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Original Research Article

Important for preventing but also living well with cognitive impairment – The associations between social relationships, well-being, and cognition in very old adults

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ABSTRACT

Objectives: Social relationships are well-researched as protective factors against cognitive impairment, but their role for individuals experiencing cognitive impairment is less clear. The present study examined the associations between cognitive impairment, social relationships, and well-being in very old adults (80 + years), a high-risk group for cognitive impairment.
Design: Using representative data from the Study on Quality of Life and Well-Being in North-Rhine Westphalia (NRW80+ Study), we analyzed three social factors (close network, leisure activity, loneliness) and two well-being measures (depressiveness, positive affect) across very old individuals with and without cognitive impairment. We also investigated whether cognitive impairment affected the associations between social factors and well-being.
Setting: Computer-assisted interviews were conducted with target persons or proxies in private housing and care facilities.
Participants: The final sample included 1516 participants: 66.80 % without cognitive impairment, 15.00 % with mild impairment, and 18.20 % with major impairment.
Measurements: Social and well-being measures were assessed through standardized interviews.
Results: Cognitive impairment was associated with poorer social outcomes and lower well-being. Meanwhile, stronger social connections were linked to higher well-being. The associations were partially influenced by cognitive impairment. Notably, low leisure engagement was more strongly associated with increased depressiveness in individuals with major cognitive impairment than in those without ($B = -0.53$ [−0.83, −0.23], $p < .001$).
Conclusions: Our findings emphasize the importance of social integration in preserving well-being for individuals with cognitive impairment. As the incidence of cognitive impairment rises, future research should not only focus on prevention but also on improving the situation for those affected.

Introduction

Positive aspects of social relationships have been consistently associated with higher well-being, whereas negative aspects like social isolation and loneliness have been linked to poorer mental health [1,2]. However, defining “good social relationships” is challenging, as social relationships represent a multidimensional construct. They can be described along three different dimensions [3]. The structural dimension addresses the objective and observable aspects, such as the network size, marital status, or the frequency of social interactions. The functional dimension focuses on the mechanisms of social relationships, such as different types of social support. Lastly, qualitative aspects refer to the underlying emotional processes such as relationship satisfaction or strain [3].

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Yet, social relationships not only encompass different dimensions. They also evolve across varying levels of intimacy, from casual acquaintances to deep connections. The Social Convoy Model is a theoretical framework that aims to grasp this complexity [4]. It captures the dynamics of social relationships using three convoys: The inner, middle, and outer social convoy, which differ regarding their level of intimacy and closeness. These convoys change throughout life due to age-associated events such as retirement or illness. Especially in very old age, key events like chronic diseases or widowhood shape social networks. Typically, the number of distant ties declines while close network members such as family and long-term friends become increasingly central [5–8]. In conclusion, research shows that social relationships are crucial for well-being, but their multidimensional nature and changing dynamics throughout life make it complex to study them.

Social relationships and cognitive impairment

Cognitive impairment is an age-associated event that strongly impacts social networks and social identity [9]. While many studies examined social relationships as risk factors for cognitive impairment (before its onset), few have focused on their role in individuals experiencing cognitive impairment [10–12]. However, given the importance of social relationships for psychological well-being, they could play an important role in buffering the negative consequences of cognitive impairment [2].

Indeed, studies on individuals with cognitive impairment have highlighted their need to engage in social interactions and maintain a social identity despite their condition [11,13,14]. At the same time, research shows that individuals with cognitive impairment often have smaller social networks and are less socially active than people without impairment [15–17]. They also tend to experience more loneliness than people without cognitive impairment [17–19]. The trend is especially pronounced in those living in institutional settings [20–22]. Therefore, individuals with cognitive impairment often face reduced social integration and increased loneliness despite their need for social connection.

Cognitive impairment, well-being and the role of social relationships

Cognitive decline has been linked to lower well-being and reduced quality of life, especially in people with cognitive impairment [23–26]. It seems possible that the decline in social interaction and social bonding explains some part of the decrement in well-being. In fact, in individuals with cognitive impairment and dementia, positive social relationships were associated with greater well-being [11,27,28]. In contrast, social isolation and loneliness were linked to lower quality of life, increased neuropsychiatric symptoms, and higher use of psychotropic medications [29–32]. Interestingly, in a sample of people with dementia, a positive relationship quality with the carer reduced the negative impact of loneliness and social isolation on life satisfaction [33]. Similar results have been reported in other studies [34]. Moreover, individuals with cognitive impairment who lived alone reported lower well-being than those living with others despite having better cognitive and functional abilities [35]. Additionally, regular social interaction has been shown to improve mood, reduce psychiatric and behavioral symptoms, and enhance well-being in people with cognitive impairment [36,37]. For instance, positive interactions with staff were linked to increased positive emotional expressions in individuals with dementia [38]. In conclusion, these findings underscore the importance of social integration in buffering the negative outcomes of cognitive impairment.

