Contributions of having a pet to living well with dementia over time: Longitudinal findings from the IDEAL cohort

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Abstract

Objectives

Pets may be beneficial for people living with dementia but understanding of longitudinal benefits is limited. This study investigated whether having a pet was associated with differences over time in 'living well', cognition, functional ability, depression or loneliness.

Method

This study utilised 3 assessment timepoints from the IDEAL Programme, a longitudinal cohort study of people with mild-to-moderate dementia. The relationships between having a pet, a dog, and caring for a pet (vs no pet/no dog/not caring) and outcome changes were assessed using mixed effects models with data from 1,532 people with dementia at baseline, 1,173 at 12-months and 846 people at 24 months.

Results

People with dementia with a pet had slower decline in informant-rated well-being, satisfaction with life, and self-rated functional ability over time than those with no pet. Those with a dog had slower decline in self-rated quality of life and functional ability, cognitive function, and informant-rated well-being and functional ability than those with a different pet or no pet.

Conclusion

Having a pet may be beneficial for people living with dementia, with dogs offering additional benefits. Enabling people living with dementia to have a pet could help them maintain their independence and ability to live well for longer.

Key words: Alzheimer's disease, neurodegenerative, companion animals, animal care, human-animal interaction.

Introduction

There are approximately 57 million people living with dementia worldwide (World Health Organization, 2025) and although new treatments show some promise, there is currently no effective method of prevention or cure for dementia. This makes it imperative to enable those living with dementia to live as well as possible. The capacity to live well with chronic illness and disability has been defined as experiencing 'the best achievable state of health that encompasses all dimensions of physical, mental, and social well-being' (Institute of Medicine, 2012 p32). In dementia, a comprehensive model of living well highlights the importance of maintaining psychological health and, to a degree, physical fitness and physical health to help enable people to live well (Clare et al., 2019). Having a pet may contribute to both psychological and physical health (Dooley et al., 2021; Opdebeeck et al., 2021; Rusanen et al., 2021; Taniguchi et al., 2023; Välimäki et al., 2022); enabling people with dementia to have a pet may be a way in which they can be assisted to live well for longer.

A recent scoping review of the six unique studies investigating pets in the lives of people living with dementia highlighted the important role that pets may play in living well with dementia from promoting immediate well-being to active participation and social citizenship (Monks & Clark, 2024). Within these studies, dogs were the only pet consistently considered across all six; other pets were considered within three, but no other animal species was analysed individually. While these studies have begun to identify the potential benefits of pets for people living with dementia, the authors of the review highlight the need for further high-quality research to fully understand the potential benefits. Delineating the associations between having a pet and living well with dementia, especially the longitudinal associations, could help to inform future interventions involving human-animal interaction. Within the below literature review, when we refer to pets rather than a specific animal, it means the authors did not perform analysis by a specific animal species but rather considered pets in general.

Only two published reports to date have considered whether having a pet has any benefits longitudinally for people with dementia living in the community, both utilising data from the Alzheimer's Disease Follow-Up (ALSOVA) study (Rusanen et al., 2021; Välimäki et al., 2022). Välimäki et al. (2022) evaluated differences in self-rated quality of life, informant-rated quality of life and satisfaction with life, suggesting that having a pet was related to significantly better quality of life over time but only in terms of informant-rated quality of life and they did not report analyses by pet type. Rusanen et al. (2021) reported significant positive effects on activities of daily living, neuropsychiatric symptoms, and disease progression for people with pets compared to those without but no differences for cognition for pets in general. They also found no relationships between pets and any of the outcomes when considering dogs or 'other pets' separately; however, this may be due to the very small numbers of people with pets in the study. The dataset used for these studies provided a significant follow-up period of 5 years; however, only people with Alzheimer's disease were included and the sample was relatively small with only 223 total participants, just 40 of whom had pets which may have impacted the power of the study to detect effects. The ALSOVA study also did not explore whether involvement in caring for the animal influenced associations, which is noted as relevant in previous cross-sectional work (Opdebeeck et al., 2021). Our current study will add further knowledge to this by examining the longitudinal associations in a large cohort with participants with greater variation in type of dementia, animal and with information on involvement in animal care.

