Extended Abstract – EPC 2026

The Impact of Human Social Networks and Pets on Cognitive Outcomes and Mortality: A Longitudinal Analysis of the German National Cohort (2014–2019)

Jonas Mauersberger, Constantin Reinke, Gabriele Doblhammer

Theoretical focus:

Social relationships are essential for human well-being and play a key role in maintaining health and reducing mortality. The lack of social relationships resulting in loneliness and social isolation is a significant—yet fundamentally modifiable—risk factor of cognitive decline. Cognitive decline in later life constitutes a major public health challenge, as it is associated with reduced competence in activities of daily living and independence, depressive symptoms, and increased mortality (1-3). In light of population aging, smaller family sizes, and a growing number of older adults living alone, understanding these interrelations and identifying the factors that shape cognitive performance and mortality is of central importance from a public health perspective (4,5).

Social embeddedness—that is, the web of relationships in which individuals are situated—has long been discussed as a relevant determinant of cognitive functioning. Epidemiological studies have shown that loneliness and limited social networks are associated with a higher risk of cognitive decline and dementia, as well as with increased mortality (6,7). Most studies, however, rely on single indicators of the social environment and thus capture only partial aspects of social life. In contrast, the present study examines the association between different dimensions of social embeddedness—the concept of "network type"—and cognitive performance as well as mortality. The aim is to identify vulnerable groups and thereby derive points of departure for targeted prevention and intervention strategies. A distinctive feature of this work is the systematic integration of pet ownership as a potentially modifiable component of social embeddedness. This aspect has received little attention in prior social network research, yet could, due to emotional attachment and daily structures of responsibility, make an independent contribution to mental and physical health. Recent literature identifies pets—particularly dogs—as important social and emotional partners for humans (8) that can amplify the effects of social networks but also compensate for their absence.

Data:

The research is based on the German National Cohort (NAKO), Germany's largest population-based longitudinal study on the determinants of health. From the study's launch in March 2014 through September 2019, the baseline assessment (Wave 1) recruited more than

200,000 women and men aged 19 to 75 from the general population via random sampling from municipal population registers across 18 regionally distributed study centers, in order to obtain a broadly representative picture of health in Germany (9). NAKO permits the analysis of the associations between lifestyle factors (e.g., diet, physical activity), biomedical parameters (e.g., blood markers), environmental exposures (e.g., air quality), disease risks, as well as regional and socioeconomic disparities (10).

For the present study, we used data from the first survey wave (Wave 1), supplemented by the mortality follow-up (status as of May 2024), which—where applicable—includes date of death. Analyses are restricted to individuals who were at least 50 years old at the relevant baseline measurement in 2019. Four key variables—the first two serving as outcomes—were included as follows: (1.) mortality as a binary indicator capturing whether a person died during the observation period; (2.) cognition as performance in two domains: episodic memory (e.g., word-list recall) and semantic/executive functions (e.g., category fluency, inhibitory control); (3.) social networks as a structural and functional construct summarizing the size and composition of personal networks (family, friends, household members), contact intensity, and received support; and (4.) animals in the household as an indicator of pet ownership, differentiated into dog, cat, other pets, or no pet, to capture potential differences in social embeddedness and daily routine.

Methods:

We employed three complementary procedures for operationalization and for the core multivariate analyses: (1.) Factor analysis based on six items from neuropsychological tests identified two substantively interpretable domains (episodic memory based on the immediate recall 1 and 2 as well as delayed recall of the word list memory test and semantic–executive functions based on Language test (listing animal names) and Stroop test (color-word interference test)). For each domain individual items were z-standardized and aggregated into summed indices. Within each five-year age group, these indices were categorized into three categories of cognitive performance (low/medium/high) with the cut point set at ±1.5 standard deviations. (2.) k-means cluster analysis based on z-standardized continuous indicators and dummy-coded nominal variables was used to derive a data-driven typology of social networks and identify five prototypical profiles (family-poor, close-family, multi-tie (friends), multi-tie (family), family & household rich)), which enter the outcome models as multidimensional predictors. Pets are recorded as separate categories and are not included in the cluster formation. (3.) Logistic regression was used for exploring the effect of social networks on cognition and

mortality. The cognition domains (with reference group "low" versus "medium/high") and the binary mortality measure served as the dependent variables. Network types and pet categories are the key predictors (with sociodemographic and health covariates). The mortality model, in addition, includes the cognition domains. Effects are reported as odds ratios with 95% CIs.

