

Do personality characteristics predict longevity? Findings from the Tokyo Centenarian Study

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Abstract To explore whether personality influences longevity we examined the personality characteristics of centenarians. We developed a new method that compares an actual personality test score for centenarians with a predicted test score for a 100-year-old, calculated from younger controls. The participants consisted of 70 cognitively intact Japanese centenarians aged 100–106 years and 1812 elderly people aged 60–84 years, all residents of Tokyo. The NEO five factor inventory (NEO-FFI) was used to assess the “big five” personality traits: neuroticism, extraversion, openness, agreeableness, and conscientiousness. The results showed higher openness in both male and female centenarians, and higher conscientiousness and extraversion in female centenarians, as compared to controls. These results suggest that high scores in the specific personality traits conscientiousness, extraversion, and openness, are associated with longevity. We speculate that these personality traits contribute to longevity through

health-related behavior, stress reduction, and adaptation to the challenging problems of the “oldest old”.

Key words centenarian · longevity factors · NEO-FFI · personality traits

There is a common belief among the lay public and among some researchers in the existence of a “longevity personality”, whereby individuals who are optimistic and easy going are more likely to live longer. In fact, among many putative longevity factors, it has been suggested that personality is the fourth most important, next to genetic, physical, and biological factors (Lehr 1982). The present study was conducted to examine whether personality does indeed influence longevity, and if so what specific personality traits are responsible, using a new method to factor out centenarian-specific personality characteristics.

To date, three personality traits associated with certain types of behavior and emotion, have found general support in the literature as candidate longevity-associated factors. First, in relation to behavior, conscientiousness, which includes competence, self-discipline, and deliberation, predicts mortality in young to middle-aged (Friedman et al. 1993) and elderly (Wilson et al. 2004) individuals. Individuals with higher conscientiousness are more likely to exhibit health-related behavior such as regular exercise and less likely to exhibit unhealthy forms of behavior such as excess drinking and smoking (Bogg and Roberts 2004), thus creating a personality-mortality causal relationship.

Secondly, from an emotional aspect, neuroticism, which includes anxiety, depression, and vulnerability,

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and extraversion, which includes activity, excitement-seeking, and positive emotion, predicts mortality in the elderly (Wilson et al. 2005; Wilson et al. 2004). Individuals with higher neuroticism have a higher risk of poor mental health (Davis et al. 1995; Jerram and Coleman 1999) and depression (Weinstock and Whisman 2006), and this may also influence their morbidity and mortality. On the other hand, Optimistic thinking, having an external attribution style, and higher self-efficacy in individuals with higher extraversion (Marshall et al. 1994), may have a positive influence on health and survival via stress reduction. The serotonin transporter gene (5HTT-LPR) has been linked to anxiety-related personality traits and may play a role (Munafò et al. 2003). A recent study of genetic variation in centenarians also supported the importance of emotional traits (Gondo et al. 2005b). A study by Gondo et al. (2005b) found a higher frequency of the L/L genotype and a higher number of L alleles for 5HTT-LPR gene, accompanied by low anxiety, in female centenarians.

Researchers have tried to find longevity factors in centenarians because such individuals are believed to be representative of “healthy aging” (Hitt et al. 1999). With regard to personality, previous centenarian studies have reported that centenarians have distinguishing personality profiles in comparison with younger controls (Inagaki et al. 1996; Martin et al. 2002; Martin et al. 1992; Samuelsson et al. 1997; Shimonaka et al. 1996). These characteristics may help to reveal key personality traits for longevity. However, the results of those previous studies were not always in agreement, perhaps because of differences in the personality tests employed. These tests include the 16 personality factor questionnaire (Cattell et al. 1970), Minnesota multiphasic personality inventory (MMPI), Bem sex role test (Bem 1974), and Shinpuku personality profile (Inagaki et al. 1996) in the Georgian and Swedish centenarian studies, and the Shimonaka and Inagaki studies in Japan, respectively.

Our hypothesis is that those who become centenarians may share common personality profiles that enhanced their prospects for longevity. In exploratory work, we conducted an initial assessment of overall trends in personality profiles in different studies to investigate whether a larger study was of value. We transformed each of the personality traits established in previous centenarian studies into five representative traits based on the “big five” personality model

(e.g., NEO-PI-R; (Costa and McCrae 1992) using the similarity of traits concept.