The approach taken in the Improving the experience of Dementia and Enhancing Active Life (IDEAL) study, a large cohort study of people living with dementia, was to consider living well in terms of quality of life, well-being, and satisfaction with life (Clare et al., 2014). Rather than relying on a single measure of quality of life, this approach provided a more comprehensive understanding of how a person perceives their ability to live well. The current study utilises data from IDEAL and builds upon the previous cross-sectional study of having a pet (Opdebeeck et al., 2021). The IDEAL cohort allows a unique insight into having a pet and living well with dementia from the perspective of a large

cohort of people with dementia and their carers. This comprehensive study allows us to investigate associations not just linked with having a pet but also in relation to involvement in care of the pet and to consider these from the perspective of both the person with dementia and their carer. We can also examine the associations in terms of pets in general and specifically for dogs. We focus on dogs as there is strong evidence for their benefit to human health across a biopsychosocial framework (Gee et al., 2021). In relation to dementia, dogs are most commonly employed in animal assisted interventions (Babka et al., 2021) making a focus on dogs in this population particularly pertinent. The overarching aim of the present study was to investigate whether having a pet was associated with different trajectories of quality of life, well-being, satisfaction with life, cognition, functional ability, depression, or loneliness, using both self-rated and informant-rated measures where available. The selected outcomes allow for comparison with previous studies in dementia and expansion to benefits found for healthy older people (Gee & Mueller, 2019; Hughes et al., 2019; Hui Gan et al., 2020; Krause-Parello, 2012; Obradovic et al., 2020; Pikhartova et al., 2014; Rostekova et al., 2025). We then sought to investigate whether the associations were different for those involved in the care of the pet compared to those with no involvement for the care of a pet, and those with a dog compared to those with a different pet or no pet.

Materials and Methods

Design

The present study utilised longitudinal IDEAL data from three assessment timepoints covering a 24-month period. Details of the aims and procedures can be found in the protocol (Clare et al., 2014). Time 1 (T1) data were collected from August 2014 to July 2016, Time 2 (T2) from August 2015 to July 2017, and Time 3 (T3) from August 2016 to June 2018. The analyses are based on version 7 of the IDEAL datasets. The IDEAL study was approved by Wales Research Ethics Committee 5 (reference

13/WA/0405) and the Ethics Committee of the School of Psychology, Bangor University (reference 2014-11684), and is registered with UK Clinical Research Network (#16593).

Study population

Participant recruitment took place at 29 National Health Service sites across England, Scotland and Wales and via the online Join Dementia Research portal. Inclusion criteria were a clinical diagnosis of any type of dementia, a Mini-Mental State Examination (MMSE; Folstein et al., 1975) score of 15 or above (indicating mild-to-moderate stages of dementia), and participants had to be residing in the community at the time of enrolment into the study. Exclusion criteria were co-morbid terminal illness and inability to provide informed consent. Trained researchers administered questionnaires to people with dementia while carers completed questionnaires by themselves, usually in a separate room.

Data were provided by 1537 people with dementia at T1, 1183 at T2, and 851 at T3. Carers, where available, provided informant-ratings; there were 1267 caregivers at T1, 978 at T2, and 751 at T3. Only those with information on having a pet at T1 were included in the analyses; therefore, there were 1532 people with dementia at T1, 1173 at T2, and 846 at T3 for the purposes of analyses.

Measures

Information about pets was assessed through several questions. Participants were asked if they had no pets, one pet, or more than one pet. If they had a pet, they were asked to specify the type of animal(s) (T1 only); questions were adapted from Connell et al. (2007). As previous research has found involvement in caring for the animal to be an important factor, e.g., Parslow et al. (2005), a single question asking whether the person with dementia was involved in the care of the animal was also included. This question asked the person with dementia to indicate whether they felt they were solely responsible for caring for the animal, shared the care with their spouse/partner or whether someone else did all the care; the type of care was not specified. To maintain robust group sizes and

avoid any ambiguity within levels of care, responses were dichotomised into no involvement in care vs. involvement in the care of the animal.