Findings

Univariate statistics

In the analysis sample (N = 101,235), 3.0% (3,052) died during the observation period, while 97.0% (98,183) were alive at the end of follow-up (these and subsequent results in Table 1). For both cognitive domains, mid-range levels predominated; low performance was observed in 7.1% (Cognition 1: episodic memory) and 6.8% (Cognition 2: concentration/processing speed/verbal fluency). Regarding social network types, roughly one quarter (25.0%) of respondents are classified as the vulnerable "Family poor" type. The largest share belongs to the "Close Family" network (36.8%), followed by multi-tie types emphasizing friendships (5.7%) or family (8.3%), and the "Family & Household Rich" type (4.4%). A substantial share (19.8%) could not be assigned to any network type (missing cluster). The vulnerable network type "Family Poor" is characterized, among other traits, by a low average number of children (0.52), the comparatively lowest number of close relatives (3.65), infrequent contact, and living in small households (1.54) (Figure 1).

Cognition

Findings from the multivariate analysis indicate that extensive, tightly knit social networks in later life are correlated with higher cognitive performance and may constitute an important protective factor against cognitive decline at advanced ages. For example (Table 2), individuals in the Family-Rich cluster show an approximately 20% lower risk of limitations in episodic memory than those in the vulnerable Family-Poor type (OR = 0.809, p = 0.023). Likewise, individuals with diverse and quantitatively strong family ties ("Multi-Tie" network) perform better on the other cognitive domain, namely concentration and processing speed. The influence of pet ownership on cognitive functioning is nuanced: dog owners have a lower risk (OR = 0.798, p = 0.029) of low scores in concentration and processing speed compared to individuals without pets; for episodic memory, the association was in the same direction but not statistically significant. For cat owners and owners of other pets, small positive tendencies are also visible, but no statistically significant association with cognition could be confirmed.

Mortality

Large and diverse social networks—especially those with family bonds—substantially reduce the risk of death. Compared to individuals categorized as "Family poor" (ref.), characterized by few friends and relatives, few or no children, small households, and a comparatively high share reporting available support, the risk of death is reduced by up to 32% in large, close family networks (OR = 0.684, p = 0.009), controlling for socioeconomic factors and lifestyle (Table 3). For all other identified clusters, mortality risks are also significantly lower relative to the vulnerable reference type (by 13% to 25%). Pet ownership shows no significant effect on mortality in older age.

Conclusion

Our results underscore that cognitive performance and mortality in later life follow not only medical but to a considerable extent social structures. Individuals in network-poor constellations ("Family poor") exhibit the least favorable profiles, whereas broadly embedded network types ("Multi-Tie") perform consistently better—a pattern only partially explained by sociodemographic factors. Evidence suggests that psychological burdens (e.g., depression) and multimorbidity are key pathways through which social embeddedness affects cognitive risks and survival; more granular adjustment attenuates—but does not eliminate—these inequalities. In terms of cognitive performance, pet ownership—especially dog ownership—emerges as a potentially modifiable resource of social embeddedness and may compensate for negative effects of limited networks.

In further analyses, we plan to conduct the mortality models using Cox proportional hazards to leverage the strength of the NAKO mortality follow-up with exact dates of death. We also plan to examine the effects of social networks and pet ownership on cognition and mortality in subgroups with low and high health vulnerability via moderation analyses, to gather indications of possible health selection in these associations.

References:

1 Connors, M. H., Sachdev, P. S., Kochan, N. A., Xu, J., Draper, B., & Brodaty, H. (2015): Cognition and mortality in older people: the Sydney Memory and Ageing Study. *Age and ageing*, 44(6), 1049-1054. https://doi.org/10.1093/ageing/afv139

2 Aichele, S., & Ghisletta, P. (2019): Memory deficits precede increases in depressive symptoms in later adulthood. *The Journals of Gerontology: Series B*, 74(6), 943-953. https://doi.org/10.1093/geronb/gbx183

3 Sánchez-Sánchez, J. L., Lu, W. H., Gallardo-Gómez, D., del Pozo Cruz, B., de Souto Barreto, P., Lucia, A., & Valenzuela, P. L. (2024): Association of intrinsic capacity with functional decline and mortality in older adults: a systematic review and meta-analysis of longitudinal studies. *The Lancet Healthy Longevity*, 5(7), e480-e492. https://doi.org/10.1016/S2666-7568(24)00092-8

4 Pfabigan, J., Pleschberger, S., & Wosko, P. (2023): Alleinlebende ältere Menschen: Stellenwert der informellen außerfamiliären Hilfe. *Zeitschrift für Gerontologie und Geriatrie*, *56*(6), 498-504. https://doi.org/10.1007/s00391-022-02099-3