However, even after transformation to an integrated system, the inconsistencies between previous studies remained. For example, among the above three personality traits, Conscientiousness was lower in one Japanese study (Shimonaka et al. 1996) and one Georgian study (Martin et al. 1992), whereas it was higher in another Japanese study (Inagaki et al. 1996). Neuroticism was lower in one Japanese study (Inagaki et al. 1996) and a Swedish study (Samuelsson et al. 1997), whereas it was higher in the Georgian study. On the other hand, with regard to extraversion, both Japanese and Georgian studies reported higher tendencies. These inconsistencies might be due to cultural differences or due to methodological differences between studies.

In order to more fully test our hypothesis that centenarian-specific personality characteristics exist, we focused on overcoming the methodological challenges across study designs. This was facilitated by the recent longitudinal studies of personality and survival. For example, gradual but significant age-related differences in the average scores for several personality traits have been reported in longitudinal studies (Mroczek and Spiro 2003; Steunenberg et al. 2005; Terracciano et al. 2005). These findings have not always been in concordance with cross-sectional findings from centenarian studies. For example, in a recent longitudinal study, Terracciano et al. (2005) reported decreases in neuroticism, extraversion, and openness, and increases in agreeableness and conscientiousness as individuals aged from younger ages to old-old (20–84 years of ages). They also reported a reverse trend for an increase in neuroticism and a decrease in conscientiousness with aging from the old-old ages (75–84 years of age) to oldest-old ages (85-plus years of age). A similar U-shaped trend for neuroticism in the elderly has also been reported (Mroczek and Spiro 2003; Steunenberg et al. 2005). In terms of personality difference in the oldest-old, several studies have been conducted (Martin et al. 2002; Smith and Baltes 1999). These studies demonstrated an increase in neuroticism and a decrease in openness in both cross-sectional comparison (Smith and Baltes 1999) and longitudinal study (Martin et al. 2002). These observed age-related differences might reflect the personality characteristics of people who survive to an extremely old age.

On the other hand, since there are discordant findings across many direct comparison studies, age-related differences in mean scores for personality traits may have led to misleading conclusions. That is, the aforementioned centenarian studies, where much of the thinking about a putative “longevity personality” has been derived, directly compared mean scores between younger control groups and centenarians. These comparisons found differences between personality characteristics in centenarians and younger controls but, as direct comparison studies, they were unable to detect the specific personality features of centenarians independent of age-related differences. If a decreasing trend in a particular personality trait were observed in the elderly, then a lower score in centenarians could be a consequence of age-related difference, whereas maintenance of a particular score level in centenarians might indicate a centenarian-specific personality characteristic.

Therefore, in order to better understand this issue, we developed a new methodology for the study of personality characteristics of centenarians. In the current study, we compared the actual personality test scores for centenarians with the predicted mean scores for a 100-year-old, calculated from younger controls from past trends. This method made it possible to separate the effect of age-related difference from the potentially more static “longevity personality” of centenarians. Since findings from longitudinal studies previously demonstrated significant, but not large, intra-individual changes in personality during an individual’s life span (Mroczek and Spiro 2003; Terracciano et al. 2005), we hypothesized that if disjunction was found between the actual and predicted scores for a certain personality trait, then that trait might be causally related to longevity and be part of a centenarian personality profile.

Methods

Participants

Centenarian group

A total of 70 cognitively intact Japanese centenarians (23 men, 47 women) living in the 23 wards of metropolitan Tokyo participated in this survey. All of them had participated in the Tokyo Centenarian Study

(Arai et al. 2006; Gondo et al. 2006; Gondo et al. 2005b; Shimizu et al. 2004). Details of this study have been described elsewhere (Gondo et al. 2006). They represented a proportion of the participants in the home visit survey ($n=304$), accounting for 25.5% of the recruited centenarians ($n=1194$).

The clinical dementia rating (Hughes et al. 1982) was used to assess the mental state of participants and all of the 70 participants were found to be cognitively intact ($CDR=0$ or $CDR=0.5$). The mean age of the participating centenarians was 100.8 years ($SD=1.4$, range: 100–106), and their mean Barthel Index score (Collin et al. 1988), which assessed their activity of daily living (ADL) levels, was 74.8 ($SD=25.9$). This indicates that the participants in this study maintained relatively good cognitive function and physical function. Sixty-one of them lived with their family, and nine were institutionalized.

