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ORIGINAL INVESTIGATION

Personality and health in middle age as predictors for well-being and health in old age

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Abstract In research literature, the question to what extent specific personality traits and health functioning in midlife can predict physical and psychological well-being in old age is still discussed controversially. The present study aims to shed light on this issue by using data from the Basel Longitudinal Study on Ageing. Structural equation modelling was performed in order to test the relation between personality dimensions, namely, self-preoccupation and emotional reactivity, as well as cardiovascular functioning (blood pressure) and medication intake (tranquilizer use) in middle age on psychological and physical well-being and health as assessed in old age 24 years later. Results show that high levels of self-preoccupation in middle age are negatively related to psychological and physical well-being in old age, but not to medical diagnoses. In addition, blood pressure and tranquilizer use in middle age predict physical well-being in old age; blood pressure is furthermore related to medical diagnoses. Our findings emphasize the importance for the adoption of a life-span approach and further interdisciplinary prospective studies in order to better predict pathways to well-being and health in old age.

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Introduction

Considering the increasing life expectancy in old age on the one hand and the significant age-related decline in various domains on the other, the maintenance of physical and psychological well-being and health for the elderly represents a central concern to gerontologists, geriatricians and health policy makers. Ageing research univocally demonstrated the age-associated increase of multimorbidity and multiple losses in various domains of functioning, losses which render old age in general, and very old age in special into a vulnerable phase. Forgetfulness, health problems, functional limitations, and loneliness are among the most frequently reported concerns by a majority of aged persons and seem to be part of the normal ageing process (Hellström et al. 2004). However, it has also been shown that ageing is a highly heterogeneous process mirrored in a large interindividual variability with regard to biological functions, cognitive competence, as well as psychological functioning, and the maintenance of social relations (Baltes and Smith 2004). Nonetheless, there is empirical evidence suggesting a high intraindividual stability, which means that older persons are in various regards not fundamentally different from what they were in their younger years. This intraindividual stability has been related to lifestyle, health and cognitive behaviour, and especially, psychological adaptation (Schmutte and Ryff 1997; Vaillant and Mukamal 2001; Ozer and Benet-Martinez 2006). Against this background, it becomes evident that the identification of determinants responsible for the large interindividual differences in functioning and

adaptation in old age, but also for their stability is of central interest in contemporary ageing research.

We will first focus on the issue of interindividual differences. The search of determinants for well-being and health in old age has led to the development of a variety of theoretical approaches such as models of successful ageing (Rowe and Kahn 1998) or path-models to longevity (Friedman 2000). These research strands share the fundamental assumption that healthy ageing is a result of a lifelong developmental and behavioural process that involves both, the interaction of predispositions and personality traits present in early life, and the cumulative life experiences made in certain contexts. There is empirical evidence showing that two central outcome variables in old age, namely, well-being and physical health, are associated with attitudes such as humour, self-discipline, search for cognitive stimulation, and openness for new experiences and for social relations, which in turn, are strongly associated with specific personality traits (Ranzijn and Luszcz 1999; Vaillant and Mukamal 2001; Andrews et al. 2002; Ozer and Benet-Martinez 2006). The three personality factors which have been most studied in relation to well-being and health are extraversion, neuroticism and psychoticism (when referring to the three-factor model by Eysenck 1991) or conscientiousness, respectively (when referring to the Big Five model by Costa and McCrae 1992). Data from several studies indeed suggest that high scores in extraversion and conscientiousness and low scores in neuroticism are among the best predictors of well-being and health in old age (Samuelsson et al. 1997; Baltes and Mayer 1999; Friedman 2000). While extraversion has been found to be linked to positive health behaviour and to the expression of less psychological and physical symptoms, neuroticism has been associated with more reports of psychological symptoms, poorer perceived health, more health complaints, more self-focussed attention and preoccupation, and a lower level of psychological well-being (Jerram and Coleman 1999; Schwarzer 1996; Woodruff-Borden et al. 2001; Gilhooly et al. 2007). Wilson et al. (2005) examined over 6,000 individuals over 65 years of age in a general community-bases census and found that people with high scores of neuroticism or low levels of extraversion had a higher rate of mortality. However, findings from other large-scale studies revealed some inconsistencies regarding the predictive power of specific personality dimensions for health and well-being in old age (Vaillant and Mukamal 2001; McCrae 2002; Mroczek and Spiro 2003; Cloninger 2005). In a follow-up-study carried out by Weiss and Costa (2005) with 1,000 individuals over 65 years of age, high neuroticism or low extraversion were only weakly associated with survival and health outcomes. However, people with high levels of conscientiousness were more likely to survive than those with average or low scores.

