Determinants of psychosocial factors among the oldest old – Evidence from the representative “Survey on quality of life and subjective well-being of the very old in North Rhine-Westphalia (NRW80+)”

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Abstract
Objectives: Our aim was to examine socioeconomic and health-related variables associated with psychosocial factors among the oldest old.

Methods: Cross-sectional data were used from the representative “Survey on quality of life and subjective well-being of the very old in North Rhine-Westphalia (NRW80+)” consisting of individuals aged 80 years and over (\(n = 952\), average age was 86 years) living in North Rhine-Westphalia (most populous state of Germany). Established tools were used to quantify loneliness, life satisfaction and depressive symptoms. Socioeconomic and health-related determinants were included in regression analysis.

Results: Multiple linear regressions showed that higher life satisfaction was associated with a greater network size, lower functional impairment and better self-rated health. Moreover, higher loneliness was associated with being unmarried, a smaller network size, worse self-rated health and higher functional impairment. Additionally, more depressive symptoms were associated with lower age (i.e., 80–84 years compared to 90 years and over), asset poverty, the presence of multimorbidity, higher functional impairment and worse self-rated health.

Conclusions: Our study identified various socioeconomic and health-related factors associated with worse psychosocial factors among the oldest old. This knowledge may assist in targeting oldest old individuals at risk for worse psychosocial factors.

KEYWORDS
aged, 80 and above, depression, functional impairment, functioning, institutionalization, life satisfaction, loneliness, multimorbidity, oldest old, poverty, self-rated health, successful ageing, well-being

Key points
• Using representative data of the NRW80+, the objective was to investigate the determinants of psychosocial factors among the oldest old
1 | INTRODUCTION

The number of oldest old individuals (i.e., 80 years and over) is expected to largely increase in the following decades. Various events take place in very late life such as the loss of friends and relatives, or marked physical health deteriorations. Such socioeconomic and health-related factors can be associated with psychosocial outcomes such as loneliness (emotion that one's own social network is smaller than desired), life satisfaction (cognitive evaluation of life as a whole) or depressive symptoms. Some of these socioeconomic and health-related factors are difficult or almost impossible to change in very late life (e.g., socioeconomic factors such as chronological age, formal education or health-related factors such as the presence of certain chronic diseases like Parkinson or certain sensory impairments). However, several modifiable socioeconomic and health-related factors can be modified more easily – even among individuals aged 80 years and above. Such modifiable factors can include the social network size or self-rated health (e.g., through lifestyle factors).

To date, various previous studies have identified socioeconomic and health-related correlates of psychosocial outcomes in the general adult population and in later life. However, there is limited knowledge regarding these associations exclusively among the oldest old. Therefore, our aim was to clarify the determinants of psychosocial outcomes among the oldest old in Germany.

Knowledge about the factors associated with negative psychosocial factors is important to address individuals at risk of high loneliness, low life satisfaction or high depressive symptoms.

2 | MATERIALS AND METHODS

2.1 | Sample

Cross-sectional data were taken from the “Survey on quality of life and subjective well-being of the very old in North Rhine-Westphalia (NRW80+)” study consisting of individuals aged 80 years and over living in North Rhine-Westphalia. The representative sample was drawn from registration offices of 94 communities in North Rhine-Westphalia (random register sample) – which is the most populous state of Germany (with more than 17.9 million inhabitants; in Germany, there are currently about 83.1 million inhabitants). For each sampling point, 400 addressed were randomly drawn from the registers. Thereafter, a disproportional sampling strategy (stratified by sex and age bracket) was used to select a sample (8040 individuals were contacted). Thus, a multistage sampling was used with a random sample of individuals aged 80+ living in private homes and institutionalized settings. Men and individuals aged 85+ were oversampled. Face-to-face interviews (computer-assisted) were conducted from August 2017 to February 2018. The interviews lasted about 90 min. The aim of the NRW80+ study was to build a database among the oldest old to explain discrepancies in outcomes related to quality of life covering, among other things, information about socioeconomic factors as well as health-related factors.

Individuals were included when they were 80 years or over (date of birth before 1 August 1937) and had a registered main residence in North Rhine-Westphalia (both including individuals living in private households and individuals residing in institutionalized settings). The response rate was about 23.4%. However, factors such as gender, age group or living situation were not associated with the likelihood of non-response. Further details are given by Wagner et al. and particularly regarding non-response by a second study performed by Wagner et al.