Control group

As a control, we analyzed the personality traits of 1812 community-dwelling middle-aged to elderly people (725 males and 1087 females, aged 60–84 yr; Mean age=70.2 $SD=6.7$), who were participants in a longitudinal follow-up study project to investigate the impact of life events on the psychological well-being of elderly individuals (Shimonaka et al. 1995). The longitudinal follow-up study started in 1991, and was carried out every year until 2000. Personality characteristics were assessed in the 2000 survey. All of the controls were cognitively intact.

Measurement and procedure

We administered the five-factor inventory (NEO-FFI; Costa and McCrae 1992) Japanese version (Shimonaka et al. 1999) to assess personality traits (neuroticism, extraversion, openness, agreeableness, and conscientiousness). Reliability of each dimension of personality was confirmed by Cronbach’s alpha coefficients (Cronbach 1951). Scores for neuroticism, extraversion, openness, agreeableness, and conscientiousness were .83, .78, .75, .68, and .77 respectively (Shimonaka et al. 1999). Factor validity was also confirmed on NEO-PI-R Japanese version (Shimonaka et al. 1998; Shimonaka et al. 1999). The participants evaluated each of 60 statements on a 5-point scale (strongly disagree, disagree, neutral, agree, and strongly agree).

Both centenarians and controls were interviewed on a one-to-one basis.

Data analysis and results

Table 1 shows the mean scores and reliability (Cronbach's alpha) of the younger controls and centenarians for each personality trait. Although the coefficients of reliability for the centenarian group were lower than younger controls, the scores were sufficiently high for further analysis. Comparison of the mean scores between younger controls and centenarians by two sided Students t-test showed significantly lower openness in female centenarians and higher agreeableness in male centenarians. These results, however, may not express the nature of the personality characteristics of long-lived individuals, due to the cross-sectional nature of the data. Thus, to clarify personality traits that could be considered longevity-related, we compared the actual personality

test scores for centenarians with the predicted mean scores for a 100-year-old, calculated from younger controls. We analyzed each personality trait separately by sex, because mean scores and age-related trends for the control groups differed according to sex.

First, to confirm the age-related score difference in the control group, regression analyses were conducted for each personality score, with age as an independent variable. As a result, we adopted either a linear or a quadratic best fitted regression model for each personality trait (Terracciano et al. 2005) except for neuroticism in women and conscientiousness in men, for which no significant age-related differences were observed. Table 2 shows the model selected and parameters for each personality trait by sex.

Second, we calculated the predicted value for each personality trait for a 100-year-old based on the selected model. In cases where a significant effect was not observed (neuroticism in women and conscientiousness in men), we used the grand mean score for the control group. Then we calculated the actual

Table 1 The reliability and means for big-five personality traits of Five-Factor Inventory Japanese version on younger controls and centenarians.

		Means				Reliability	
		younger controls (SD)	centenarians (SD)	t	p	alpha ^b of control	alpha of centenarians
Neuroticism	Men	16.3 (6.50)	15.5 (7.52)	.60	n.s. ^a	.78	.82
	Women	17.6 (6.48)	19.7 (8.89)	1.62	n.s.		
Extraversion	Men	26.8 (5.73)	26.6 (6.27)	.17	n.s.	.78	.57
	Women	27.1 (6.21)	26.4 (5.29)	.77	n.s.		
Openness	Men	24.7 (5.61)	24.7 (5.61)	.12	n.s.	.60	.66
	Women	25.0 (4.93)	22.3 (6.42)	2.78	<.01		
Agreeableness	Men	32.5 (5.17)	35.4 (4.91)	2.70	<.01	.76	.69
	Women	34.6 (5.02)	35.1 (5.05)	.56	n.s.		
Conscientiousness	Men	31.8 (6.37)	33.0 (5.14)	.90	n.s.	.83	.69
	Women	31.1 (6.28)	31.8 (6.14)	.68	n.s.		

a: non significant

b: Cronbach's alpha

Table 2 Predicted models and scores for each personality traits for 100 years old in younger controls, and mean scores and 95% confidence intervals in centenarians.