Outcome measures (with self- and informant-ratings)

The Quality of Life in Alzheimer's Disease scale (QoL-AD; Logsdon, 2000) assessed QoL. The measure comprises 13 items with responses given on a 4-point scale (1 = poor to 4 = excellent) and incorporates multiple aspects of life. Scores were summed to provide a total ranging from 13 to 52 with higher scores indicating more positive ratings of QoL.

Well-being was assessed using the World Health Organization-Five Well-Being Index (WHO-5; Bech, 2004). This is a five-item scale that investigates psychological well-being. Each question has six responses ranging between 'at no time' to 'all the time'. Scores range between 0 to 25; these have been converted to a percentage in the present study where 0 refers to the worst possible well-being while 100 relates to the best possible well-being.

Satisfaction with life was assessed using the Satisfaction with Life Scale (SwL; Diener et al., 1985). This is a five-item scale designed to measure global judgements of satisfaction with life. Each question has seven possible responses that range between 'strongly agree' to 'strongly disagree'. Scores range between 5 and 35 with higher scores indicating better satisfaction with life.

Functional ability was assessed using the Functional Activities Questionnaire (Pfeffer et al., 1982), a measure of instrumental activities of daily living modified from the original 10 items to include a question concerning telephone use which has been described elsewhere (Martyr et al., 2012). Each item was rated on a 0 to 3 scale leading to a score range of 0 to 33; a higher score indicated greater perceived difficulty with functional ability.

Outcome measures (objective or self-rated only)

Cognition was assessed with the Addenbrooke's Cognitive Examination-III (ACE-III; Hsieh et al., 2013). Scores for the ACE-III range between 0 and 100, with higher scores indicating better cognitive

function. The ACE-III also provides scores for five cognitive subdomains (Attention, Verbal fluency, Language, Memory, Visuospatial). At T2 and T3 when a person scored below 10 on the Mini Mental State Examination (MMSE), the ACE-III was not administered. Instead, the MMSE score was used to impute the ACE-III scores for these people. There were 25 ACE-III scores imputed at T2 and 55 imputed at T3 as described previously (Martyr et al., 2024).

Loneliness was assessed with the De Jong Gierveld 6-item loneliness scale (De Jong Gierveld & Van Tilburg, 2006) at T1 and T3. This is a 6-item measure of loneliness with possible scores ranging from 0 to 6 with higher scores indicating greater loneliness.

The Geriatric Depression Scale-10 (Almeida & Almeida, 1999) was used to measure depression in participants living with dementia, with higher scores indicating more self-reported depressive symptoms.

Covariates

Covariates included for analysis purposes were age, sex and dementia type. Dementia diagnosis was taken from medical records and comprised Alzheimer's disease, vascular dementia, mixed Alzheimer's disease and vascular dementia, frontotemporal dementia, Parkinson's disease dementia, dementia with Lewy bodies and unspecified dementia incorporating other rarer forms of the disease. Other covariates considered were social class, to represent socioeconomic status, and living situation (living alone vs. with others). Neither of these variables impacted the results and so were not included in the final analyses.

Statistical analyses

Mixed effects models (Rabe-Hesketh & Skrondal, 2022) were used to investigate change in outcomes measured over the three timepoints of data collection (T1-T3) using Stata 17 (StataCorp, 2021). Conditional (covariate-adjusted) random coefficient models, with a random intercept and a random slope (Skrondal & Rabe-Hesketh, 2004) were fitted initially and tested against a random intercept

model to see if adding the random slope improved model fit. In cases where the model fit was not improved, a random intercept model was used. All models had unstructured covariance allowing subject-specific random slopes to vary freely over time. All outcome measures were continuous, and residuals were examined for normality and either linear models or generalised linear models with a gamma distribution and a log link were fitted.