The present study

As outlined, cognitive impairment represents a key life event that influences our social connections [4]. The likelihood of cognitive impairment increases with age, particularly in adults aged 80 years and above. Approximately 25 % of adults from 80 to 84 years show mild cognitive impairment, and 12 % experience major cognitive impairment [39,40]. Prior research highlights the importance of social relationships for well-being and points out the risks of cognitive impairment for lower social integration. Still, few studies have investigated how cognitive impairment, social relationships, and well-being interact.

The present study aims to address this gap by comparing individuals with varying levels of cognitive impairment (no impairment, mild impairment, and major impairment) across multiple aspects of social relationships and well-being. Additionally, we aim to explore whether cognitive impairment moderates the associations between social relationships and well-being. In the analyses, we use representative data from the Study of Quality of Life and Well-Being in North-Rhine Westphalia (NRW80+ Study). Based on previous research, we hypothesize that higher cognitive impairment is associated with lower social outcomes and reduced psychological well-being [16,17]. Furthermore, better social outcomes are linked to increased well-being and poorer social outcomes to decreased well-being, particularly among individuals with cognitive impairment [25,28,33].

Methods

Study design

Our analyses are based on data from the NRW80+ Study. It is available at the GESIS - Leibniz Institute for the Social Sciences data repository [41]. The study focuses on the health, well-being, and quality of life of very old adults (80+ years) in North Rhine-Westphalia (NRW), the most populous state in Germany. NRW encompasses a variety of rural and urban areas and has a rich immigration history, making it a representative depiction of Germany.

The study integrated a two-step sampling method, where participants were randomly chosen from 94 pre-selected communities in NRW [42]. Participants lived in private households and care facilities. The assessments were conducted using computer-assisted interviews, either with the participants themselves or with proxies. Proxies were assessed if participants were unable to respond personally but selected a proxy to respond on their behalf. The data collection occurred over two measurement waves: The first wave (W_1) took place from 2017 to 2018, during which 1863 very old adults were interviewed. The second measurement wave (W_2) occurred from 2019 to 2021. 1862 participants were recruited, from which 912 also participated in the first wave.

Participants

Our study focused on participants from the first wave (n = 1863) because data from the second wave was partly collected during the COVID-19 pandemic. This circumstance would have changed the research context and the interpretation of our results. To obtain a representative sample, we included target-person and proxy interviews. In the target-person interviews, cognition was assessed using the Dementia Detection Test (DemTect) (n = 1687). We excluded participants without a cognitive assessment. It included participants who refused the assessment (n = 73) or showed incomplete data (n = 270). The proxy interviews evaluated cognition with the Global Deterioration Scale (GDS) *(n = 176).* Including proxy information allowed us to analyze data of individuals, who usually do not engage in standard research. We excluded proxy interviews without a GDS rating. It applied to cases where proxies refused to provide a rating (n = 2) or did not know how to respond (n = 2). Eventually, the final sample consisted of 1516 participants, including 1344 target-person interviews and 172 proxy interviews.

Research materials

Cognitive assessment

In the target-person interviews, cognitive status was assessed by the DemTect. It is an effective and validated tool for screening cognitive

impairment [43]. Compared to other cognitive screenings like the Mini-Mental-State-Examination (MMSE), the DemTect demonstrates a higher sensitivity for minor cognitive impairment [44]. It comprises five subtests: Immediate recall, number transcoding, verbal fluency, digit span, and delayed recall. In immediate recall, participants recall a list of 10 words twice immediately after hearing it. In number transcoding, they convert numbers to numerals and vice versa. For verbal fluency, they name as many supermarket products as possible in one minute. In the digit backward span task, they repeat number sequences in reverse order. In delayed recall, they freely recall the wordlist from the first task after a delay of approximately 10 min. All subtest performances are recoded using an age-standardized coding scheme and then combined into a total score [45]. The total score ranges from 0 to 18. A performance between 13 and 18 points is considered age-appropriate, 9 to 12 points suggest mild cognitive impairment and scores below 9 points indicate major cognitive impairment/dementia. McDonald's Omega was acceptable (ω = .71).

