disability at baseline.

Although life satisfaction is typically used as an outcome in gerontological studies, it is also relevant as a prognostic variable, as old age is a period when many biological, psychological and social changes take place. The few studies analysing life satisfaction as an exposure, all of which assessed the variable with LSI-A, have consistently shown that it is associated with mortality [19–21]. Furthermore, a Taiwanese longitudinal study of older adults, which also used LSI-A, found an association between life satisfaction and functional status over an eight-year period [22], although they did not examine longitudinal trajectories of functional status. Life satisfaction captures quality of life based on a person's internal frame of reference and is therefore less vulnerable to within-person instability than other measures of psychological well-being, such as affect or happiness [23]. It may

Table 3. Association between levels of psychological factors and annual increase in the number of chronic diseases and ADL + IADL disabilities over the 9-year follow-up amongst participants without multimorbidity (<2 chronic diseases) or disability (0 ADL + IADL disabilities) at baseline

	People without multimorbidity at baseline		People without ADL + IADL disabilities at baseline	
	β	95% CI	β	95% CI
Life satisfaction (high vs. low)	**−0.064**	−0.116; −0.011	**−0.063**	−0.098; −0.028
Health outlook (positive vs. negative)	**−0.065**	−0.121; −0.008	**−0.042**	−0.079; −0.004
Resistance to illness (high vs. low)	0.005	−0.055; 0.065	0.010	−0.029; 0.049
Sickness orientation (low vs. high)	−0.027	−0.079; 0.024	**−0.038**	−0.073; −0.003
Health worry (low vs. high)	0.014	−0.040; 0.068	−0.007	−0.043; 0.029

Models adjusted by all covariates.

Psychological exposures are dichotomized according to the following median values of the 0–100 score range: life satisfaction = 60, health outlook = 62, resistance to illness = 75, sickness orientation = 50, health worry = 56.

Statistically significant three-way interactions for multimorbidity as the outcome: life satisfaction (high vs. low) * time * extraversion (high vs. low), β coefficient = −0.159, $P = 0.031$.

Statistically significant three-way interactions for ALD + IADL disabilities as the outcome: life satisfaction (high vs. low) * time * neuroticism (high vs. low), β coefficient = 0.106, $P = 0.028$; health outlook (positive vs. negative) * time * age (continuous), β coefficient = −0.005, $P = 0.026$; health outlook (positive vs. negative) * time * education (≤8 vs. >8 years), β coefficient = −0.110, $P = 0.049$; health outlook (positive vs. negative) * time * openness (high vs. low), β coefficient = −0.095, $P = 0.023$.

Numbers in bold represent a statistically significant association ($P < 0.05$).

reflect the extent to which a person is able to adapt to cumulative deficits inherent in the ageing process through assimilative actions such as positive lifestyle changes, better self-care, use of external aids to improve functioning and/or adjusting desired goals to what is really possible.

As far as we are aware, no previous study has used the HPQ in the context of aging research. A person's scores in the different HPQ subscales reflect his or her identification with attributes of wellness or illness and infirmity, beyond the self-rated health, and is an important determinant of involvement in social roles, occupational and physical activities, and interpersonal interactions [24]. In a previous study, primary care patients whose perceived health was lower than expected for their levels of physical health tended to experience greater emotional distress, use health care resources more frequently, feel less able to resist diseases and exhibit a poorer sense of well-being than those who had higher health perception scores [25]. In our study, health outlook and sickness orientation were the two subscales that were significantly associated with the outcomes. An evaluation of the psychometric properties of the HPQ [24] found that health outlook correlated most highly and positively with the rest of the subscales, with other measures of physical health, mental health and psychological well-being and with rejecting the sick role. Like Davies and Ware, we also found that the beneficial effect of having a positive health outlook became even stronger at older ages (Table 3, footnotes), probably because of the increased challenge but also added value of maintaining a sense of well-being when becoming very old. On the other hand, in the previous report [24], sickness orientation was the subscale most weakly correlated with physical and mental health measures, questioning the meaning of the scores obtained for this subscale. This, together with the poor reliability of the subscale in ours and other studies, suggest its prudent use in research. The negative correlation between sickness orientation and age reported by Davies and Ware [24] is in line with our results and seems to indicate that older adults tend to be less accepting of illness as part of their lives than younger adults.

In agreement with previous literature, our study found that higher levels of life satisfaction were correlated with younger age, married status, lower levels of depressive symptoms, a rich social network and positive personality traits [26–32]. Thus, a positive attitude toward life and health in older adults may be enabled by both internal traits and external factors. Internal traits such as a positive personality may help older adults frame problems in a way that can lead to a positive outcome or call on physiological reserves that allow them to recover quickly. External factors, such as having good social and medical care access or being able to rely on social networks in times of need may also promote coping strategies. This hints at the possibility that by changing external factors related to the social environment, older adults' levels of physical resilience could be enhanced, slowing their rate of accumulation of chronic diseases and disabilities.

Strengths of this study include the objective and comprehensive measurement of chronic diseases by SNAC-K physicians, which minimized the risk of self-report bias. Moreover, by examining trajectories of multimorbidity and disability accumulation, we were able to investigate the temporal progression of disease and disability burden. Unlike other measures of psychological well-being, the ones used in this study focus on people's internal frame of reference—and not that much on social criteria of success or competence—minimizing the influence of investigators' value judgments. The LSI-A was developed specifically to measure well-being in old age and is reliable across a variety of sample characteristics. Lastly, we controlled our analyses by most variables

previously identified as correlates of both study exposures and outcomes.

A potential weakness of the study is the inability to generalize the findings, as the results are only valid for those who completed the questionnaire: the physically and cognitively well-functioning segment of the study population. However, this is a shortcoming in any study assessing variables related to psychological well-being. Moreover, a negative attitude toward life and health might also be related to specific diseases. Our aim, however, was to explore the association between such attitudes and trajectories of morbidity and disability accumulation, which are potential indicators of progressive loss of homeostasis in old age. Lastly, we lacked data on the psychological scores at follow-ups, which may be problematic for those factors less likely to maintain within-person stability over time.

Conclusion

In framing a public-health response that might strengthen older adults' ability to navigate and adapt to the health losses they are likely to experience with ageing, a shift toward a more positive focus on factors that support well-being instead of those that cause ill health is starting to gain force. Our study suggests that positive attitudes toward life in general and health in particular may be especially important in old age, when the cumulative effects of biological and environmental factors inevitably lead to accelerated health decline. These findings should encourage researchers to use measures of psychological well-being to better understand the multifactorial and diverse process of ageing.

Supplementary data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

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