5 Wang, F., Gao, Y., Han, Z., Yu, Y., Long, Z., Jiang, X., ... & Zhao, Y. (2023): A systematic review and meta-analysis of 90 cohort studies of social isolation, loneliness and mortality. *Nature human behaviour*, 7(8), 1307-1319. https://doi.org/10.1038/s41562-023-01617-6

6 Schutter, N., Holwerda, T. J., Comijs, H. C., Stek, M. L., Peen, J., & Dekker, J. J. (2022): Loneliness, social network size and mortality in older adults: a meta-analysis. *European journal of ageing*, 19(4), 1057-1076. https://doi.org/10.1007/s10433-022-00740-z

7 Schwartz, E., Khalaila, R., & Litwin, H. (2019): Contact frequency and cognitive health among older adults in Israel. *Aging & Mental Health*, 23(8), 1008-1016. https://doi.org/10.1080/13607863.2018.1459472 - only available as authors manuscript in PMC: 2020 Aug 1: <https://pmc.ncbi.nlm.nih.gov/articles/PMC6215531/>

8 Gee, N. R., Rodriguez, K. E., Fine, A. H., & Trammell, J. P. (2021): Dogs supporting human health and well-being: A biopsychosocial approach. *Frontiers in Veterinary Science*, 8, 630465. https://doi.org/10.3389/fvets.2021.630465

9 NAKO (2025a): Datenhandbuch für die NAKO Gesundheitsstudie. Ausgabe: Juni 2025. <https://transfer.nako.de/transfer/index> (zuletzt abgerufen am 04.08.2025)

10 Schipf, S., Schöne, G., Schmidt, B., Günther, K., Stübs, G., Greiser, K. H., ... & Ahrens, W. (2020): Die Basiserhebung der NAKO Gesundheitsstudie: Teilnahme an den Untersuchungsmodulen, Qualitätssicherung und Nutzung von Sekundärdaten. *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz*, 63, 254–266. https://doi.org/10.1007/s00103-020-03093-z

Tables and figures:

Table 1: Univariate Statistics

Variable		N	%
Mortality (DV)	alive	98.183	97,0
	deceased	3.052	3,0
Cognition 1 (3-cat, IV) *(Episodic Memory)*	Low (≤ Mean - 1.5*Std. dev.)	7.152	7,1
	Medium (Mean ± 1.5*Std. dev.)	87.331	86,3
	High (≥ Mean + 1.5*Std. dev.)	6.752	6,7
Cognition 2 (3-cat., IV) *(Attention, Processing Speed, Verbal Fluency)*	Niedrig (≥ Mean + 1,5*Std.dev)	6.838	6,8
	Medium (Mean ± 1.5*Std. dev.)	90.911	89,8
	High (≤ Mean - 1.5*Std. dev.)	3.486	3,4
Gender	Male	49.382	48,8
	Female	51.853	51,2
Age (cat.)	50 - 59 years	50.983	50,4
	60 - 69 years	46.308	45,7
	70 - 75 years	3.944	3,9
Social Network Types	Family Poor (vulnerable)	25.317	25,0
	Close Family	37.207	36,8
	Multi-Tie (Friends)	5.765	5,7
	Multi-Tie (Family)	8.439	8,3
	Family & Household Rich	4.477	4,4
	Missing Cluster	20.030	19,8
Pets	Dog as pet	3.143	3,1
	Cat as pet (without dog)	2.760	2,7
	Other pet	816	0,8
	No pet	15.412	15,2
	Missing	79.104	78,1

Source: Own calculations based on the NAKO Health Study (Wave 1)

Table 2: Multivariate Statistics – Regression Models with Cognition (excerpt)

Binary logistic regression - Cognition 1 and 2 (Risk of low cognition)					
Variable	**Category**	**Cognition 1**		**Cognition 2**	
		OR	**p**	**OR**	**P**
Social Network Types	Family poor (vulnerable)	1 (Ref.)		1 (Ref.)	
	Close Family	0,967	0,369	0,959	0,297

	Multi-Tie (Friends)	0,952	0,464	0,928	0,321
	Multi-Tie (Family)	0,980	0,727	0,868	0,028
	Family & Household Rich	0,809	0,023	0,877	0,164
	Missing Cluster	1,830	<0,001	2,258	<0,001
Gender	Male	1 (Ref.)		1 (Ref.)	
	Female	0,281	<0,001	0,505	<0,001
Age (years, metric)		1,090	<0,001	1,054	<0,001
Pets	Dog as pet	0,879	0,177	0,798	0,029
	Cat as pet (without dog)	0,838	0,085	0,860	0,161
	Other pet	0,744	0,139	0,887	0,531
	No pet	1 (Ref.)		1 (Ref.)	
	Missing	1,042	0,294	1,031	0,466

