Personality and functional impairment. Evidence from the Survey of Health, Ageing and Retirement in Europe

André HAJEK and Hans-Helmut KÖNIG

Department of Health Economics and Health Services Research, University Medical Center Hamburg-Eppendorf, Hamburg Center for Health Economics, Hamburg, Germany

Correspondence: André Hajek, PhD, PD, Department of Health Economics and Health Services Research, University Medical Center Hamburg-Eppendorf, Hamburg Center for Health Economics, Martinistraße 52, 20246 Hamburg, Germany. Email: a.hajek@uke.de

Disclosure: The authors have no potential conflicts of interest to disclose.

Received 24 May 2021; revision received 12 July 2021; accepted 26 July 2021.

Abstract

Background: To date, only a few studies have investigated the association between personality and functional impairment. Therefore, our purpose was to add to this knowledge.

Methods: Data from wave 7 of the Survey of Health, Ageing and Retirement in Europe (SHARE) were used (70 028 individuals in the analytical sample). Personality was measured using the 10-item Big Five Inventory (BFI-10). Functional impairment was quantified using activities of daily living (ADL) and instrumental activities of daily living (IADL) indices. Multiple linear regressions were conducted.

Results: Regressions showed that an increased likelihood of limitations in ADL was associated with higher extraversion, higher agreeableness, lower conscientiousness, higher neuroticism, and higher openness to experience. Similarly, an increased likelihood of limitations in IADL was associated with higher agreeableness, lower conscientiousness, higher neuroticism, and higher openness to experience (only with one IADL index).

Conclusions: This knowledge of associations between personality and functional limitations may help in determining individuals at risk for increased functional impairment (e.g., individuals with low conscientiousness or high neuroticism). Future research is needed to clarify the underlying mechanisms.

INTRODUCTION

Functional impairments refer to limitations in basic activities of daily living (ADL; such as bathing) or instrumental activities of daily living (IADL; such as handling finances or using the telephone). Such limitations in household management behaviours are also considered as aspects of disability. A more pronounced discussion of the terminology is also given by Bruce. In accordance with the Disablement Process model (suggested by Verbrugge and Jette) acute and chronic diseases can ultimately contribute to body impairments. When such body impairments increase, functional impairments markedly increase. It has been demonstrated that functional impairments are associated with outcomes such as admission to a nursing home or mortality. The number of individuals with functional impairments is likely to increase for reasons of demographic ageing, stressing the importance of this topic.

Various—mostly socioeconomic and health-related—determinants of functional impairment have been identified. For example, it has been shown that ageing, low social support, or increased depressive symptoms are associated with functional impairment. However, thus far, far less is known about the association between personality and functional impairment. For example, based on data from 265 primary care patients aged 60 years and over, one study showed that higher openness to experience was associated with lower functional impairment. A study conducted in a rural Japanese community with 676 older adults showed lower extraversion to be associated with a risk of future functional decline. Furthermore, a German study based on longitudinal data from the Berlin Ageing Study showed that neuroticism...
predicted future functional health. Additionally, they found that decreases in extraversion predicted subsequent decreases in functional health. Moreover, another recent study (using data from eight longitudinal samples from the United States, Japan, and England) showed that personality factors are associated with both ADL and IADL limitations in various cohorts. More precisely, this study showed that higher neuroticism was associated with a higher probability of concurrent and incident ADL and IADL limitations, whereas higher openness to experience, higher extraversion, and higher conscientiousness were associated with lower risk. Additionally, while higher agreeableness was associated with a lower probability of concurrent ADL and IADL limitations, it was not associated with incident limitations.

In sum, there is limited evidence regarding the association between personality and functional impairment among older adults. Hence, our purpose was to clarify the association between personality and functional impairment among older adults based on data from the established Survey of Health, Ageing and Retirement in Europe (SHARE).

Personality is often divided into five main traits (known as the Big Five): agreeableness (referring to the tendency to be trusting and cooperative), conscientiousness (referring to the tendency to be organized and careful), extraversion (referring to the tendency to be social and assertive), neuroticism (referring to the tendency to experience negative emotional states such as being nervous, insecure, or anxious), and openness to experience (referring to the tendency to be imaginative, curious, and open-minded).