2.2 | Outcomes: Psychosocial factors

Life satisfaction was quantified using the widely used single-item measure ranging from 0 = completely dissatisfied to 10 = completely satisfied. Previous research has shown that this measure is valid and reliable.

Loneliness was measured using a single item measure ranging from 1 = never/almost never to 4 = almost or almost always. Previous research has shown that such a single-item measure is a sensitive measure and is highly correlated with the UCLA loneliness scale.

The “depression in old age scale” (DIA-S) was used to quantify depressive symptoms, consisting of four items (in each case: no or yes). A sum score was calculated (from 0 to 4, with higher values indicating more depressive symptoms). Good psychometrical qualities of the DIA-S have been demonstrated. Furthermore, it demonstrated a markedly higher discriminatory power for the items’ test specificity and internal consistency compared to the Geriatric Depression Scale (15-item version).

2.3 | Independent variables

In regression analysis, socioeconomic independent variables were included as follows: sex, age group (80–84 years; 85–89 years; 90 years and over), marital status (married, living together with spouse;...
Other including married, living separated from spouse, widowed, divorced, and single), living situation (living in a private household; living in an institutionalized setting), educational level (ISCED-97\textsuperscript{15} classification: low, medium, or high education), size of the social network, income poverty (threshold: 60% of median household net equivalence income, in our study: 968 Euro) and asset poverty (0–2500 Euro). Since there is no consensus about asset poverty,\textsuperscript{16} different cut-offs (second definition: 0–500 Euro; third definition: 0 Euro) were used in robustness checks.

Moreover, health-related factors were included in regression analysis as follows: self-rated health (ranging from 1 = very bad to 4 = very good), functional impairment (IADL), and multimorbidity (according to a previous multimorbidity index,\textsuperscript{17} including 19 chronic diseases [in each case: 0 = no or 1 = yes]: myocardial infarction, heart failure, hypertension, stroke, mental illness, cancer, diabetes, respiratory or pulmonary disease, back pain, gastric or intestinal disease, kidney disease, liver disease, blood disease, joint or bone disease, bladder disease, sleep disorder, eye disease or visual disorder, ear disease or hearing impairment, and neurological disease). A sum score was computed, with higher values indicating more chronic diseases. Functional impairment was quantified using a modified Lawton and Brody IADL scale,\textsuperscript{18} consisting of seven items. Each item ranges from 0 = only possible with help to 2 = no help required. The functional impairment score is formed by the average value of the respective seven items (from 0 to 2, with higher values reflecting lower functional impairment).

2.4 | Statistical analysis

Initially, sample characteristics are given. Thereafter, multiple linear regressions were estimated to identify the determinants of the three psychosocial outcomes. We also checked for multicollinearity (using variance inflation factors [VIFs]). For example, when depressive symptoms served as outcome measure the mean VIF was 1.31 and the highest VIF was 1.33. Very similar VIFs were detected with life satisfaction and loneliness as outcome measures. Thus, multicollinearity is not a threat. In sensitivity analysis, full-information maximum likelihood (FIML) was used to address missing data.\textsuperscript{19} The statistical significance was defined as $p$ value of $\leq 0.05$. Statistical analyses were conducted using Stata 16.1 (Stata Corp., College Station, Texas).

3 | RESULTS

3.1 | Sample characteristics

Sample characteristics for the analytical sample are shown in Table 1. Only about 45% of the individuals were female (due to the oversampling of men, see the Sample section) and mean age was 85.8 years (SD: 4.2 years), ranging from 80 to 101 years. Average life satisfaction score was 8.0 (SD: 1.8), average loneliness score was 1.3 (SD: 0.6) and average depressive symptoms score was 0.9 (SD: 1.1). Further details are given in Table 1. Additionally, a correlation matrix is shown in Supplementary Table 1.