In the proxy interviews, cognitive status was measured with the GDS [46]. In the GDS, proxies rate the severity of cognitive impairment of the target person on a 7-stage item from 0 (no cognitive decline) to 7 (very severe cognitive decline). Stages 1 and 2 indicate no cognitive impairment, stage 3 mild cognitive impairment, and stages 4 to 7 major cognitive impairment/dementia.

Assessment of social relationships

We chose three social measures from multiple structural and functional social variables that were available in the data. They were selected for their ability to capture the various dimensions of social relationships. The first variable, a close network index, served as a qualitative and structural measure of social relationships. Specifically, participants named up to four of their closest social ties and rated their closeness on a scale from 1 (not close at all) to 4 (very close). The individual ratings were recoded as follows: 0 (no or less close network member), 1 (close network member), and 2 (very close network member). The scores were summarized into a total score from 0 (no close network) to 8 (very close network). McDonald's Omega was acceptable (ω = .77). The second variable, social leisure activity, served as a structural indicator of social engagement. It was indicated by averaging the engagement frequency in 14 leisure activities, which was rated from 0 (never) to 5 (daily). A list of all activities can be found in the supplementary materials. We deliberately avoided a narrow definition of social activities, recognizing that activities like walking or practicing artistic hobbies may also encompass social aspects. McDonald's Omega was acceptable (ω = .68). Lastly, we included loneliness as a functional and qualitative measure, as it represents insufficient functional and qualitative needs. It was assessed using a single item that asked participants how lonely they felt in the past two weeks. Responses ranged from 1 (“never”) to 4 (“almost always or always”).

Assessment of psychological well-being

We used the subscale of the Positive and Negative Affect Schedule (PANAS)- Short Scale to assess positive affect [47,48]. It comprises five items that assess the frequency of positive emotions such as “enthusiastic” or “excited” experienced in the last year on a scale from 1 (never) to 5 (very often). McDonald's Omega was good (ω = .89). As the data did not include the subscale on negative affect, we used depressives as our second outcome variable. It was captured with the short version of the Depression in Age Scale (DIA-S4) and consisted of four yes/no items on depressive mood during the last two weeks [49]. McDonald's Omega was very good (ω = .93).

Control measures

The interview type was captured as 1 (target person) and 2 (proxy). The age of participants was indicated as a continuous variable with two decimals. Sex was indicated by 1 (male) or 2 (female). Education was classified into 1 (low), 2 (medium), or 3 (high). The form of housing was indicated as 1 (private) or 2 (care facility). Functional ability was measured by asking participants to rate their independence on seven instrumental activities of daily living on a scale of 0 (full help needed) to 2 (no help needed). McDonald's Omega was very good (ω = .93). Lastly, we controlled for the current relationship status, which was defined as 1 (currently single) or 2 (currently married or in a relationship).

Statistical analyses

Data preparations were conducted in IBM SPSS Statistics and R. We handled missing data by multiple imputation through the "mice" package in R [50]. We imputed all variables except cognition because this information was not missing at random. Twenty datasets were generated using predictive mean matching (PMM), which replaces the missing values by choosing non-missing data with predicted values close to those of the missing sample. Each dataset was analyzed separately, and the results were subsequently pooled following Rubin’s Rules.

To answer our hypotheses, we performed linear regression models using the standard R package [51]. The models were weighted to correct selection biases due to age, sex, household size, region, municipality size, housing form, and marital status [52]. Most variables were entered as continuous. Exceptions were the nominal variables (sex, interview type, housing form, and relationship status) and the ordinal variables (education and cognitive impairment). For the ordinal variables, we used simple contrasts, comparing each level to a reference level. In all analyses, omnibus tests were performed to evaluate whether the overall effect of cognitive impairment was statistically significant before interpreting the pairwise comparisons.

To investigate the first hypothesis, we predicted social aspects (close network index, leisure activity, loneliness) and well-being (depressiveness, positive affect) based on cognitive impairment, adjusting for relevant control variables (interview type, age, sex, education, housing form, and functional ability). For the second hypothesis, we computed two models for each well-being outcome. Model A (reduced model) predicted well-being from the social aspects and cognitive impairment. Model B (full model) added the interactions between social factors and cognitive impairment. In both models, we controlled for the previously mentioned control variables and additionally accounted for relationship status due to its potential influence on social relationships and well-being. We compared the model fit between Model A and Model B with likelihood ratio tests. Specifically, we conducted likelihood ratio tests separately in each dataset and then pooled the chi-square statistics across datasets using the “miceadds” package in R [53]. We also compared the average Akaike Information Criterion (AIC) values across imputations.