		Predicted model based on younger control					Actual value of centenarians			
		adopted model	R ² of adopted model	Coeffecents of adopted model			Predicted score at 100 years from younger controls	95% LCI for mean of centenarians	means of centenarians	95% UCI for mean of centenarians
				β 0	β 1	β 2				
Neuroticism	Men	Quadratic	.024**	47.815	-.746	.004	15.17	12.25	15.50	18.75
	Women	–	–	17.57 ^a	–	–	17.57	16.93	19.58	22.23
Extraversion	Men	Quadratic	.015**	44.689	-.405	.002	25.33	23.87	26.58	29.29
	Women	Quadratic	.044**	12.843	.593	-.006	17.10	25.25	26.69	28.13
Openness	Men	Linear	.024**	32.942	-.120	–	20.96	22.26	24.69	27.12
	Women	Linear	.067**	38.440	-.190	–	19.39	20.59	22.54	24.49
Agreeableness	Men	Linear	.018**	25.122	.105	–	35.63	33.31	35.43	37.55
	Women	Linear	.007**	30.069	–	–	36.52	33.03	34.85	36.67
Conscientiousness	Men	–	–	31.75 ^a	–	–	31.75	30.74	32.96	35.18
	Women	Quadratic	.027**	-4.938	1.165	-.009	19.68	29.89	31.80	33.71

***p* < .01, β 0=intercept; β 1=linear slope; β 2=quadratic slope
 LCI=lower confidence interval, UCI=upper confidence interval
 a: grand mean of the control group

mean scores for each personality trait by sex for the 70 centenarians and the 95% upper and lower confidence intervals for centenarians to compare with predicted score (Table 2).

Figures 1, 2, 3, 4, and 5 show scatter plots and best-fit regression lines for the younger controls and the actual mean score with 95% confidence interval for the centenarians in each personality trait by sex. When the predicted score was located outside the 95% confidence interval range, we considered this personality trait to be centenarian-specific.

For example, in the case of the extraversion in women, we adopted a quadratic model ($y=12.843+$

$.593X-.006X^2$; $R^2=.044$ $p < .01$) and calculated the expected score for 100 years old as 17.10. The score outlying the 95% confidence intervals of the actual score of female centenarians was a mean=26.69; CI 25.25–28.13. Thus, we treated the extraversion of female centenarians as higher than younger controls.

The results of the comparison between actual score and predicted score for each personality trait were as follows. In men, there was an apparently higher actual score than the predicted score for openness, whereas no notable differences were observed for Neuroticism, Extraversion, Agreeableness and Conscientiousness. In women, an apparently higher actual score than

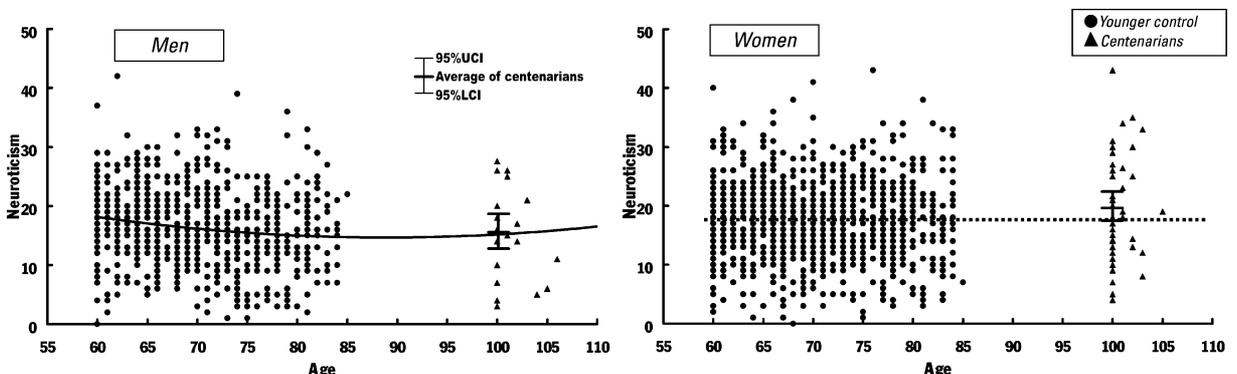


Figure 1 Comparison of neuroticism between centenarians and younger controls by sex (left panel, men; right panel, women)