3.2 | Regression analysis

Findings of multiple linear regressions are shown in Table 2 (first three models using listwise deletion). Moreover, results of hierarchical linear regressions are shown in Supplementary Table 2. Multiple linear regressions showed that higher life satisfaction was associated with a greater network size ($\beta = 0.02$, $p < 0.001$), lower functional impairment ($\beta = 0.66$, $p < 0.001$) and better self-rated health ($\beta = 0.45$, $p < 0.001$). Moreover, higher loneliness was associated with being unmarried ($\beta = -0.27$, $p < 0.001$), a smaller network size ($\beta = -0.01$, $p < 0.05$), worse self-rated health ($\beta = -0.08$, $p < 0.05$) and higher functional impairment ($\beta = -0.11$, $p < 0.05$). Additionally, more depressive symptoms were associated with lower age (i.e., 80 to 84 years compared to 90 years and over, $\beta = -0.20$, $p < 0.05$), asset poverty ($\beta = 0.29$, $p < 0.001$), the presence of multimorbidity ($\beta = 0.30$, $p < 0.001$), higher functional impairment ($\beta = -0.42$, $p < 0.001$) and worse self-rated health ($\beta = -0.46$, $p < 0.001$).

In sensitivity analysis, FIML was used to handle missing data in our regression model (please see the last three models presented in Table 2). Compared to our main model, findings remained similar. It is worth noting that living in an institutionalized setting (compared to living in a private home) was also associated with lower life satisfaction and higher loneliness.

In another sensitivity analysis, two other cut-offs were used to quantify asset poverty (second definition: 0–500 Euro; third definition: 0 Euro). When using the second and third definition, the association between asset poverty and depressive symptoms remained nearly the same (second definition, with listwise deletion: $\beta = 0.25$, $p < 0.01$, with FIML: $\beta = 0.23$, $p < 0.01$; third definition, with listwise deletion: $\beta = 0.32$, $p < 0.01$, with FIML: $\beta = 0.29$, $p < 0.01$).

4 | DISCUSSION

The aim of this study was to clarify the determinants of psychosocial factors among the oldest old based on data from the representative NRW80+. Multiple linear regressions showed that decreased life satisfaction was associated with a smaller network size, higher functional impairment and worse self-rated health. Moreover, higher loneliness was associated with being unmarried, a smaller network size, worse self-rated health and higher functional impairment. Additionally, more depressive symptoms were associated with lower age (i.e., 80–84 years compared to 90 years and over), asset poverty, the presence of multimorbidity, higher functional impairment and worse self-rated health.

With regard to depressive symptoms, two socio-economic factors (age and asset poverty) as well as all included health-
related factors were associated with this outcome measure in our study. Previous research, mainly based on older adults, also demonstrated that decreased health is associated with more depressive symptoms. Similar results were also found among the oldest old.

The association between higher age groups and fewer depressive symptoms may be explained by the fact that individuals in higher age groups have already overcome various critical life events such as the loss of spouse and their well-being ultimately bounces back to their baseline level, whereas individuals aged 80–84 years may experience more critical life events.

One particular benefit of our study is that we also demonstrated an association between asset poverty, but not income poverty, and depressive symptoms among the oldest old. This association of asset poverty and increased depressive symptoms may be explained as follows: Asset poverty may increase pessimism for the future. Moreover, it may increase worries and concerns about one’s own and the future of the inheritors. These emotions may contribute to feelings of depressive symptoms. Another explanation may be that those who do not have any assets in the form of residential property in very old age have to spend a large share of their net income on rent – which can be difficult. For those who own property, even a small income might be sufficient, as other consumer spending no longer plays a major role. Furthermore, the missing association between income poverty and depressive symptoms adds to the existent mixed evidence.

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**TABLE 1** Sample characteristics for the analytical sample (n = 952)