Sensitivity analyses

Analyses were repeated without survey weights and excluding proxy interviews to ensure that the results were robust against small changes in the analytic design.

Results

Sample characteristics

Table 1 displays the characteristics of the imputed and weighted samples. A total of 257 participants had missing data in at least one and at most four variables. Only two variables showed missingness greater than 5 %: Depressiveness had 6.60 % missing values and the close network index at 5.30 %.

Cognitive impairment as a predictor of social relationships and well-being

In this section, we report the results of the main predictor, cognitive impairment, but not the control variables. More details are available in

Table 1
Sample characteristics of the imputed and weighted sample (n = 1516).

	Means (SD) and Frequencies	
Variable	Unweighted sample	Weighted sample
Target-person interviews	88.70 %	89.90 %
Age	86.80 (4.50)	85.40 (4.05)
Male sex	49.30 %	34.80 %
Education		
Low	25.70 %	29.40 %
Medium	51.50 %	50.40 %
Private housing	92.20 %	89.90 %
Functional ability	1.40 (0.68)	1.44 (0.67)
Not in a relationship	54.00 %	57.10 %
Close network index	4.94 (2.21)	4.94 (2.25)
Leisure activity	1.28 (0.63)	1.34 (0.63)
Loneliness	1.37 (0.69)	1.35 (0.67)
Cognition		
No cognitive impairment	66.80 %	69.10 %
Mild cognitive impairment	16.00 %	15.00 %
Depressiveness	0.93 (1.12)	0.91 (1.12)
Positive affect	3.23 (0.90)	3.27 (0.90)

Note. n = 257 had missing values in at least one and at most four variables.

Table 2. There was a significant effect of cognitive impairment on the close network index ($F(2, 52960) = 8.40$, $p < .001$). Post-hoc comparisons showed no difference between MCI and no cognitive impairment ($B = 0.06$, 95 % *CI* [−0.27, 0.39], $p = .700$) but major cognitive impairment was associated with a lower close network index compared to no impairment ($B = -0.77$, 95 % *CI* [−1.15, −0.38], $p < .001$). Cognitive impairment was also associated with leisure activity ($F(2, 52894) = 29.28$, $p < .001$). Both MCI ($B = -0.17$, 95 % *CI* [−0.25, −0.09], $p < .001$) and major cognitive impairment ($B = -0.36$, 95 % *CI* [−0.46, −0.26], $p < .001$) were associated with reduced leisure activity compared to no cognitive impairment. Loneliness was also associated with cognitive impairment ($F(2, 6414) = 8.41$, $p < .001$). There was no difference between MCI and no cognitive impairment ($B = -0.01$, 95 % *CI* [−0.10, 0.09], $p = .900$), while major cognitive impairment was associated with increased loneliness compared to no impairment ($B = 0.24$, 95 % *CI* [0.12, 0.35], $p < .001$). No significant association was found between depressive symptoms and cognitive impairment ($F(2, 3593) = 2.19$, $p = .112$). Lastly, cognitive impairment was associated with positive affect ($F(2, 55344) = 25.31$, $p < .001$). Both MCI ($B = -0.15$, 95 % *CI* [−0.28, −0.03], $p = .015$) and major cognitive impairment ($B = -0.52$, 95 % *CI* [−0.67, −0.38], $p < .001$) were associated with reduced positive affect compared to no cognitive impairment.

Cognitive impairment as a moderator of social relationships and well-being

In this section, we only report the results from the models preferred based on the pooled likelihood ratio tests. The pooled test results may differ from single-dataset likelihood ratio tests because they account for the variation across the imputed dataset. Full results are presented in Table 3.

Depressive symptoms

The pooled likelihood ratio test comparing Model A and Model B indicated that including the interaction terms improved model fit ($X^2(6) = 4.03$, $p < .001$), which was also supported by comparing the mean AIC (Model A = 4556.67; Model B = 4537.59). In Model B, the close network index was negatively associated with depressive symptoms ($B = -0.03$, 95 % *CI* [−0.06, 0.00], $p = .043$), as was leisure activity ($B = -0.14$, 95 % *CI* [−0.25, −0.03], $p = .017$). Loneliness was positively associated with depressive symptoms ($B = 0.55$, 95 % *CI* [0.44, 0.65], $p < .001$). The overall effect of cognitive impairment was not significant ($F(2, 715) = 1.08$, $p = .339$).