Models were adjusted for age, sex, and dementia type. Missing data on outcome measures was handled using full information maximum likelihood estimation. Main effects of having a pet at T1 (vs. no pet) and change per timepoint for those with no pet were reported for longitudinal outcomes, in addition to the interaction between having a pet at T1 and time (indicating the expected difference in slope between those with a pet and those with no pet). Analyses were repeated for caring for a pet (vs. not caring for a pet) and having a dog (vs. no dog, i.e., a different pet or no pet at all). Sensitivity analyses were conducted for having a pet and pet care. For each sensitivity analysis, participants were included in the having a pet/care groups if they had a pet/cared for it at every timepoint they participated in or in the no pet/no care groups if they had no pet/no involvement in pet care at all the timepoints in which they participated. This limited the groups to those who had/cared for a pet at all the timepoints in which they took part, including and beyond baseline, and reduced the number of participants in each group, allowing us to investigate whether any associations seen in the longitudinal analyses were maintained. No sensitivity analyses were conducted for having a dog as type of pet was only asked at T1. Since we had selected relevant outcomes a priori for planned analyses and interpreted results based on point estimates or rate ratios and confidence intervals, we did not adjust for multiple testing as argued in previous large cohort research (Cadman et al., 2024).

Results

There were 462 people with pets at T1, 350 at T2 and 248 at T3, representing approximately a third of all people with dementia at each timepoint. However, of the 833 people with relevant data at all

timepoints, only 152 had a pet at all timepoints while 526 never had a pet and 155 had a pet during at least one timepoint, indicating that having a pet was not static. Demographic and clinical characteristics are summarised by pet status at T1 in Table 1, and details of scores on study measures by pet status in Table 2. Compared to those without a pet, a higher proportion of those with a pet at T1 were younger, male, and had a diagnosis other than Alzheimer's disease. Participant characteristics, scores on study measures by pet care vs. no pet care and having a dog vs. no dog, and results for sensitivity analyses are presented in supplementary Tables 1-6. Comparisons of those who did and those who did not participate at subsequent timepoints are presented in supplementary Table 7.

Tables 1 and 2 about here

Having a pet

At T1, people with a pet had slightly lower scores on average for informant-rated QoL-AD and self-rated SwL (see Table 3). Over time, on average participants showed a decline in informant-rated QoL-AD, self- and informant-rated WHO-5, informant-rated SwL, cognition, and self- and informant-rated functional ability. There were no changes over time for loneliness or scores on the Geriatric Depression Scale. Compared to those without a pet at T1, those with a pet had a slightly slower decline in the informant-rated WHO-5 (2.39 vs. 3.84 points decrease per year), estimate for interaction: 1.45 (95% CI 0.12, 2.79), p = .033 and the informant-rated SwL (0.66 vs. -1.31 points decrease per year), estimate for interaction: 0.65 (95% CI -0.15, -1.15), p = .011. Those with a pet also had slower decline in self-rated functional ability over time than those with no pet at T1 (13% vs 21% per year); rate ratio (RR) for interaction: 0.93 (95% CI 0.87, 0.99), p = .020 (see Table 3). Sensitivity analyses (Supplementary Table 5) between those who had a pet at all timepoints in which they participated (n = 341) and those who did not have a pet at any timepoint (n = 1,020) demonstrate very similar results with a more marked difference for functional ability (7% vs 20%); RR: 0.89 (95% CI 0.83, 0.95), p = .001.

Pet care

At T1, those who were involved in caring for their pet (n = 328) had higher cognition scores and better informant-rated functional ability than those with no pet or who had a pet but with no involvement in its care (n = 1,204; see Table 4 and Supplementary Tables 1 and 2 for demographic information and outcome scores by pet care status). For pet care vs. no care at T1, the only difference in trajectory was for self-rated SwL. Those who had a pet and cared for it had, on average, a small increase in self-rated SwL score while those who had no pet or a pet but no involvement in its care showed a small decrease in SwL score on average (0.36 vs. -0.13 points per year); estimate for interaction: 0.49 (95% CI 0.07, 0.91), p = .023. However, sensitivity analyses (Supplementary Table 6) evaluating those who cared for a pet at all timepoints in which they took part (n = 234) compared to those who did not care for a pet at any timepoint (n = 1,104) suggested that there was also a slower decline in cognition and self-rated functional ability for those that cared for a pet. Those who cared for a pet at all timepoints had a slower decline in cognition compared to those who never cared for a pet (4.27 vs. 6.05 points of decline per year) estimate for interaction: 1.33 (95% CI 0.01, 2.64), p = .048. Those who cared for a pet at all timepoints also had slower decline in self-rated functional ability than those who never cared for a pet (3% vs. 19%), rate ratio: 0.87 (95% CI 0.80, 0.95), p = .001. There was no difference in self-rated SwL trajectory in the sensitivity analyses.