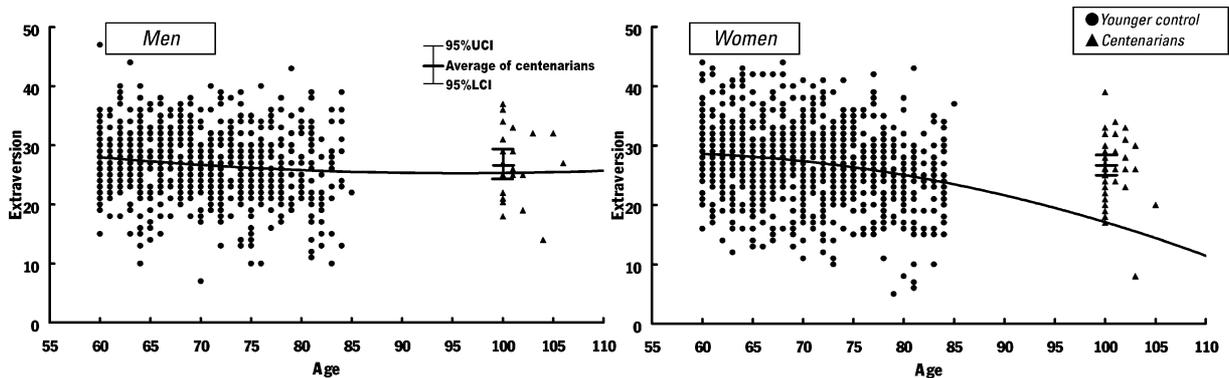


Figure 2 Comparison of extraversion between centenarians and younger controls by sex (left panel, men; right panel, women)

predicted was observed for extraversion, openness and conscientiousness, whereas this was not observed for neuroticism and agreeableness.

Discussion

To explore the influence of personality on longevity and to identify potential personality traits that might contribute to the centenarian phenotype, we investigated the personality characteristics of centenarians using a novel method. We examined the difference between the actual observed personality score for centenarians and the predicted score for a 100-year-old calculated by younger elderly controls. While this is a novel method of assessing centenarian personality profiles, there are, nevertheless, strengths and weakness of this approach.

A strength is that we have some means of controlling for differences related to aging itself or other factors that affect personality as one ages. This may help to clarify lifelong “protective” personality

characteristics of centenarians. On the other hand, there are certain limitations of this method. One limitation is that since the control group is not extinct there are potential centenarians embedded within the control group. However, since the centenarian phenotype is rare, occurring in approximately 20 per 100,000 persons in Japan, few of the control group would reach this age and most would not survive beyond their mid-eighties (Ministry of Health, Labour and Welfare, 2005). Also, to further narrow down the control group to “usual” survivors we excluded those who lived beyond 85 years of age from the calculation of “expected personality scores” of centenarians.

Interestingly, we found sex differences in longevity-related personalities. Little is known, however, about the sex-specific pathway by which personality influences mortality. The life contextual difference between men and women (Smith and Baltes 1998) could be a confounding factor causing such sex differences. Or, the null effect for men in some of these characteristics might have been due to lack of

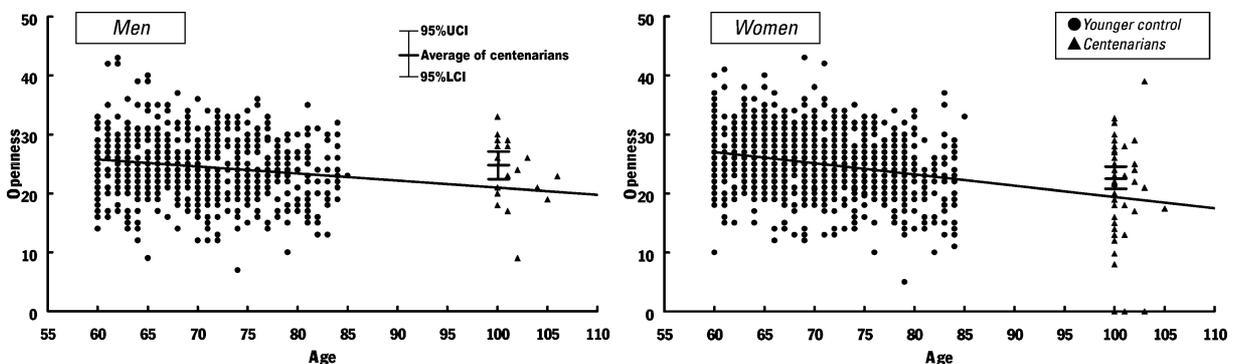


Figure 3 Comparison of openness between centenarians and younger controls by sex (left panel, men; right panel, women)