Previous studies have also shown that personality factors are associated with various lifestyle factors as well as health-related factors. For example, it has been demonstrated that they are associated with smoking behaviour, alcohol intake, or obesity. These factors could contribute to functional impairments. Moreover, personality factors are associated with depressive symptoms which could contribute to functional decline. Furthermore, personality factors are associated with other health-related factors such as self-rated health or chronic illnesses which could have an impact on functional impairments.

**METHODS**

**Sample**

For the current study, data were taken from wave 7 (year 2017) of the SHARE study. This wave was used for reasons of data availability (i.e., personality was only assessed in wave 7).

This study examined community-dwelling individuals living in private households aged 50 years and over (and their spouses) in various countries of Europe (plus Israel). In the SHARE study, nationally representative samples were drawn. Additionally, it is worth noting that the SHARE study includes various topics such as occupational status, social relations, and health. Börsch-Supan et al. gave further details with regard to the SHARE study.

The Ethics Committee of the University of Mannheim reviewed and approved the SHARE study (waves 1 to 4). Most recently in 2020 the Ethics Council of the Max-Planck-Society reviewed and approved wave 4 and the following waves (waves 5 to 8) of the SHARE project. Participants gave oral consent prior to being interviewed.

**Dependent variables**

We used two assessments of impairments in basic activities of daily living and two measures of impairments in instrumental activities of daily living as outcome measures (in each case, assessing the report of ‘any difficulty’: $0 =$ absence of difficulty, $1 =$ presence of difficulty). In accordance with the STROBE guidelines, different indices were used to test the robustness of our findings (also called ‘sensitivity analysis’).

The first ADL index corresponds to the sum of the tasks ‘eating, cutting up food’, ‘bathing/showering’, and ‘dressing’, ranging from 0 to 3.

The second ADL index refers to the sum of the tasks ‘eating, cutting up food’, ‘bathing/showering’, ‘dressing’, ‘getting in or out of bed’, and ‘walking across a room’, ranging from 0 to 5. Both scales were adapted from Katz et al.

The first IADL index corresponds to the sum of ‘managing money’, ‘telephone calls’, and ‘taking medications’, ranging from 0 to 3. The second IADL index refers to ‘managing money’, ‘telephone calls’, ‘taking medications’, ‘preparing a hot meal’, and ‘shopping for groceries’, ranging from 0 to 5. Both tools were adapted from Lawton and Brody.
All scores correspond to the sum of activities the participants reported as having difficulties in performing. Thus, count scores (which do not have specific labels) were computed. For each count score, higher scores correspond to higher impairments. However, due to small frequencies, all indices were dichotomized (0 = not reporting any difficulties; 1 = reporting at least one difficulty in performing).

Independent variables
Our key independent variables were the personality factors. They were quantified using the 10-item Big Five Inventory (BFI-10) covering agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience. This tool can be considered as an established personality inventory. Each dimension ranges from 1 to 5, with higher values corresponding to higher agreeableness, higher conscientiousness, higher extraversion, higher neuroticism, and higher openness to experience.

In the regression analysis, adjustment was made for the sociodemographic covariates of age (in years), sex, family status (married, living together with spouse/registered partnership; married, living separated from spouse; never married; divorced; widowed), and educational level (primary education; secondary education; tertiary education; according to ISCED-97). Further, adjustment was also made in the regression analysis for these health-related covariates: self-rated health (from 1 = excellent to 5 = poor), cognitive functioning (ranging from 0 = worst to 10 = best; adapted from the Ten-Word Delay Recall Test), and the number of chronic conditions (count score from 0 to 10, with higher values reflecting more chronic conditions).