Having a dog

Those who had a dog at T1 (n = 267) had lower self- and informant-rated QoL-AD, informant-rated WHO-5 and self-rated SwL scores and higher depression scores, but better self-rated functional ability, than those without a dog at T1 (n = 1,265; see Table 5 and Supplementary Tables 3 and 4 for demographic information and outcome scores by dog status). Those who had a dog at T1 showed a small increase in QoL-AD over time, from an initially lower mean score than those with no dog, while those with no dog at T1 showed a small decrease in QoL-AD over time (+0.16 vs. -0.31 points per year), estimate for interaction: 0.47 (95% CI 0.04, 0.89), p = .03. Over time, cognition and informant-

rated WHO-5 declined for both groups but there was a slower decline for those with a dog compared to those with no dog in cognition (4.83 vs. 6.32 points decrease per year), estimate for interaction: 1.49 (95% CI 0.32, 2.67), p = .013 and in informant-rated WHO-5 scores (1.75 vs. 3.76 points decrease per year), estimate for interaction: 2.01 (95% CI 0.43, 3.59), p = .013. Additionally, those who had a dog at T1 declined more slowly compared to those who had no dog at T1 on self-rated functional ability (8% vs 20%); rate ratio (RR) for interaction: 0.90 (95%CI 0.84, 0.97), p = .007 and informant-rated functional ability (15.9% vs 22%); rate ratio for interaction: 0.95, (95% CI 0.90, 0.99), p = 0.01.

Tables 3, 4 and 5 about here

Discussion

The aim of the present study was to investigate whether having a pet was associated with different trajectories of quality of life, well-being, satisfaction with life, cognition, functional ability, depression, and/or loneliness over time in people living with dementia. We then sought to investigate whether associations differed if the person was involved in their pet's care or not, or if they had a dog compared to a different pet or no pet. Our results suggest that having a pet is associated with slower decline in informant-rated well-being and satisfaction with life and self-rated functional ability over time. There were more evident benefits for dogs; having a dog at T1 was associated with slower decline in self-rated quality of life, informant-rated well-being, and cognition as well as self- and informant-rated functional ability. Therefore, having a dog may be associated with less decline for people living with dementia over other pets. There was a small benefit to trajectories of self-rated satisfaction with life for those who cared for a pet, but this was not evident within the sensitivity analyses. However, in the sensitivity analyses, positive associations for cognition and self-rated functional ability were noted which could indicate there may be a need for consistent pet care over time for any positive association with cognition and functional ability to become evident. No differences in trajectories of depression and loneliness were observed in any of the analyses, similar to results noted in general populations when considering pets in general (Martins et al., 2023).

Having a pet has been noted to be of potential health and well-being benefit across multiple populations and this study provides evidence that there could be long-term benefits of having a pet for people with dementia.

Difference across time between those with and without pets in the indices of living well were more frequently observed for the informant- than self- rated measures. This may be because greater average decline was observed within informant than self-rated indices of living well, allowing differences in trajectories to become evident. Slowing decline in informant-rated well-being and satisfaction with life may result in observable rather than felt benefits for people living with dementia. Generally, people with dementia rated indices of living well higher than their informants at all time points and, on average, self-ratings remained stable, similar to results in other studies (O'Shea et al., 2020). Qualitative research has reported a wide range of benefits of pets for people living with dementia, indicating that pets have helped people living with dementia to maintain a sense of purpose, develop and retain skills and abilities and to remain living at home for longer, as well as acting as facilitators of reciprocal joy and support (Dooley et al., 2021; McGrath et al., 2021; Serota, 2020). These findings may go some way to explaining the associations observed here between having a pet and informant-rated indices of living well and functional ability.