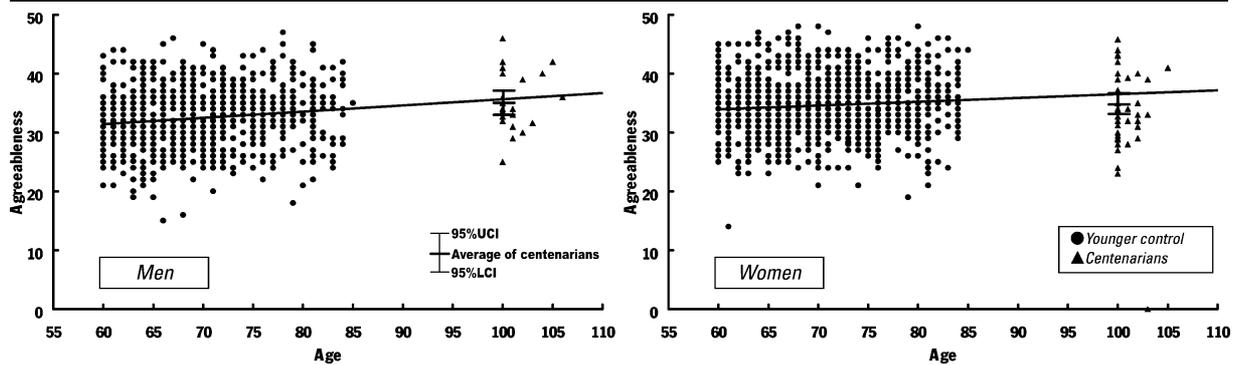


Figure 4 Comparison of agreeableness between centenarians and younger controls by sex (left panel, men; right panel, women)

statistical power from the small number of male centenarians examined ($n=23$). Therefore, such differences must be viewed with caution. On a related note, in the following sections, we compare and contrast our sex-specific findings for each personality trait with mixed (i.e., sex neutral) findings from the literature due to the lack of published sex-specific comparative data.

In our initial findings, for behavior-regulating aspects of personality, we observed higher conscientiousness in centenarian women. This was consistent with previous reports that conscientiousness was associated with mortality in both the middle age (Friedman et al. 1993) and elderly (Wilson et al. 2004). The present findings extend the notion that higher conscientiousness has a positive influence on survival at the extreme end of the oldest-old ages as well. Relationships between conscientiousness and health-related behavior such as smoking (Terracciano and Costa 2004), drinking (Ruiz et al. 2003), and regular exercise (Marks and Lutgendorf 1999) have been reported. In addition, higher self-control (Marshall et al. 1994) and a tendency to dutifully follow medical advice (Friedman et al. 1993)

have been reported in individuals with higher conscientiousness. These attitudes may help to maintain a healthy lifestyle, or to recover more quickly from illness. Such health-defensive behavior would have a positive influence throughout life. Thus, individuals with higher conscientiousness might be more capable of maintaining their health.

Among emotion-related aspects of personality, higher extraversion was observed in female centenarians. Higher extraversion is characterized by higher optimism, higher self-efficacy, and an external attribution style (Marshall et al. 1994). These factors work to decrease the impact of stress by underestimating the threat of the stressor. Furthermore, such individuals frequently seek help from others, which helps to decrease the impact of stress (Swickert et al. 2002). Thus, extraversion might contribute to longevity through stress reduction.