The interaction between the close network index and cognitive impairment was not significant ($F(2, 488) = 0.54$, $p = .585$). A significant interaction was found between leisure activity and cognitive impairment ($F(2, 247) = 5.77$, $p = .004$). Post-hoc comparisons showed no differences between MCI and no cognitive impairment ($B = -0.08$, 95 % *CI* [−0.33, 0.17], $p = .500$), but a difference in the strength of the association between leisure activity and depressive symptoms between major cognitive impairment and no impairment ($B = -0.53$, 95 % *CI* [−0.83, −0.23], $p < .001$). Specifically, the negative association was stronger for participants with major cognitive impairment than those without cognitive impairment (see Fig. 1a). The interaction between loneliness and cognitive impairment was also significant ($F(2, 20702) = 6.366$, $p = .002$). The post-hoc comparison showed that the strength of the positive association between loneliness and depressive symptoms was weaker for MCI than no cognitive impairment ($B = -0.42$, 95 % *CI* [−0.65, −0.18], $p < .001$), while no difference emerged between major cognitive impairment and no impairment ($B = -0.12$, 95 % *CI* [−0.31, 0.07], $p = .200$) (see Fig. 1b).

Positive affect

The pooled likelihood ratio test between Model A and Model B showed that adding the interaction terms did not improve model fit ($X^2(6) = 0.78$, $p = .583$), which was also supported by comparing the mean AIC between models (Model A = 3832.71; Model B = 3839.45). In Model A, the close network index ($B = 0.03$, 95 % *CI* [0.01, 0.05], $p = .002$) and leisure activity ($B = 0.41$, 95 % *CI* [0.33, 0.48],

Table 2
Pooled linear regression analyses predicting social relationships and well-being by cognitive impairment, adjusted for relevant covariates.

Predictor	Group	Means (SD)	Contrast	B (95 % CI)[a]
Close network index	1	5.14 (2.18)		
	2	5.14 (2.13)	Group 1 versus 2	0.06 (−0.27, 0.39)
	3	3.91 (2.37)	Group 1 versus 3	−0.77 (−1.15, −0.38)**
Leisure activity	1	1.47 (0.61)		
	2	1.24 (0.56)	Group 1 versus 2	−0.17 (−0.25, −0.09)**
	3	0.87 (0.53)	Group 1 versus 3	−0.36 (−0.46, −0.26)**
Loneliness	1	1.28 (0.60)		
	2	1.29 (0.59)	Group 1 versus 2	−0.01 (−0.10, 0.09)
	3	1.71 (0.86)	Group 1 versus 3	0.24 (0.12, 0.35)**
Depressiveness	1	0.81 (1.06)		
	2	0.84 (1.02)	Group 1 versus 2	−0.04 (−0.20, 0.12)
	3	1.42 (1.29)	Group 1 versus 3	0.19 (−0.01, 0.38)
Positive affect	1	3.43 (0.83)		
	2	3.21 (0.86)	Group 1 versus 2	−0.15 (−0.28, −0.03)*
	3	2.62 (0.91)	Group 1 versus 3	−0.52 (−0.67, −0.38)**

Note. Group 1 = no cognitive impairment (n = 1012); group 2 = mild cognitive impairment (n = 242); group 3 = major cognitive impairment (n = 262). *p ≤ .05, **p ≤ .01.
[a] Models are controlled for the effects of age, sex, education, interview type, and form of housing.

Table 3
Pooled linear regression analysis investigating the moderating role of cognitive impairment on the association between social relationships and well-being, adjusted for relevant covariates.