| Table 1 Sample characteristics stratified by ADL index 1 (n = 70 028) |
|---------------------------------------------------------------|
| ADL index 1: not reporting any difficulties | ADL index 1: reporting at least one difficulty | Total | P-value |
| N = 63 633 | N = 6395 | N = 70 028 |<|
| Gender | | |<|
| Male | 27 446 (91.2%) | 2640 (8.8%) | 30 086 (100.0%) |<0.01 |
| Female | 36 187 (90.6%) | 3755 (9.4%) | 39 942 (100.0%) |<0.01 |
| Age | 67.7 (9.2) | 74.5 (10.4) | 68.3 (9.5) |<0.001 |
| Marital status | | |<0.001 |
| Marital status: Married and living together with spouse; registered partnership | 18 897 (86.8%) | 2868 (13.2%) | 21 765 (100.0%) |<0.001 |
| Other: Married, living separated from spouse; never married; divorced; widowed | 44 736 (92.7%) | 3527 (7.3%) | 48 263 (100.0%) |<0.001 |
| Educational level | | |<0.001 |
| Primary education | 21 987 (87.1%) | 3263 (12.9%) | 25 250 (100.0%) |<0.001 |
| Secondary education | 27 024 (92.4%) | 2225 (7.6%) | 29 249 (100.0%) |<0.001 |
| Tertiary education | 14 622 (94.2%) | 907 (5.8%) | 15 529 (100.0%) |<0.001 |
| Self-rated health (from 1 = excellent to 5 = poor) | 3.1 (1.0) | 4.2 (0.8) | 3.2 (1.0) |<0.001 |
| Chronic conditions (count score from 0 to 10, with higher values reflecting more chronic conditions) | 1.2 (1.2) | 2.1 (1.5) | 1.2 (1.2) |<0.001 |
| Cognitive functioning (from 0 to 10, with higher values reflecting better cognitive functioning) | 5.3 (1.8) | 4.2 (2.0) | 5.2 (1.8) |<0.001 |
| Agreeableness (from 1 to 5, higher values reflect higher agreeableness) | 3.7 (0.8) | 3.6 (0.9) | 3.7 (0.8) |0.02 |
| Conscientiousness (from 1 to 5, higher values reflect higher conscientiousness) | 4.1 (0.8) | 3.9 (0.9) | 4.1 (0.8) |<0.001 |
| Extraversion (from 1 to 5, higher values reflect higher extraversion) | 3.5 (0.9) | 3.4 (0.9) | 3.5 (0.9) |<0.001 |
| Neuroticism (from 1 to 5, higher values reflect higher neuroticism) | 2.6 (1.0) | 2.9 (1.1) | 2.7 (1.0) |<0.001 |
| Openness to experience (from 1 to 5, higher values reflect higher openness to experience) | 3.3 (0.9) | 3.2 (1.0) | 3.3 (0.9) |<0.001 |

ADL, activities of daily living.
physical illnesses (sum score, ranging from 0 to 11, for the following conditions: high blood pressure or hypertension; high blood cholesterol; stroke or cerebral vascular disease; diabetes or high blood sugar; chronic lung disease; arthritis, including osteoarthritis, or rheumatism; cancer or malignant tumour; stomach or duodenal ulcer, peptic ulcer; Parkinson’s disease; cata-

Statistical analysis
The sample characteristics are first displayed stratified by ADL index 1. Moreover, effect sizes (i.e., Cohen’s d) were calculated. Subsequently, multiple logistic regressions were used to clarify the association between personality factors and functional impairment. In further analysis, explorative examination was made as to whether country moderates the association between personality factors and functional impairment (by using the interaction term: personality factor × country). With regard to the countries, Austria was used as the reference category. Interaction terms for each personality factor and each country were added (worth repeating: with Austria as the reference category).

The significance level was set at 0.05. All statistical analyses were performed using Stata 16.0 (Stata Corp., College Station, Texas).

RESULTS
Bivariate analysis
Sample characteristics for the analytical sample stratified by ADL index 1 are shown in Table 1.

In the total sample, the average age was 68.3 years (SD = 9.5 years; ranging from 50 to 105 years) and about 57% of the individuals were female. In sum, 9.1% of the individuals reported having at least one difficulty with ADL index 1 (similarly, 10.3% reported at least one difficulty with ADL index 2, 4.2% with IADL index 1, and 8.5% with IADL index 2).

In bivariate analysis, ADL index 1 was associated with all explanatory variables. Additionally, in Table 2, the frequency of impairments is displayed for our analytical sample.

We also calculated Cohen’s d for the association between personality factors (agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience) and basic functional impairment (ADL index 1). Cohen’s d was 0.03, 0.26, 0.10, −0.29, and 0.12, respectively.