Therefore, although there seems to be some relationship between personality factors and health and well-being in old age, the exact determinants have not been revealed yet. The reasons for this unclear situation seem to be multiple. First of all, a large majority of prospective studies on ageing included only participants at later stages of life. All these studies have contributed to a valuable understanding of the course of older age, but very few of them allow reliable long-term predictions for well-being and health from middle age to old age (Vaillant and Mukamal 2001; McCrae 2002). Second, there are also large inconsistencies with regard to the operationalization of the outcome variables, namely well-being and health (Schmutte and Ryff 1997; Ryan and Deci 2001; Keyes et al. 2002). Depending on the disciplinary perspective, either objective variables such as health problems (geriatrics) were assessed, or subjective variables such as well-being (gerontology, life span psychology) or ill-being (clinical psychology, personality psychology). Even though there are increasing efforts to merge these different perspectives, there are only a few prospective interdisciplinary studies which simultaneously focus on objective and subjective health and well-being outcomes. The consideration of both, objective and subjective indicators of health, could contribute to get a better insight concerning the interrelation of these variables, which is still not well understood (Pinquart 2001). Finally, very few studies have investigated the predictive power of biological determinants and health behaviour in addition to personality dimensions on outcome variables such as psychological well-being and objective and subjective health. Such an approach would allow the direct investigation of whether there are differential effects on these outcome variables (Ryff et al. 2006), which is the aim of the present paper.

We know from literature that the link between personality, health and well-being can be viewed either directly via health behaviour or indirect through symptoms or symptom reporting (Gilhooly et al. 2007). Different studies have revealed mediating mechanisms such as personality-associated medication usage or physiological reactivity (Chapman et al. 2007; Egan et al. 2000; Bogunovic and Greenfield 2004). It is known for example that increased cardiovascular reactivity such as hypertension is negatively related to different personality dimensions such as conscientiousness, openness, agreeableness, and extraversion (Chaudhry et al. 2004; Goodwin and Friedman 2006). Hypertension has also been found to be positively related to hostility or low agreeableness, trait anger, and inhibition of emotions (Keyes et al. 2002; Flaa et al. 2007). In comparison to the number of cross-sectional studies looking into this issue, there are few prospective studies that focus on the link between hypertension and personality dimensions, and their results are mixed (Jonas and Lando

2000). The inconsistency of the results could be explained by the fact that mostly self-reports or medication use were considered as indicators for hypertension, but that objective measures were often neglected.

Another significant mediating mechanism for the prediction of health and well-being in old age might be medication usage, especially the use of tranquilizers. Tranquilizer intake has been shown to be associated with personality traits such as anxiety, depression as well as with somatoform disorders (Egan et al. 2000; Bogunovic and Greenfield 2004; Petrovic et al. 2002). Even though there is empirical evidence that tranquilizer use over a prolonged period can be detrimental for well-being and health, the long-term consequences are not well understood (Cook et al. 2007). As different reviews emphasize (e.g. Voyer et al. 2004; Wilson and Mottram 2002), tranquilizer use is rather frequent in middle and old age with an average prevalence of about 12% in middle age and of 21% in community-dwelling persons older than 65 years. Against this background, the long-term consequences of prolonged tranquilizer intake deserve special attention.

Rationale for this study

In this contribution, our goal is to shed light on some of these issues. The data presented here stem from the Basel Interdisciplinary Study on Ageing (IDA-Study) designed to assess long- and short-term determinants of well-being, health and autonomy from middle-age to old age (Perrig-Chiello et al. 1996). One of the strengths of this prospective study is that a large representative sample was followed for several decades, delivering dominantly biomedical data, but also psychological variables such as personality and well-being. By using a latent variable approach, the outline of this study allows the investigation of the differential impact of specific personality dimensions, medication intake and cardiovascular functioning (i.e. blood pressure) in middle age on physical and psychological well-being as well as objective health (in terms of medical diagnoses) in old age. In addition, we are able to test the long-term intraindividual stability of personality dimensions.

Our aim is to develop a long-term prediction model for psychological and physical well-being and objective health parameters in old age, which is of importance since these outcome variables can be conceptualized as indicators for successful adaptation in old age. On the one hand, we use the construct "medical diagnoses" as indicator for objective health status, and physical well-being as indicator for the subjective interpretation of health. On the other hand, we use psychological well-being. Based on empirical work, we expect that these outcome variables are interrelated in different ways (Markides et al. 1993; Perrig-Chiello et al. 1999): Physical well-being is expected to be strongly related to psychological well-being, whereas the total amount of medical diagnoses is expected to be only moderately related to physical well-being, and not at all correlated with psychological well-being (Baltes and Mayer 1999).