	Depressiveness		Positive affect	
	Model A	Model B	Model A	Model B
Predictors	B (95 % CI)	B (95 % CI)	B (95 % CI)	B (95 % CI)
Intercept	2.03**	1.82**	1.84**	1.83**
	(0.72, 3.35)	(0.50, 3.14)	(0.85, 2.83)	(0.82, 2.83)
Close network index	−0.02	−0.03*	0.03**	0.02
	(−0.05, 0.01)	(−0.06, 0.00)	(0.01, 0.05)	(0.00, 0.05)
Leisure activity	−0.23**	−0.14*	0.41**	0.42**
	(−0.33, −0.13)	(−0.25, −0.03)	(0.33, 0.48)	(0.33, 0.50)
Loneliness	0.47**	0.55**	−0.13**	−0.12**
	(0.38, 0.55)	(0.44, 0.65)	(−0.19, −0.07)	(−0.20, −0.04)
Cognition				
Group 1 versus 2	−0.15*	0.34	−0.06	0.13
	(−0.30, 0.00)	(−0.27, 0.94)	(−0.18, 0.06)	(−0.36, 0.62)
Group 1 versus 3	−0.21*	0.32	−0.24**	−0.59*
	(−0.40, −0.01)	(−0.27, 0.92)	(−0.39, −0.10)	(−0.88, −0.03)
Close network index* Cognition				
Group 1 versus 2	-	0.03	-	0.01
		(−0.03, 0.10)		(−0.05, 0.07)
Group 1 versus 3	-	0.04	-	0.03
		(−0.03, 0.11)		(−0.02, 0.08)
Leisure activity* Cognition				
Group 1 versus 2	-	−0.08	-	−0.10
		(−0.33, 0.17)		(−0.29, 0.09)
Group 1 versus 3	-	−0.53**	-	0.07
		(−0.83, −0.23)		(−0.14, 0.28)
Loneliness* Cognition				
Group 1 versus 2	-	−0.42**	-	−0.09
		(−0.65, −0.18)		(−0.27, 0.10)
Group 1 versus 3	-	−0.12	-	0.01
		(−0.31, 0.07)		(−0.13, 0.16)
Pooled R^2	0.25	0.27	0.26	0.26
Mean AIC	4556.67	4537.59	3832.71	3839.45
Pooled χ^2	-	4.03**	-	0.78

Note. The models are controlled for age, sex, education, interview type, form of housing, functional ability, and relationship status. Group 1 = no cognitive impairment (n = 1012); group 2 = mild cognitive impairment (n = 242); group 3 = major cognitive impairment (n = 262). *p ≤ .05, **p ≤ .01.

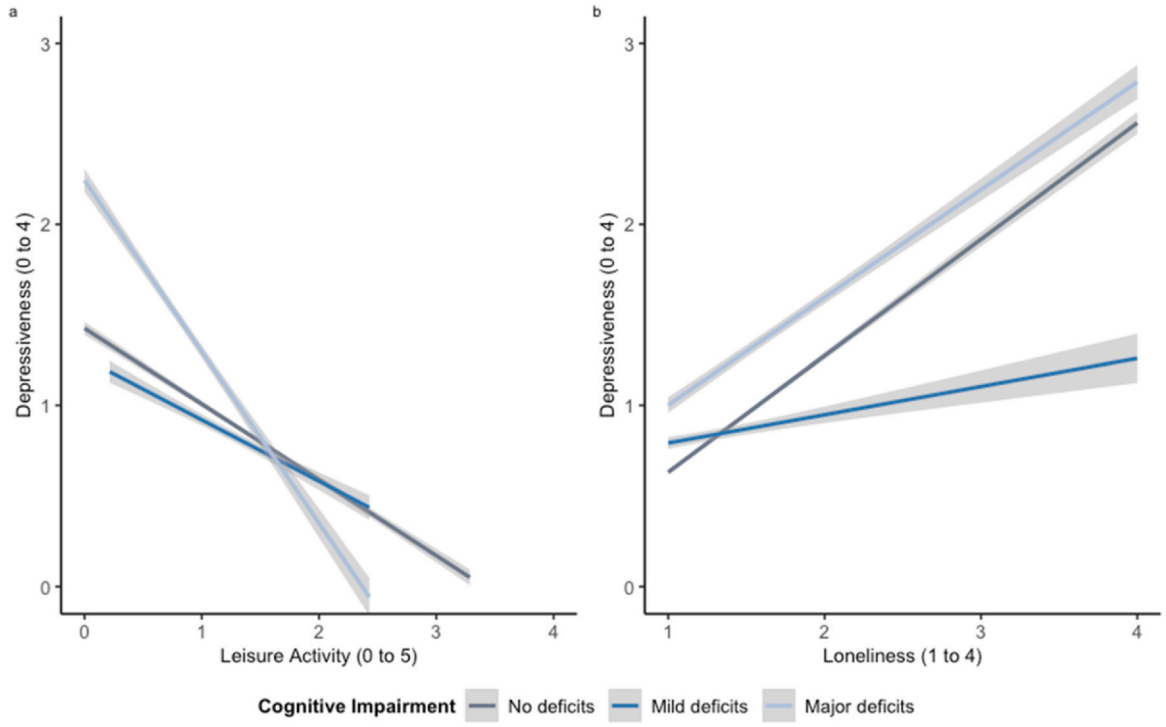

Fig. 1. The associations between leisure activity, loneliness, and well-being by cognitive impairment.