Moreover, we calculated Cohen’s d for the association between the personality factors and instrumental

Table 2 Frequency of impairments in ADL and IADL indices (n = 70 028)

|                      | N (%)       |
|----------------------|-------------|
| **ADL index 1**      |             |
| 0                    | 63 633 (90.9%) |
| 1                    | 4013 (5.7%)  |
| 2                    | 1810 (2.6%)  |
| 3                    | 572 (0.8%)   |
| **ADL index 2**      |             |
| 0                    | 62 841 (89.7%) |
| 1                    | 3921 (5.6%)  |
| 2                    | 1625 (2.3%)  |
| 3                    | 756 (1.1%)   |
| 4                    | 526 (0.8%)   |
| 5                    | 359 (0.5%)   |
| **IADL index 1**     |             |
| 0                    | 67 091 (95.8%) |
| 1                    | 2029 (2.9%)  |
| 2                    | 553 (0.8%)   |
| 3                    | 355 (0.5%)   |
| **IADL index 2**     |             |
| 0                    | 64 093 (91.5%) |
| 1                    | 3246 (4.6%)  |
| 2                    | 1371 (2.0%)  |
| 3                    | 677 (1.0%)   |
| 4                    | 342 (0.5%)   |
| 5                    | 299 (0.4%)   |
| **ADL difficulties: dressing** |             |
| Not impaired         | 65 068 (92.9%) |
| Impaired             | 4960 (7.1%)  |
| **ADL difficulties: walking across a room** |             |
| Not impaired         | 68 602 (98.0%) |
| Impaired             | 1426 (2.0%)  |
| **ADL difficulties: bathing or showering** |             |
| Not impaired         | 66 614 (95.1%) |
| Impaired             | 3414 (4.9%)  |
| **ADL difficulties: eating, cutting up food** |             |
| Not impaired         | 69 053 (98.6%) |
| Impaired             | 975 (1.4%)   |
| **ADL difficulties: getting in or out of bed** |             |
| Not impaired         | 67 465 (96.3%) |
| Impaired             | 2563 (3.7%)  |
| **IADL difficulties: preparing a hot meal** |             |
| Not impaired         | 67 750 (96.7%) |
| Impaired             | 2278 (3.3%)  |
| **IADL difficulties: shopping for groceries** |             |
| Not impaired         | 65 624 (93.7%) |
| Impaired             | 4404 (6.3%)  |
| **IADL difficulties: telephone calls** |             |
| Not impaired         | 69 119 (98.7%) |
| Impaired             | 909 (1.3%)   |
| **IADL difficulties: taking medications** |             |
| Not impaired         | 69 116 (98.7%) |
| Impaired             | 912 (1.3%)   |
| **IADL difficulties: managing money** |             |
| Not impaired         | 67 649 (96.6%) |
| Impaired             | 2379 (3.4%)  |

ADL, activities of daily living; IADL, instrumental activities of daily living.
functional impairment (IADL index 1). Cohen’s $d$ was $-0.003, 0.36, 0.21, -0.34, and 0.30$, respectively. Similar effect sizes are present for the association between personality factors and both ADL index 2 and IADL index 2 (results not shown, but available upon request).

Regression analysis
Findings of multiple logistic regressions are shown in Table 3 (with four outcomes: ADL index 1, ADL index 2, IADL index 1, and IADL index 2).

Regressions showed that an increased likelihood of limitations in ADL was associated with higher extraversion (e.g., with ADL index 1, odds ratio (OR) = 1.06, 95% confidence interval (CI): 1.03–1.09), higher agreeableness (OR = 1.05, 95% CI: 1.01–1.09), lower conscientiousness (OR = 0.82, 95% CI: 0.79–0.85), higher neuroticism (OR = 1.12, 95% CI: 1.08–1.15), and higher openness to experience (OR = 1.04, 95% CI: 1.01–1.07).

An increased likelihood of limitations in IADL was associated with higher agreeableness (e.g., with IADL index 1, OR = 1.10, 95% CI: 1.05–1.16), lower conscientiousness (OR = 0.76, 95% CI: 0.72–0.80), higher neuroticism (OR = 1.15, 95% CI: 1.11–1.20), and higher openness to experience (only with IADL index 1: OR = 0.94, 95% CI: 0.90–0.98).