In this model, we strive to link these outcome variables primarily to personality dimensions as assessed with the Freiburg Personality Inventory (Fahrenberg and Selg 1970; see below) in middle age. As stated above, there seem to be especially two personality dimensions which have been related to well-being and health in old age, namely neuroticism and extraversion (Baltes and Mayer 1999; Friedman 2000; Gilhooly et al. 2007; Jerram and Coleman 1999; Samuelsson et al. 1997; Schwarzer 1996; Woodruff-Borden et al. 2001; Weiss and Costa 2005). Based on these findings and considering the FPI-scales available from the first measurement of our sample (i.e. nervousness, depression, excitability, reactive aggression, openness, dominance, inhibition, imperturbability, and sociability), we suggest that there are two distinct latent constructs which might serve as early predictors for health, and physiological and psychological well-being in old age. These latent constructs can be described as two higher order factors of personality: The first factor, which we refer to as *self-preoccupation* (composed of the scales nervousness, depression, and inhibition) corresponds to the dimension of neuroticism. The other factor, which we refer to as *emotional reactivity* (consisting of the scales openness, dominance, reactive aggression, excitability, imperturbability, and sociability), corresponds to extraversion. These latent constructs as assessed at middle age are thought to have a differential impact on the three outcome variables as assessed in old age, i.e. physical and psychological well-being and health (Watson and Walker 1996; Keyes et al. 2002). Based on literature, we expect that there is a negative relationship between the personality variables addressing high self-preoccupation and psychological and physical well-being (Ozer and Benet-Martinez 2006). However, personality variables addressing emotional reactivity, such as dominance, reactive aggression and openness, should show positive relations with health outcomes and should only moderately relate to psychological and physical well-being (DeNeve and Cooper 1998; Friedman 2000).

Since the latent personality variable "emotional reactivity" seems to be related to cardiovascular functioning (Chaudhry et al. 2004; Goodwin and Friedman 2006), we will consider systolic blood pressure as predictor in our model in addition to self-rated measures on personality. We expect that blood pressure is a long-term predictor for subjective and objective health in old age, but not for psychological well-being.

Finally, we will introduce tranquilizer use as a further predictor in our model. As stated above, there is a

considerable lack of reliable prospective data on whether regular tranquilizer consumption and personality are independent long-term predictors of health and well-being outcome in old age (Barnas 2003).

Method

Participants

This study is part of the Basel Inter-Disciplinary Study on Ageing (IDA-Study; Perrig-Chiello et al. 1996). The project consists of a follow-up of a prospective study in which dominantly biomedical data were collected from a large sample of 6,400 healthy persons with status measurements in 1960, 1965, 1971, and 1985. In the 1993 and 1995 follow-ups, psychological measures were integrated in the study design and participants from the original sample were recruited if they fulfilled two criteria: First, they had to be at least 65 years old, and second, they had to live independently (i.e. not in an institution) in the area of Basel. From 3,768 persons who fulfilled these criteria, 848 persons were randomly selected and invited to participate in the study. This restriction had to be made due to the complex and expensive design of the study. A total of 442 persons aged 65–94 years (312 males, 132 females, mean age: 75 years) agreed to participate and were tested in 1993. The sample can be considered as representative for the healthy elderly urban population in Switzerland with regard to education and marital status (Perrig-Chiello et al. 1996). Participants arrived in the morning with an empty stomach. After blood samples had been drawn they had a breakfast. Next a team of physicians collected the anthropometric and clinical data; psychometric data were collected by a team of psychologists. Two years later, in 1995, 337 participants (227 men) were re-tested. A telephone inquiry revealed that the main reasons for attrition were illness (42%), death (22%), and absence from home/travel in the scheduled test period (16%).

The data presented here refer to the data collection in 1971 and the 1995. In 1971, participants were in their middle age (mean age: 50.7 years), whereas they were in their old age in 1995 (mean age: 74.6 years). In 1971, a personality inventory (Freiburg Personality Inventory (FPI); Fahrenberg and Selg 1970) was administered. In addition, various health and health behaviour variables were assessed. In the 1995 data collection, a medical assessment and an extensive psychological testing (including personality assessment, which was not the case in the 1993 data collection) were performed. From the whole sample, 301 agreed to fill out the FPI, and 120 out of them did this for the second time (in 1971 and in 1995). These 120 persons represent the sample for the present study (73 men, mean age: 75.9 years; 47 women, mean age: 73.4 years, range: 68–86).

Measures

Variables as assessed in 1971 (t_1)

Personality (t_1) was assessed with a self-report questionnaire, the Freiburg Personality Inventory FPI (Fahrenberg and Selg 1970). The FPI is one of the most commonly used personality inventories in German speaking countries. It consists of a total of 112 items (statements with yes/no responses) which are transformed into nine scales as suggested by Fahrenberg and Selg (1970): Nervousness, depression, imperturbability, excitability, reactive aggression, sociability, dominance, inhibition, and openness.

Systolic blood pressure (t_1) (mmHg) as measured sitting and standing.

Tranquilizer intake (t_1) as measured on a 3-point-scale (1 = never, 2 = now and then, 3 = regular use).