|                           | Count (%) |
|---------------------------|-----------|
| **Sex**                   |           |
| Men                       | 528 (55.5%) |
| Women                     | 424 (44.5%) |
| **Age**                   | 85.8 (4.2) |
| **Marital status**        |           |
| Married, living separated from spouse; widowed; divorced; single | 542 (56.9%) |
| Married, living together with spouse | 410 (43.1%) |
| **Living situation**      |           |
| Living in a private household | 938 (98.5%) |
| Living in an institutionalized setting | 14 (1.5%) |
| **Educational level (ISCED-97)** |   |
| Low                       | 206 (21.6%) |
| Medium                    | 505 (53.0%) |
| High                      | 241 (25.3%) |
| **Income poverty (60% of median household net equivalence income, here: 968 Euro)** | |
| Absence of income poverty | 829 (87.1%) |
| Presence of income poverty | 123 (12.9%) |
| **Asset poverty (0–2500 Euro)** | |
| Absence of asset poverty  | 717 (75.3%) |
| Presence of asset poverty | 235 (24.7%) |
| **Size of the social network** | 7.5 (8.5) |
| **Multimorbidity**        |           |
| Absence of multimorbidity | 188 (19.7%) |
| Presence of multimorbidity | 764 (80.3%) |
| **Self-rated health (ranging from 1 = very bad to 4 = very good)** | 2.6 (0.7) |
| **Functional impairment (IADL; ranging from 0 to 2, with higher values corresponding to lower functional impairment)** | 1.5 (0.6) |
| **Life satisfaction (from 0 = completely dissatisfied to 10 = completely satisfied)** | 8.0 (1.8) |
| **Loneliness (from 1 to 4, with higher values corresponding to higher levels of loneliness)** | 1.3 (0.6) |
| **Depressive symptoms (DIA-S4, ranging from 0 to 4, with higher values corresponding to more depressive symptoms)** | 0.9 (1.1) |
TABLE 2  Determinants of psychosocial factors. Results of multiple linear regressions (first three models: with listwise deletion, last three models: with FIML)

| Independent variables | Life satisfaction | Loneliness | Depressive symptoms | Life satisfaction | Loneliness | Depressive symptoms |
|-----------------------|------------------|------------|-------------------|------------------|------------|-------------------|
| Sex: Women (Ref.: Men)| −0.19 (0.13)     | −0.07 (0.05) | −0.01 (0.08)      | −0.01 (0.10)     | −0.05 (0.04) | 0.03 (0.06)       |
| Age group             |                  |            |                   |                  |            |                   |
| 85 to 89 years (Ref.: 80–84 years) | 0.22* (0.13) | 0.04 (0.04) | −0.10 (0.07)      | 0.08 (0.10)     | 0.05 (0.04) | −0.10+ (0.06)     |
| 90 years and over     | 0.18 (0.18)     | 0.02 (0.06) | −0.20* (0.09)     | 0.15 (0.12)      | 0.05 (0.04) | −0.13* (0.07)     |
| Marital status        |                  |            |                   |                  |            |                   |
| Married, living together with spouse (Ref.: Married, living separated from spouse; widowed; divorced; single) | −0.13 (0.13) | −0.27*** (0.05) | 0.02 (0.08)       | −0.03 (0.10) | −0.23*** (0.04) | 0.02 (0.06)       |
| Living situation      |                  |            |                   |                  |            |                   |
| Living in an institutionalized setting (Ref.: Living in a private household) | 0.24 (0.50) | 0.41 (0.29) | 0.21 (0.30)       | −0.48** (0.17) | 0.14* (0.06) | 0.16 (0.10)       |
| Educational level (ISCED-97) |                  |            |                   |                  |            |                   |
| Medium (Ref.: low)    | −0.08 (0.17)     | 0.04 (0.06) | −0.01 (0.10)      | −0.02 (0.12)     | 0.01 (0.04) | 0.00 (0.07)       |
| High                  | −0.03 (0.19)     | −0.06 (0.06) | −0.09 (0.11)      | −0.09 (0.15)     | −0.00 (0.05) | 0.01 (0.08)       |
| Income poverty: Presence of income poverty (Ref.: Absence of income poverty) | −0.12 (0.20) | −0.08 (0.06) | −0.07 (0.10)      | −0.11 (0.16)    | −0.10+ (0.06) | −0.12 (0.09)      |
| Asset poverty: Presence of asset poverty (Ref.: Absence of asset poverty) | −0.09 (0.15) | 0.05 (0.05) | 0.29*** (0.08)   | −0.07 (0.14)    | 0.06 (0.05) | 0.27*** (0.07)    |
| Size of the social network | 0.02*** (0.01) | −0.01* (0.00) | −0.01 (0.00)     | 0.03** (0.01)   | −0.01*** (0.00) | −0.01* (0.00) |
| Multimorbidity: Presence of multimorbidity (Ref.: Absence of multimorbidity) | −0.11 (0.14) | 0.05 (0.05) | 0.30*** (0.07)  | −0.10 (0.11)    | 0.00 (0.04) | 0.18** (0.06)    |
| Self-rated health (ranging from 1 = very bad to 4 = very good) | 0.45*** (0.09) | −0.08* (0.04) | −0.46*** (0.05) | 0.58** (0.06) | −0.11*** (0.02) | −0.47*** (0.03) |
| Functional impairment (IADL; ranging from 0 to 2, with higher values corresponding to lower functional impairment) | 0.66*** (0.12) | −0.11* (0.04) | −0.42*** (0.07) | 0.77*** (0.08) | −0.11*** (0.03) | −0.42*** (0.04) |
| Constant              | 5.98*** (0.46)  | 1.88*** (0.17) | 2.63*** (0.26)   | 5.15*** (0.32)  | 1.97*** (0.12) | 2.59*** (0.18) |
| Observations          | 952              | 949         | 897               | 1863            | 1863       | 1863             |
| $R^2$                 | 0.13             | 0.11        | 0.25              | 0.13            | 0.11       | 0.25             |