In addition to the above expected factors, openness also emerged as a longevity-related personality trait in both men and women. Higher openness was reported in both the Japanese centenarian study (Shimonaka et al. 1996) and the Georgia centenarian study (Martin

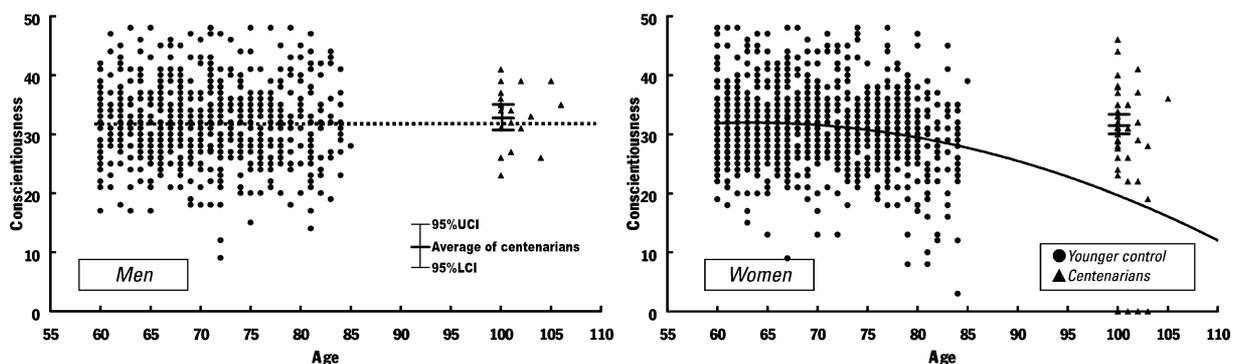


Figure 5 Comparison of conscientiousness between centenarians and younger controls by sex (left panel, men; right panel, women)

et al. 1992). Our findings are consistent with these studies. However, because of the lack of a theoretical framework and empirical support, openness has not received attention as a health-related or longevity factor. At present, we are unsure what effect openness has in younger individuals, but we speculate that in the oldest-old, higher imaginativeness and openness to new experiences would help them to adapt to the many losses (friends, family, health, function) that occur in advanced age. Further study is needed to confirm the life span effect of openness and its potential relation to morbidity and mortality.

As an emotion-related characteristic of personality, neuroticism was reported to have a negative influence on health and mortality (Wilson et al. 2004). We were unable to find a lower score for this trait in both sexes, and in fact noted a small but opposite tendency, in the form of higher Neuroticism, in female centenarians. This contradictory result might indicate that the influence of personality on morbidity and longevity differs at various ages. As well as eliciting negative emotions, higher neuroticism has efficacy in motivating individuals to consult doctors (Jerram and Coleman 1999), thus enabling early detection of disease. Therefore, higher neuroticism might have a positive influence in the oldest-old, who are frailer and have a higher risk of incidental disease than younger individuals.

Previous studies have indicated that personality traits responsible for promoting healthy behaviors and decreasing negative emotions may be factors related to longevity (Friedman et al. 1993; Wilson et al. 2005; Wilson et al. 2004). Higher conscientiousness and extraversion in female centenarians in this study reconfirmed the importance of two behavior-related personality traits. We also observed higher openness, which has not been mentioned in previous papers, and the same level of neuroticism, which contradicted the previously held notion.

It is possible that such personality traits might have been more common in the present study because we tested centenarians, who represent the extreme end of the oldest-old of the human population. Oldest-old individuals have differences in physical and cognitive function (Baltes and Mayer 1999), genetic background (Juva et al. 2000), and psychological adaptation (Gondo et al. 2005a) compared with young old (ages 65-plus) or old-old (ages 75-plus) individuals and may have different personality profiles. We speculate that higher openness and a similar level of neuroti-

cism with younger controls may enhance survival of oldest-old individuals through behaviors that promote adaptation to frailty and loss. Our findings may also suggest that the influence of personality traits is not always consistent at different ages, and in fact may vary according to life context, sex, or age.

Finally, while these findings are interesting and merit further study there are also several limitations in addition to the previously cited methodological limitations. Specifically, only a small proportion of centenarians are able to answer personality tests by themselves. Thus the personality traits observed here are representative of centenarians who are cognitively and physically intact and may differ from other centenarians. Second, there may be cohort or ethnicity-specific effects that have affected study results. Lastly, the novel method we developed for detecting longevity personality traits is not yet well established. As a consequence, our findings may not be robust and need to be considered tentative. Nevertheless, such studies of centenarians can provide clues for future studies of the link between personality and longevity. Further investigations are warranted to explore the influence of personality on life span from a contextual viewpoint from childhood to extreme old age.

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