$p < .001$) were positively associated with positive affect. Loneliness was negatively associated with positive affect ($B = -0.13$, 95 % *CI* [−0.19, −0.07], $p < .001$). The omnibus test showed a significant overall effect of cognitive impairment on positive affect ($F(2, 31380) = 8.41, p = .004$). Post-hoc comparisons showed no difference between participants with MCI and those without impairment ($B = -0.06$, 95 % *CI* [−0.18, −0.06], $p = .300$), but lower positive affect in those with major impairment compared to those without impairment ($B = -0.24$, 95 % *CI* [−0.39, −0.10], $p < .001$).

Sensitivity analyses

The analyses conducted without survey weights and excluding proxy interviews did not produce results that meaningfully differed from the current findings. The only exception was the significant difference in depressive symptoms between participants with major cognitive impairment and those without it ($B = 0.28$, 95 % *CI* [0.09, 0.46], $p < .001$) in the unweighted analyses. Additional details are available in the supplementary materials (Tables S1 – S4).

Discussion

The present study investigated the associations between cognitive impairment, social relationships, and well-being in very old age using representative data from the NRW80 + Study. We compared individuals with no, mild, and major cognitive impairments across multiple aspects of social relationships and well-being. We hypothesized that cognitive impairment would be linked to poorer social outcomes and lower well-being. Furthermore, we explored whether cognitive impairment moderated the associations between social relationships and well-being. Here, we expected that higher social outcomes would be associated with increased well-being and lower social outcomes with decreased well-being, especially in people with cognitive impairment. Our findings partly supported the hypotheses.

For the first hypothesis, we found that cognitive impairment was associated with poorer social outcomes and lower well-being. Specifically, having mild cognitive impairment was associated with less leisure engagement and lower positive affect than having no cognitive impairment. Major cognitive impairment was associated with a reduced close network index, less leisure engagement, increased loneliness, and lower positive affect compared to no cognitive impairment. Interestingly, no significant differences were found for depressive symptoms. It may be partly explained by our use of a brief screening tool, which might lack the sensitivity to detect more subtle mood disturbances. Nonetheless, results showed a clear trend towards more depressive symptoms in people with major cognitive impairment, also supported by the sensitivity analyses. All in all, our results mostly align with prior studies, which have underlined the risk of reduced social and psychological health for individuals with cognitive impairments, especially with severe forms [25,28].

For the second hypothesis, we found that more leisure activity was associated with higher positive affect and fewer depressive symptoms. On the other hand, loneliness was linked to lower positive affect and more depressive symptoms. These findings are consistent with previous research that has underlined the negative impact of social isolation and loneliness on well-being [1,2,29,30]. In contrast, the associations between close networks and well-being were mixed. The close network index showed an inconsistent positive association with positive affect and a similarly inconsistent negative association with depressive symptoms. The inconsistency may be due to the complexity of the index, particularly in very old age. Close networks not only depict the number of supportive relationships but also include various roles, such as caregiving. The associations may vary based on these roles. Additionally, close networks tend to be stable over time, with significant fluctuations occurring mainly during critical life events like widowhood [7]. This stability may explain the weak connection to the more fluctuating concepts of positive affect and depressive mood. Indeed, previous research has shown that older adults, including those with cognitive impairment, tend to lose more distant social connections rather than close relationships [7,54]. In summary, we found that increased social activity and decreased feelings of loneliness were consistently linked to better well-being, while the findings regarding the close network were more varied.

Furthermore, we found that cognitive impairment moderated the associations between social factors and depressive symptoms. For people with major cognitive impairment, participating in leisure activities was more strongly associated with less depressive symptoms than for those without cognitive impairment. In turn, participating in few leisure activities was more strongly linked to more depressive symptoms than for those without cognitive impairment. It aligns with the theory that the development of depressive symptoms is linked to dysfunctional cognitive and emotional regulation processes, which may be affected by cognitive impairment [55]. Thus, engaging in social activities could serve as a valuable external resource for managing negative emotions in individuals with cognitive impairment. Moreover, we observed differences between participants with no cognitive impairment and those with MCI. The positive association between loneliness and depressive symptoms was less pronounced for individuals with MCI. While this observation might seem surprising, it could be attributed to the unique condition of MCI. Although individuals with MCI experience cognitive deficits, their daily functioning typically remains largely intact. They also seem to maintain a certain degree of social engagement. Our findings support this interpretation, as participants with MCI had similar outcomes in the close network index and loneliness as participants without cognitive impairment. Therefore, they have more cognitive resources than individuals with major cognitive impairment and may retain more regulatory skills. Even more, individuals with MCI are often aware of their cognitive deficits [56]. This awareness may encourage them to adopt additional compensatory strategies to adjust to changes in their social lives, such as modifying their expectations. Such adjustments may help mitigate the impact of loneliness on negative affect and depression.