Variables as assessed 24 years later (i.e. 1995; t_2)

Personality (t_2) as assessed with the FPI (see above).

Psychological well-being (t_2) as assessed by means of a nine-item-questionnaire, which includes the following dimensions: satisfaction with own past, purpose of life, and mastery (3-point-scale: 1 = I do not agree to 3 = I absolutely agree). It thus ranges from low well-being (min = 9) to high well-being (max = 27). This instrument meets all psychometric standards (Cronbach's alpha = 0.69; 3-year-stability: $r = 0.60$, $P < 0.001$) (Perrig-Chiello 1997).

Physical well-being (t_2) refers to a compound score[1] consisting of the following components:

- *Subjective health* as indicated on a 3-point scale (1 = very good, 3 = very bad).
- *Health complaints* consisting of a list of 11 frequent health complaints (e.g. headaches, stomach/intestinal complaints, rheumatic pains, heart troubles, respiratory difficulties, etc.; all indicated by yes/no responses). In addition, participants had the possibility to report three further idiosyncratic health problems at maximum.

[1] For statistical analyses the polarity of this scale was reversed, i.e. high values mean high physical well-being.

Medical diagnoses (*health status; t_2*) refer to the sum of diagnosed diseases operationalized by 20 medical parameters. The parameters as well as their cut-off-points were set by a medical expert at the Geriatric Clinic. Each parameter was assigned either 0 (=absence of disease) or 1 (=deviation/disease). The indicators were: Blood pressure (systolic blood pressure (mmHg) measured sitting and standing), heart rate (pulse), serum parameters (cholesterol, iron, blood sugar, ferritin, haemoglobin, MCV (mean cell volume), HDL (high density lipoprotein), triglycerides, leukocytes, thrombocytes), and electro-cardiogram parameters (rhythm blocks, ischaemia, necroses, hypertrophy, and digitalis)

Statistical procedures

We used AMOS 7 (Arbuckle 2006) to estimate latent variable models. Missing data were controlled for by using the Full Information Maximum Likelihood procedure. Further, the data were screened for both, univariate and multivariate outliers. Univariate outliers were defined as cases more than three standard deviations from the mean and they were replaced by values three standard deviations from the mean. Multivariate outliers were identified by calculating *Mahanalobis' d^2* (Kline 1998). All confirmatory factor analyses (CFA) and structural equation models (SEMs) were checked for multivariate normality (Mardia 1970), as well as for multicollinearity (Kline 1998). We used the common criterion of the chi-square divided by the degrees of freedom being less than 2 as an indication of adequate fit of the models. In addition, we used other fit indices including the comparative fit index (CFI) as suggested by Hu and Bentler (1998), the Bentler–Bonett normed fit index (NFI), and the root mean square error of approximation (RMSEA). For the CFA, we also used the Jöreskog–Sörbom goodness of fit index (GFI) (Kline 1998).

Results

We shall present the results in three sections. First, descriptive statistics and first-order correlations are reported. Second, results of a confirmatory factor analyses (CFA) are shown in order to validate the measurement model. Third, two SEMs are presented. A first model examines the relationship between the personality measures as assessed in 1971 and the outcome variables, i.e. the psychological and physical well-being measures, as well as the number of medical diagnoses as assessed in 1995. For the second SEM, we added blood pressure and the tranquilizer intake as assessed in 1971 as further predictors.

Table 1 Internal consistency (Cronbach's alpha) and stability (Pearson's correlation; *r*) of the personality measures (FPI scales)

Scale	Number of items	*Cronbach's alpha*	*r* (1971–1995)
Inhibition	10	0.69	0.62
Nervousness	17	0.79	0.59
Depression	14	0.78	0.68
Excitability	10	0.75	0.53
Reactive aggression	13	0.68	0.61
Openness	14	0.69	0.53
Dominance	10	0.69	0.65
Sociability	14	0.74	0.72
Imperturbability	10	0.67	0.59

Descriptive statistics and missing data

From the 120 participants, 93% (112 cases) yielded complete data for all measures (the missing data resulted from incomplete data of the medical diagnoses variable only). Indications about internal consistency (Cronbach's alpha) and stability (Pearson's correlation) for the FPI scales are presented in Table 1. Note that the stability is greater than $r = 0.50$ for all scales, confirming a remarkable intraindividual stability even over a period of 24 years.