With regard to covariates, an increased likelihood of limitation in ADL and IADL was associated with higher age, not being married and living together with spouse, tertiary education, worse self-rated health, more chronic conditions, and lower cognitive functioning.

In further analysis, it was examined whether country moderates the association between personality factors and functional impairment (by including the corresponding interaction term:

### Table 3 Determinants of functional impairment (0 = not reporting any difficulties; 1 = reporting at least one difficulty)

| Independent variables                          | (1)     | (2)     | (3)     | (4)     |
|------------------------------------------------|---------|---------|---------|---------|
| Gender: Female (Reference category: Male)      | 0.91**  | 0.99    | 1.07    | 1.27*** |
| Age                                            | (0.85–0.96) | (0.94–1.05) | (0.98–1.17) | (1.19–1.36) |
| Marital status: Married and living together with spouse; registered partnership (Reference category: Other) | 0.78*** (0.79–0.79) | 0.79*** (0.75–0.78) | 0.74*** (0.68–0.81) | 0.69*** (0.64–0.73) |
| Education: - Secondary education (Reference category: Primary education) | 0.95 | 0.98 | 0.82*** (0.74–0.90) | 0.86** (0.80–0.93) |
| - Tertiary education                           | 0.88** (0.81–0.96) | 0.89** (0.82–0.97) | 0.83** (0.73–0.95) | 0.82** (0.75–0.91) |
| Self-rated health (from 1 = excellent to 5 = poor) | 2.81*** (2.71–2.92) | 2.81*** (2.71–2.91) | 2.10*** (1.99–2.21) | 2.89*** (2.78–3.02) |
| Chronic conditions (count score from 0 to 10, with higher values reflecting more chronic conditions) | 1.21*** (1.18–1.23) | 1.20*** (1.17–1.22) | 1.17*** (1.13–1.20) | 1.16*** (1.14–1.19) |
| Cognitive functioning (from 0 to 10, with higher values reflecting better cognitive functioning) | 0.93*** (0.91–0.95) | 0.92*** (0.91–0.94) | 0.72*** (0.70–0.73) | 0.81*** (0.80–0.83) |
| Personality characteristics:                  |         |         |         |         |
| Agreeableness (from 1 to 5, higher values reflect higher agreeableness) | 1.05** (1.01–1.09) | 1.04* (1.01–1.08) | 1.10*** (1.05–1.16) | 1.04* (1.01–1.09) |
| Conscientiousness (from 1 to 5, higher values reflect higher conscientiousness) | 0.82*** (0.79–0.85) | 0.83*** (0.80–0.86) | 0.76*** (0.72–0.80) | 0.79*** (0.77–0.82) |
| Extraversion (from 1 to 5, higher values reflect higher extraversion) | 1.06*** (1.03–1.09) | 1.06*** (1.03–1.09) | 1.00 (0.95–1.04) | 1.00 (0.97–1.03) |
| Neuroticism (from 1 to 5, higher values reflect higher neuroticism) | 1.12*** (1.08–1.15) | 1.13*** (1.10–1.16) | 1.15*** (1.11–1.20) | 1.12*** (1.08–1.16) |
| Openness to experience (from 1 to 5, higher values reflect higher openness to experience) | 1.04* (1.01–1.07) | 1.04* (1.01–1.07) | 0.94* (0.90–0.98) | 0.98 (0.95–1.01) |
| Constant                                        | 0.00*** (0.00–0.00) | 0.00*** (0.00–0.00) | 0.00*** (0.00–0.00) | 0.00*** (0.00–0.00) |
| Observations                                    | 70 028 70 028 70 028 70 028 |
| Pseudo-$R^2$                                    | 0.21 | 0.21 | 0.27 | 0.29 |

Findings of multiple logistic regressions are reported as the odds ratios with 95% confidence intervals in parentheses. ADL, activities of daily living; IADL, instrumental activities of daily living. *** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, ‘ $P < 0.10$;
DISCUSSION
Main findings
Based on SHARE data, our aim was to examine the association between personality and functional impairment. By doing this, our study extends the limited knowledge regarding this association. According to recent guidelines in gerontology, the effect sizes (of personality factors and functional impairment) can be classified as small to medium (particularly for conscientiousness and neuroticism). Our regressions showed that an increased likelihood of limitations in ADL was associated with higher extraversion, higher agreeableness, lower conscientiousness, higher neuroticism, and higher openness to experience. Similarly, an increased likelihood of limitations in IADL was associated with higher agreeableness, lower conscientiousness, higher neuroticism and higher openness to experience (only with one IADL index).