Lastly, cognitive impairment did not moderate the associations between social relationships and positive affect. These associations remained consistent across cognitive groups and including interaction terms did not improve the model fit. These varying results between depressive symptoms and positive affect underline the understanding that they represent distinct constructs that are influenced by different factors [48]. Depressive symptoms represent a particularly complex state, characterized by low positive and high negative affect [57]. Overcoming depressive symptoms requires increased cognitive and emotional regulatory skills [55]. This assumption is supported by studies that have demonstrated a link between cognitive impairment and depressive symptoms [58]. Consequently, cognitive decline primarily affects the regulation of negative emotions, moderating the relationship between social activity and depressive symptoms but not positive affect. These findings also align with prior research by [24,59]. These authors have emphasized the benefits of social engagement and activity in enhancing quality of life and well-being, regardless of cognitive impairment. In conclusion, while cognitive impairment affected the associations between social factors and depressive symptoms, it did not appear to moderate the relationship with positive affect. Nonetheless, individuals with cognitive impairment showed the highest levels of loneliness and the lowest levels of leisure activity, highlighting their general social and mental health risks.

Limitations

While our study provides interesting findings, they need to be interpreted with certain limitations. Firstly, our research focused on very old adults. This age group differs from younger age groups in socio-economic and health characteristics. For instance, very old adults often experience multimorbidity, which not only influences their experience of cognitive impairment but also affects their social and psychological health [6,60]. Consequently, our findings should be replicated in samples without an age limit to enhance the generalizability. Secondly, we aimed to create a

representative sample for our analyses. In the main analyses, we used survey weights and proxy information to create a representative sample of very old adults with cognitive impairment. However, proxy interviews introduce potential biases because they tend to rate well-being lower than the individuals themselves [32]. To address this, we repeated the analyses using only data from the target-person interviews. The risk here, however, is the underrepresentation of individuals with more severe cognitive impairment. These individuals are less likely to participate in target-person interviews due to communication barriers and difficulties in comprehension. Thus, each approach has its strengths and limitations. Thirdly, we categorized individuals into three groups (no, mild, and major cognitive impairment) to combine target-person and proxy outcomes into a single variable. While this approach gave us the opportunity to include data from participants who normally do not take part in standardized research, it limited our ability to explore variations across the broader spectrum of cognitive impairment. Creating these groups also increased the number of comparisons, which raises the risk of Type I errors and should therefore be acknowledged. Lastly, as the present study used cross-sectional data, no causal conclusions can be drawn. Future research with longitudinal designs is needed to better understand the direction of the associations at hand.

Conclusions

The present study investigated the associations between cognitive impairment, social relationships, and well-being in very old age. As expected, cognitive impairment was associated with poorer social outcomes and lower well-being. Poorer social outcomes were associated with lower positive affect and more depressive symptoms, while higher social outcomes were associated with higher positive affect and fewer depressive symptoms. The associations between social factors and positive affect did not depend on cognitive status, while it partly influenced the associations between social aspects and depressive symptoms. Most importantly, individuals with major cognitive impairment showed more depressive symptoms than those with no cognitive impairment when they had low leisure engagement. At the same time, when they showed high leisure engagement, they experienced fewer depressive symptoms compared to those without cognitive impairment.

In conclusion, our findings highlight the importance of social connections for well-being, particularly for individuals with major cognitive impairment. In our study, they faced the highest risk of experiencing decreased social and psychological health. Likewise, a decline in social engagement had more negative consequences for them than for the other cognitive groups. Our research aligns with previous studies that emphasize the increased vulnerability of people with cognitive impairment to unmet social needs, reduced social interactions, and lower well-being [13]. As the number of individuals affected by cognitive impairment continues to rise in our aging society, it is essential not only to focus on preventing cognitive decline but also to explore ways to improve the circumstances for those already experiencing it.

CRediT authorship contribution statement

Selina Vogel: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Susanne Zank:** Writing – review & editing, Supervision.

Disclosure statement

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Data availability

Our study utilized secondary data from the Study of Quality of Life and Well-Being in North-Rhine Westphalia (NRW80+ Study). The data is freely accessible through GESIS, Cologne. It can be found at https://doi.org/10.4232/1.13978, including associated information and materials.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used the AI-assisted language tool Grammarly to enhance grammar, clarity, and overall writing quality. After using this tool, we reviewed and edited the content as needed and therefore take full responsibility for the content of the publication.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.inpsyc.2025.100109.

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