Only five values in total were substituted as they did not meet the criterion of univariate normality, and no more than one value was corrected in one single variable. There were no multivariate outliers. With the exception of the FPI variable "openness", no variable met the standard criteria for univariate normality (test of Shapiro–Wilk); however, the skew for all measures was less than 2 and kurtosis for all measures was less than 1 (see Table 2). For the SEMs as well as for the CFA, the criterion for multivariate normality (Mardia 1970) was met, with a kurtosis value of less than 1.96. Table 2 reports the descriptive statistics for the variables used in the measurement and structural models after replacement of outliers. None of the first-order correlations were above 0.67 and none of the squared multiple correlations was higher than 0.82, indicating that multicollinearity is not a problem with these data at the measurement level (Kline 1998). Further support for that notion comes from the fact that the highest variance inflation factor (VIF) value is 6.62, which is clearly below the critical value of 10 (Myers 1990).

The first-order correlations of all observed indicators used in the models are presented in Table 3. There are a few aspects of the matrix that are worth mentioning: First, it is notable that the health status (medical diagnoses) does not correlate with either physical or psychological

Table 2 Descriptive statistics for the measures used in the measurement and structural models

Measure	Mean	SD	Skew	Kurtosis
Psychological well-being; t_2	23.30	2.79	−0.98	0.69
Physical well-being; t_2	−2.41	1.25	−0.90	0.11
Health (medical diagnoses); t_2	2.35	1.65	0.79	0.35
Tranquilizer; t_1	1.45	0.82	1.33	−0.15
Blood pressure; t_1	136.13	18.49	0.56	0.45
Inhibition; t_1	9.20	4.12	0.14	−0.80
Nervousness; t_1	9.36	6.36	0.64	0.17
Depression; t_1	9.30	5.87	0.68	0.00
Excitability; t_1	8.98	4.76	−0.07	−0.79
Reactive aggression; t_1	5.04	3.29	0.76	−0.03
Dominance; t_1	6.69	3.73	0.46	0.02
Openness; t_1	7.91	2.64	0.11	−0.45
Sociability; t_1	13.65	5.96	0.19	−0.79
Imperturbability; t_1	10.80	3.89	−0.04	−0.73

$N = 120$ for all variables except for the variable Health ($n = 112$); $t_1 = 1971$; $t_2 = 1995$

well-being. Second, tranquilizer intake as assessed in 1971 correlates with physical well-being assessed 24 years later, but not with the number of medical diagnoses or psychological well-being. Third, systolic blood pressure as assessed 1971 correlates with physical well-being and the number of medical diagnoses obtained 1995. Fourth, all scales of the FPI with the exception of reactive aggression and openness as assessed in 1971 are significantly correlated with physical and/or psychological well-being as assessed in 1995, but there are no significant correlations between any FPI scale (t_1) and the number of medical diagnoses (t_2). Fifth, the various FPI scales show mostly moderate intercorrelations.

Confirmatory factor analyses

As stated in the introduction, the scales of the FPI were assigned either to the latent variable *self-preoccupation* (nervousness, depression, imperturbability, and inhibition) or to *emotional reactivity* (openness, dominance, reactive aggression, excitability, and sociability). After inspection of a first measurement model (CFA1), two of the original FPI-scales (imperturbability and sociability) were excluded because of small and negative factor-loadings. With the remaining seven scales, we constructed the second measurement model (CFA2). As can be seen in Table 4, all fit indices showed a better fit for CFA2 than CFA1 and a chi-square difference test indicated that the second model did fit the data significantly better than the first model ($\Delta\chi^2$ (15, $N = 120$) = 67.99, $P < 0.001$). Consequently, CFA2 was taken as basis for subsequent structural analyses. This final model is presented in Fig. 1. The various fit indices are presented in Table 4 indicating an acceptable fit.

Whereas the first latent variable represents a construct consisting of self-referenced indicators which might also indicate pathological attributes (nervous, depressed, inhibited/anxious), the second variable rather represents the interaction of the individual with the (social) environment, i.e. how a person exerts influence on others (dominant, open), and how a person reacts on influences from others (aggressive, excited). Openness shared less variance with this construct compared to the other three variables which might be due to the fact that this variable has a more positive connotation than the other three variables.

Structural equation models

We tested two alternative SEMs. In the first model (SEM1), we investigated whether the derived latent constructs as

Table 3 Correlation matrix used in measurement and structural models

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Psychological well-being; t_2	–											
2. Physical well-being; t_2	0.29**	–										
3. Health (medical diagnoses); t_2	−0.03	−0.15	–									
4. Tranquilizer; t_1	−0.17	−0.29**	−0.04	–								
5. Blood pressure; t_1	−0.01	−0.38**	0.28**	−0.13	–							
6. Inhibition; t_1	−0.21	−0.16	−0.17	0.08	0.02	–						
7. Nervousness; t_1	−0.28**	−0.30**	−0.13	0.34**	−0.03	0.57**	–					
8. Depression; t_1	−0.25**	−0.22*	−0.07	0.14	−0.01	0.67**	0.64**	–				
9. Excitability; t_1	−0.10	−0.20*	−0.04	0.06	0.02	0.40**	0.43**	0.57**	–			
10. Reactive aggression; t_1	−0.04	−0.03	−0.18	0.11	−0.18*	0.23*	0.25**	0.44**	0.47**	–		
11. Dominance; t_1	−0.05	−0.22*	−0.01	0.16	−0.07	0.17	0.27**	0.44**	0.56**	0.56**	–	
12. Openness; t_1	−0.11	−0.06	−0.12	0.02	−0.16	−0.27**	0.28**	−0.43**	0.35**	0.56**	0.39**	–