Instrumental activities of daily living are important for independence and quality of life in people with dementia (Martyr et al., 2019; O'Rourke et al., 2015). Instrumental activities of daily living decline at a similar rate to cognition (Martyr et al., 2024); thus reducing or slowing this decline is beneficial to both the individual and society by reducing the time spent in residential care (Sabatini et al., 2025). While we cannot demonstrate why those with an animal had a reduced decline in functional abilities, it is possible that in addition to the development and retention of skills noted in the qualitative research above, the physical and mental activity involved in having a pet, from picking up, feeding, caring for and cleaning smaller animals to walking and exercising dogs or larger animals such as horses, plays a role. It was surprising then that there was no association between caring for

an animal at T1 and subsequent slower decline in functional ability; however, the association became apparent in the sensitivity analyses, as did an association with slower decline in cognition. Dogs may exert particular benefits for maintaining functional ability, self-rated quality of life and cognition through the increased physical and social activity associated with having a dog in older people with and without dementia (Dall et al., 2017; Hui Gan et al., 2020; Opdebeeck et al., 2021). It is also possible that the slower declines in functional ability and cognition noted are related to other differences; for instance, those who had pets at T1 were generally younger than those without a pet. However, as age was included as a covariate this is unlikely to account for the differences observed. Further investigation is needed to understand the direction of causation, how these possible benefits are conferred and what elements of having a pet are necessary for benefits to be evident. Understanding the mechanisms involved in gaining benefit from having a pet could help to ensure that these elements are considered in supporting those with a pet and in animal assisted interventions which could increase their consistency and efficacy.

The present study utilises data from a large cohort of people with dementia providing good statistical power and is the first longitudinal study that allowed for consideration of type of pet and pet care in associations between having a pet and multiple self- and informant-rated outcomes for people with dementia. Some caution is needed in the interpretation of these findings as we cannot be sure of the direction of causation; for example, it is possible that as functional ability and cognition decline, people cease to keep pets or choose not to get a new pet after a pet dies, so those already experiencing a slower decline may have been more likely to have a pet at T1. They also may be more likely to continue to have a pet or remain involved in pet care across the timepoints if experiencing a slower decline, accounting for the relationships seen in the sensitivity analyses. Choices about keeping or getting new pets may also be made for entirely different reasons. It would be beneficial if future research could adopt longitudinal tracking of pet type, interaction with the animal and type of care provided to fully elucidate the associations. As noted in the general population, there are also likely to be sociodemographic factors that impact relationships (Mueller et al., 2021). However,

consideration of socioeconomic status or living arrangements (living alone vs with others) did not impact the results reported here, suggesting that neither of these variables influenced the associations found in the current study. Care must be taken in recommending that people with dementia take on an animal. There are significant considerations as to the care of the animal in both the short and long term that must be acknowledged, for example planning future care and additional caregiver burden (Bibbo et al., 2022; Connell et al., 2007). Further research is needed to untangle these associations and understand the choices people living with dementia make about pets and why, and how they can best be supported in the difficulties they may face.

There are also some limitations that should be considered. To keep the burden of participation in this large study to a minimum, there was a limit as to the number of questions that could be asked in relation to having a pet. The single question relating to pet care included here only allowed for involvement or no involvement in care without any nuance as to the level or type of care provided. The findings of this quantitative study do not specify which interactions with animals may be particularly beneficial or whether the strength of the bond with the animal is important. As dogs were the most common pet and have previously demonstrated benefits across a range of populations, comparisons were only done for dogs compared to other pets; other large studies may allow for consideration of other pet types such as cats. These avenues could be explored in a future study focused on having pets. As would be expected for a large cohort study of people with dementia, there was significant attrition over time. It should be noted that those who did not complete the study at subsequent timepoints were more likely to be older, have lower self- and informant-rated quality of life, lower informant-rating of satisfaction with life and well-being, lower cognitive and functional ability, and higher levels of depressive symptoms which could lead to an over-representation of positive 'living well' trajectories in the cohort left in the study. The statistical methods employed somewhat mitigate this issue; however, it may mean that some trajectories with greater decline are missed. As there were only three timepoints spanning two years, a linear trend had to be assumed to calculate a slope, whereas in reality, patterns might be more complex; an