Source: Own calculations based on the NAKO Health Study (Wave 1)

*Controlled for age, gender, education, income, comorbidities, depression, smoking status, alcohol consumption, BMI, and physical activity

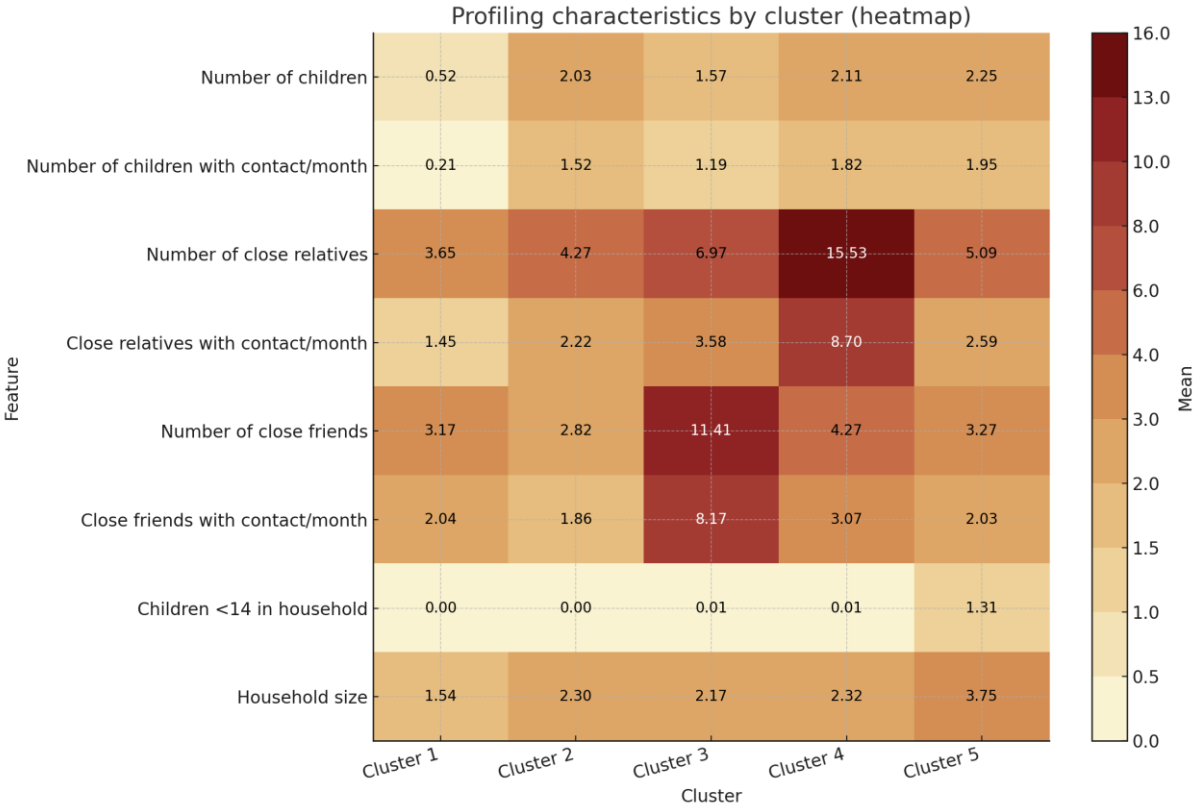
Table 3: Multivariate Statistics – Regression Model with Mortality (excerpt)

Binary logistic regression - Mortality (Risk of "deceased")			
Variable	**Category**	*	
		OR	**p**
Social Network Types	Family poor (vulnerable)	1 (Ref.)	
	Close Family	0,870	0,006
	Multi-Tie (Friends)	0,829	0,050
	Multi-Tie (Family)	0,758	0,001
	Family & Household Rich	0,684	0,009
	Missing Cluster	0,871	0,017
Gender	Male	1 (Ref.)	
	Female	0,494	<0,001
Age (years, metric)		1,080	<0,001
Pets	Dog as pet	1,094	0,517
	Cat as pet (without dog)	1,199	0,209
	Other pet	0,862	0,634
	No pet	1 (Ref.)	
	Missing	1,213	0,002

Source: Own calculations based on the NAKO Health Study (Wave 1)

*Complete model according to stepwise regression, controlled for age, gender, cognition, education, income, comorbidities, depression, smoking status, alcohol consumption, BMI, and physical activity

Figure 1: Mean values of metric characteristics per social network cluster



Source: Own calculations based on the NAKO Health Study (Wave 1)

*Cluster 1 is the identified vulnerable cluster (Family Poor)