$N = 120$ for all variables except for the variable health ($n = 112$); $t_1 = 1971$; $t_2 = 1995$; * $P < 0.05$; ** $P \leq 0.01$

Table 4 Fit statistics for CFA and SEM

Models	df	χ^2	χ^2/df	*P*	GFI	CFI	NFI	RMSEA
Two-factor measurement models								
CFA1	26	83.60	3.21	0.00	0.86	0.85	0.81	0.14
CFA2	**11**	**15.61**	**1.42**	**0.16**	**0.96**	**0.99**	**0.95**	**0.06**
Structural models								
SEM1: Predicting numbers of medical diagnoses and well-being (t_2) by personality (t_1)	28	34.68	1.24	0.18	N/A	0.98	0.91	0.05
SEM2: Predicting numbers of medical diagnoses and well-being (t_2) by personality, blood pressure, and tranquilizer intake (t_1)	44	48.16	1.10	0.31	N/A	0.99	0.90	0.03

GFI Jöreskog–Sörbom goodness of fit index, *CFI* comparative fit index, *NFI* Bentler–Bonett normed fit index, *RMSEA* root mean square error of approximation

The final CFA is indicated in bold

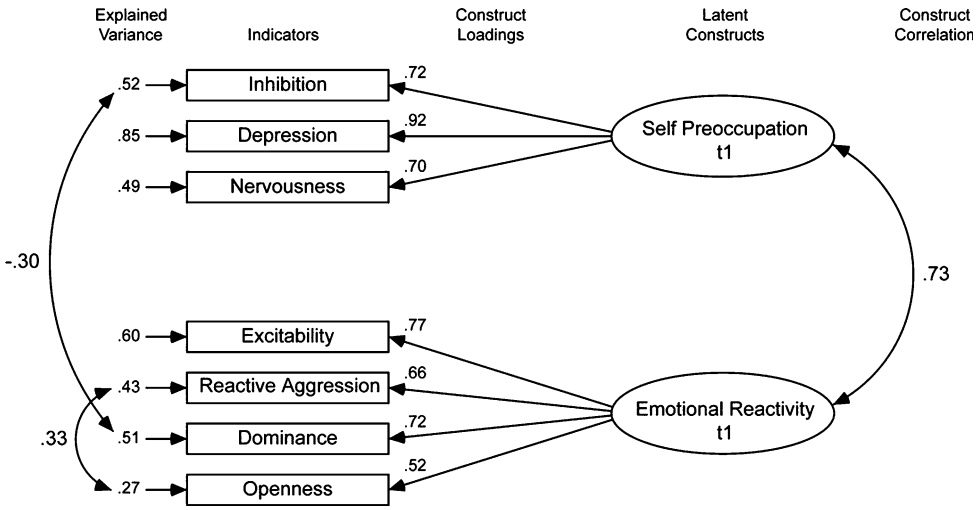

Fig. 1 The final multidimensional two-factor measurement model for the personality inventory as assessed at t_1 (1971)

assessed in 1971 would be predictive for psychological and physical well-being and health (medical diagnoses) assessed 24 years later, i.e. in 1995. Each of these well-being and health measures was taken as separate indicator (observed variable). The model is presented in Fig. 2 and its fit indices are reported in Table 4, indicating an adequate fit. The same residuals as in the CFAs were correlated, and additionally, the residuals of the two latent constructs shared considerable variance and were thus correlated. Looking at the relationship between personality in middle age and well-being in old age, it can be seen that self concern, but not emotional reactivity predicts psychological as well as physical well-being. The number of medical diagnoses is not predicted by personality. Looking at the relation between variables assessed at old age, psychological well-being is predicted by physical well-being. In addition, physical well-being is predicted by the number of medical diagnoses.

We analysed a second model (SEM2), since we were interested whether medical indicators such as systolic blood pressure and tranquilizer intake as assessed in 1971 would predict psychological and physical well-being and health as assessed in old age in addition to the personality measures. Thus, these medical indicators served as additional observed variables. The final model is presented in Fig. 3. It can be seen that systolic blood pressure, but not tranquilizer intake at middle age predicts health at old age. However, both, blood pressure and tranquilizer intake predict physical well-being. Finally, psychological well-being is neither related to the use of tranquilizers nor to blood pressure. All other significant paths remained the same as in SEM1, except for the relationship between health and physical well-being which was no more reliable.