Previous research and possible explanations
It should be first emphasized that there is rather limited knowledge (e.g.,) regarding the association between personality factors and functional impairment. Given that individuals with higher extraversion are more prone to risky behaviour (e.g., traffic accidents), the association between higher extraversion and an increased likelihood of limitations in ADL in our study seems very plausible. However, it is unclear why extraversion was only associated with likelihood of limitations in ADL, but not in IADL in our study. Future research is required to shed further light on this topic.

The associations between higher neuroticism as well as lower conscientiousness and a higher likelihood of functional impairment in our study are very plausible to us. For example, a recent study demonstrated an association between lower conscientiousness as well as higher neuroticism and the risk of falling. Additionally, such individuals are often more prone to different kinds of accidents. Falls (and accidents) in turn are commonly associated with increased functional impairment. In accordance with this, a systematic review currently under review also found an association between low conscientiousness as well as high neuroticism and increased frailty—a phenomenon (frailty) moderately to strongly associated with functional impairment.

A higher openness to experience was associated with an increased risk of limitations in both ADL and IADL in our study. A possible link may be that individuals scoring higher in openness to experience are more often open-minded and open to new experiences (and even dangerous situations). This could result in accidents which could contribute to limitations in ADL and IADL.

A higher agreeableness was associated with a higher likelihood of functional impairment in our study. Since individuals scoring high in agreeableness tend to be cooperative (e.g., in a partnership), they may put their own needs aside (e.g., the need to be physically or socially active). This could ultimately result in functional impairments.

More generally, another possible explanation may be that personality factors are associated with self-perception of functional impairment. For example, older individuals scoring high in extraversion may evaluate their functional abilities higher compared to older individuals scoring low in extraversion.

It should be noted that more individuals in our analytical sample reported having impairments in ADL compared to IADL. Given that more complex functions are commonly lost before basic ones, this appears rather surprising. A possible explanation may be that some self-assessed functional abilities (particularly in terms of IADL such as telephone calls or taking medications) are overestimated (see also the limitations section). Another (more unlikely) explanation may be that some self-assessed functional abilities (in terms of ADL activities) such as dressing are somewhat underestimated. However, future research in this area is required.

Strengths and limitations
It should be highlighted that this study adds to the limited knowledge regarding personality characteristics and functional impairment. Data were used from the well-established SHARE study. Personality factors were assessed using the BFI-10 and different indices were used to quantify functional impairment. It should be emphasized that the BFI-10 is a short scale version of the established BFI. The BFI-10 was created to provide a personality inventory for settings with extreme time constraints and has acceptable
psychometric properties. This could attenuate the findings. Future research with full-length Big Five measures based on self-reports which could lead to overestimates used to quantify functional impairment are (also) therefore desirable. Additionally, the different indices used to quantify functional impairment are (also) based on self-reports which could lead to overestimates of functional abilities. Moreover, it has been shown that these tools may not be sensitive to small changes in functional abilities. A small sample selection has been determined in the SHARE study. Moreover, this is a cross-sectional study with its inherent limitations. Furthermore, future research focusing on moderating factors in this association (such as cultural background or country of origin) should be further explored.

Conclusion
This knowledge regarding associations between personality and functional limitations may help in determining individuals at risk for increased functional impairment (e.g., individuals with low conscientiousness or high neuroticism). Future research is needed to clarify the underlying mechanisms. Furthermore, longitudinal studies are required to confirm our findings.

ACKNOWLEDGMENTS
This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

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SUPPORTING INFORMATION

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Table S1. Determinants of functional impairment (0 = not reporting any difficulties; 1 = reporting at least one difficulty). Findings of multiple logistic regressions (including interaction terms for country × personality factors).