Note: Unstandardized beta-coefficients are reported, robust standard errors in parentheses. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, +$p < 0.10$.

With regard to loneliness, the associations with social factors (i.e., marital status and network size) in our study were rather unsurprising. Additionally, we showed that it was also associated with self-rated health and functional impairment, but not multimorbidity. The missing association with multimorbidity is somewhat in contrast to previous studies and may be explained by the fact that in contrast to self-rated health and functional impairment – multimorbidity reflects a rather objective assessment relying on the number of chronic conditions (irrespective of the fact whether these chronic conditions impair one’s own life). With regard to life satisfaction – and similar to the correlates of loneliness, the network size reached statistical significance in our study. Analogously to loneliness, life satisfaction was associated with self-rated health and functional impairment, but not multimorbidity. Similarly, we assume that the rather objective assessment of multimorbidity may not reflect perceived impairments in one’s own life. Consequently, it may not be important for the cognitive evaluation of life as a whole (i.e., life satisfaction). Nevertheless, future research is required to confirm our findings.

Interestingly, neither income nor asset poverty were associated with life satisfaction or loneliness in our study. One previous study based on data from the German Ageing Survey showed that the onset of income poverty can predict decreased life satisfaction. However, this recent study also showed that the end of income poverty was not associated with changes in life satisfaction. Additionally, it showed that such changes in income poverty were not associated with changes in loneliness scores. In contrast, two studies showed an
Our study identified various socioeconomic and health-related factors associated with worse psychosocial factors among the oldest old.\textsuperscript{28,29} Furthermore, our study has shown that higher functional impairment and worse self-rated health are important for all psychosocial factors examined in our study. This confirms the idea that health-related factors are particularly important for successful ageing among the oldest old.\textsuperscript{30}

Strengths and limitations of our study are as follows: As one of a few studies, we exclusively examined individuals 80 years and over. Several socioeconomic and health-related explanatory variables were included in our study. It is also worth noting that rarely examined independent variables were included in our study (such as asset poverty). Data were taken from a large sample which has a high methodological quality (NRW80+). Despite the fact that the response rate was rather low, the data can be considered as representative for the population 80+ living in North Rhine-Westphalia, Germany.\textsuperscript{8} Medications were not added to the NRW80+. Future research is required to clarify the role of medications for life satisfaction, loneliness and particularly depressive symptoms. The outcomes were quantified using established and widely-used tools. However, future research with more sophisticated tools is required to confirm our findings. More precisely, while the single-item measure of life satisfaction has good psychometric characteristics,\textsuperscript{10} future research could use the Satisfaction with Life Scale.\textsuperscript{31} Moreover, this is a cross-sectional study with its inherent limitations. This particularly refers to the directionality (causality) of the associations.

**5 | CONCLUSION**

Our study identified various socioeconomic and health-related factors associated with worse psychosocial factors among the oldest old. This knowledge may assist in targeting oldest old individuals at risk for worse psychosocial factors.

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**CONFLICT OF INTEREST**

None.

**ETHICS STATEMENT**

The NRW80+ was approved by the ethics committee of the Medical Faculty of the University of Cologne (No. 17-169). Informed consent was obtained from all participants or their legal representatives.

**PATIENT CONSENT STATEMENT**

Not applicable.

**PERMISSION TO REPRODUCE MATERIAL FROM OTHER SOURCES**

Not applicable.

**CLINICAL TRIAL REGISTRATION**

Not applicable.

**DATA AVAILABILITY STATEMENT**

The NRW80+ data are available via gesis. For interested researchers, please see: https://search.gesis.org/research_data/ZA7558.

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SUPPORTING INFORMATION
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