Discussion

Consistent with our predictions, our results indicate that high levels of self-preoccupation in middle age are negatively related to psychological and physical well-being in

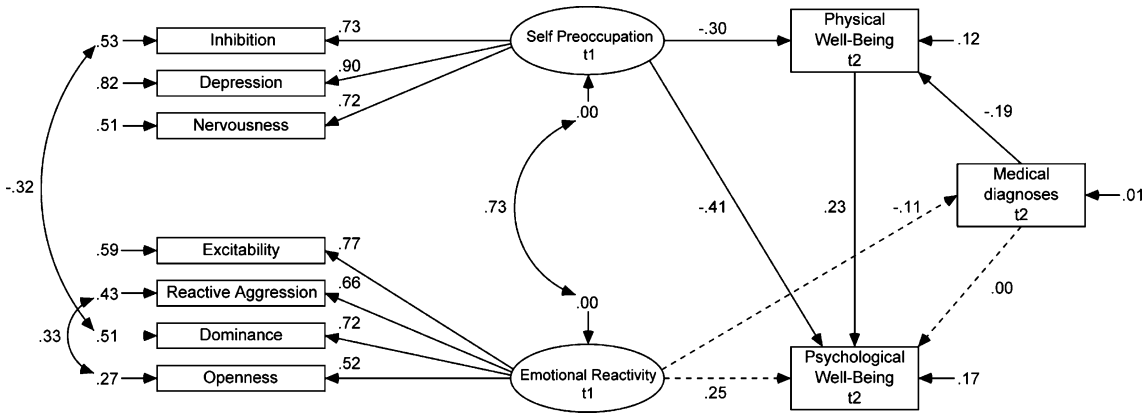

Fig. 2 Structural model predicting psychological well-being, physiological well-being, and number of medical diagnoses as assessed 1995 (observed variables) from latent variables as assessed 1971. For each path in the model, the standardized coefficient is presented. The curved line represents correlation among residuals. Dashed lines represent non-significant paths and non-dashed lines refer to significant paths

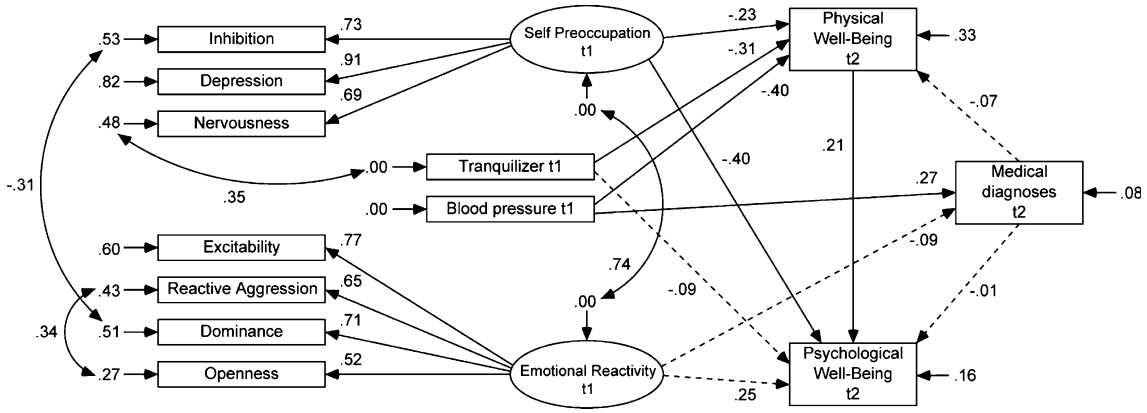

Fig. 3 Structural model predicting psychological well-being, physiological well-being, and number of medical diagnoses as assessed 1995 (observed variables) from latent variables as assessed 1971, with the addition of systolic blood pressure and the use of tranquilizers (also assessed 1971). For each path in the model, the standardized coefficient is presented. The curved line represents correlation among residuals. Dashed lines represent non-significant paths and non-dashed lines refer to significant paths

old age, but not to objective health. In addition, systolic blood pressure and tranquilizer use in middle age predict physical well-being in old age, and blood pressure is additionally related to objective health.

Thus, our findings are in line with other longitudinal studies suggesting that middle age is a crucial phase for the prediction of adaptation and well-being in old age. It has been argued that especially personality trait scores, but also health and lifestyle variables are potential predictors of later life health and well-being outcomes. However, even though there is some empirical evidence for intraindividual stability for these variables, the question to what extent measures in middle age account for physical and psychological well-being and health in old age is still a scientific topic, which is discussed controversially (McCrae 2002; Cloninger 2005). We think that the results of our study are able to resolve some of these issues. The major strength of this study is the prospective design spanning several decades, as well as its interdisciplinary approach. The fact that there is psychological and medical data from a sample followed from their middle age to their old age provides valuable possibilities to tackle a number of relevant but unresolved and controversial issues.

First of all, our study design allowed us to investigate the intraindividual stability of personality dimensions. The obtained correlations reveal a remarkable stability of personality traits over a period of almost a quarter of a century. This result confirms the claim that personality is characterized by a high intraindividual stability despite various environmental influences as reported in other longitudinal studies (Friedman 2000; McCrae 2002).

Second, thanks to the prospective design of this study and the use of a latent variable approach, it was possible to test the differential impact of personality dimensions as

assessed in middle age on physical and psychological well-being and health in old age. The results of our first model indicate that not all personality dimensions are predictive for adaptation in old age: Interindividual variability in physical and psychological well-being in old age is primarily predicted by *self-preoccupation*; a latent personality construct consisting of neuroticism, depression, and inhibition. In turn, *emotional reactivity*, consisting of excitability, reactive aggression, dominance, and openness, does not seem to have predictive power on any of the outcome variables. These results confirm findings from previous studies where neuroticism emerged as strong predictor of psychological well-being (Schmutte and Ryff 1997; Andrews et al. 2002; McCrae 2002; Ozer and Benet-Martinez 2006) and of health complaints (Seeber et al. 2000). There is indeed increasing empirical evidence from longitudinal studies showing that personality in terms of enduring dispositions remains stable after approximately age 30 and constitutes an important determinant of psychological well-being in old age. Personality dispositions seem therefore provide a dependable source for adaptation to a changing world. It is suggested that the stability of personality itself contributes to successful ageing by allowing the individual to plan for the future and by providing a sense of identity (Costa et al. 1994). Our finding also supports research reporting the prognostic importance of depressive symptoms: Depressive symptoms were predictive of similar symptoms 32 years later (Zonderman et al. 1993) and similar results are reported by Westermeyer (1998). In contrast, our results do not support findings from studies reporting that personality traits are distinct predictors of objective health (Glazer et al. 2002; Goodwin and Stein 2003; Goodwin and Friedman 2006), although it has been criticized that some associations between neuroticism and health result from reporting artefacts (Watson and Pennebaker 1989). On the other hand, our findings confirm results from other prospective studies questioning the over-rated role of openness and emotional reactivity as long-term predictors for adaptation and health in old age (Friedman 2000). In fact, emotional reactivity does not predict well-being or health in old age in any of our models.

Third, our results suggest that our outcome variables are interrelated in different interesting ways. Although being small, there is evidence that objective health status is predictive for physical, but not for psychological well-being. However, physical well-being predicts psychological well-being. This fact suggests that even though objective health and psychological well-being are not interrelated, subjectively perceived health could be seen as a mediator between objective health status and psychological well-being. In other words, the subjective interpretation of existing health problems is directly related to psychological well-being, but not with the objective problems per se. This finding might be helpful to explain the paradox of well-being in old age, which states that psychological well-being does not seem to decrease despite increasing losses of physical, cognitive and social resources (Diener and Suh 1997).

Fourth, the fact that we had objective parameters as complement to self-rated measures adds another important aspect to the prediction of health and well-being in old age. By introducing systolic blood pressure and tranquilizer use in middle age in addition to the personality variables in our second model, personality (i.e. self-preoccupation) nevertheless remains predictive for psychological and physical well-being in old age. Even so, blood pressure in middle age has a remarkable long-term predictive power on objective health, as well as on physical well-being. Our results are thus in line with findings from other studies emphasizing the strong long-term negative impact of hypertension on general health (Merecz et al. 1999; Goodwin and Friedman 2006; Rothenbacher and Brenner 2006), and physical well-being (Carroll et al. 2003) in later life. Although the details of the causal processes are not fully understood, there is some evidence that psychological well-being and heart rate are negatively associated (Steptoe and Wardle 2005). Along with the fact that tranquilizer intake in middle age predicts physical well-being 24 years later, this finding demonstrates the importance of timely preventive interventions to maintain well-being and health in old age.

Despite the limited sample size of our study requiring a cautious generalisation of the results, our findings suggest that the course for well-being and health in old age is already set decades earlier. Traits and behaviours in the middle years are apparently very stable over the years and account for a considerable amount of variance in well-being and health outcomes in old age. The findings are especially important since personality traits as predictors of well-being and health in old age are still largely underscored by geriatric and gerontological research. We see the relevance of the association between self-preoccupation, cardiovascular function, and medication use in middle age, and well-being outcomes in old age as twofold: On one hand, it shows the necessity for further prospective interdisciplinary studies. On the other hand, the practical relevance of such findings becomes evident. Until now, prevention programs in public health have mainly focused on youth and old age and have largely neglected the middle age. Our results indicate the need of action to this regard. The adoption of a life-span approach would thus help to raise the quality of public health intervention programs.

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