additional timepoint would facilitate this. People with pets are likely to be self-selecting; they may be people who would engage in more physical and social activities regardless of having a pet, which means the results could be due to other characteristics. However, other studies have noted that objective measures of physical activity and sedentary behaviours differ between older people with and without pets, though it is unclear if they are strictly caused by the presence of a pet (Dall et al., 2017). While benefits of pets were not identified in all the areas explored, the current study notes positive associations in a shorter time frame than that reported by Rusanen et al. (2021) and Välimäki et al. (2022). The present study echoes Rusanen and Välimäki in terms of noting less decline in some informant-rated indices of living well and self-rated functional ability for those people with a pet at baseline while adding the novel finding that there may be additional benefits from having a dog compared to having a different pet or no pet.

Conclusions

Overall, this large cohort study of people with mild-to-moderate dementia living in Great Britain provided a unique opportunity to identify differences in trajectories for those with and without pets. The study allowed us to explore the associations further by looking specifically at having a dog and at pet care, something which was not possible in the previous studies which have considered pet status in the trajectories of outcomes for people with dementia. This study provides evidence that having a pet is related to slower decline in informant-rated well-being and self-rated functional ability in people with dementia. Having a dog inferred additional potential benefits, with those with a dog at T1 also demonstrating slower declines in self-rated quality of life, informant-rated functional ability, and cognition than those without dogs. While there were no associations for several of the variables investigated, the possible benefits identified suggest that further research into how best to support people with dementia in having a pet at home could be valuable in terms of helping them to live well and remain independent at home for longer.

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Declaration of interests

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Disclosure Statement

The authors report there are no competing interests to declare.

Data availability

IDEAL data were deposited with the UK Data Archive in April 2020. Details of how the data can be accessed can be found here: https://reshare.ukdataservice.ac.uk/854293/.

Ethics approval and consent to participate

The IDEAL study was approved by Wales Research Ethics Committee 5 (reference 13/WA/0405) and the Ethics Committee of the School of Psychology, Bangor University (reference 2014-11684), and is registered with UK Clinical Research Network (#16593). All participants provided consent for participation.

Author's contributions

AM, JMT, CV and LC contributed to all aspects of the IDEAL project including design, supporting the conduct of field work, and data acquisition, and developed the original idea for this study. CO developed the current study, conducted the data analysis and drafted the manuscript. LDG advised on data analysis. AM and LDG curated the IDEAL datasets. All authors provided comments on the draft of the manuscript and approved the version to be published.

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Table 1. Participants' demographic and clinical characteristics by pet status at T1

	No pet at T1			Has a pet at T1		
	T1 (n=1070)	T2 (n=821)	T3 (n=587)	T1 (n=462)	T2 (n=352)	T3 (n=259)
Age (mean, sd; N)	77.8 (7.84); 1070	78.6 (7.67);821	79.9 (7.84); 587	73.1 (9.15); 462	73.8 (9.00); 352	73.9 (8.64); 259
Female (N, %)	484 (45.2%)	369 (45.0%)	271 (46.2%)	188 (40.7%)	141 (40.1%)	102 (39.4%)
Male (N, %)	586 (54.8%)	452 (55.0%)	316 (53.8%)	274 (59.3%)	211 (59.9%)	157 (60.6%)
Dementia diagnosis (N, %)						
Alzheimer's disease (AD)	612 (57.2%)	471 (57.4%)	350 (59.6%)	237 (51.3%)	184 (52.3%)	135 (52.1%)
Vascular dementia	104 (9.7%)	70 (8.5%)	49 (8.4%)	65 (14.1%)	45 (12.8%)	33 (12.7%)
Mixed AD/vascular dementia	241 (22.5%)	198 (24.1%)	140 (23.8%)	82 (17.7%)	65 (18.5%)	45 (17.4%)
Frontotemporal dementia	24 (2.2%)	18 (2.2%)	15 (2.6%)	30 (6.5%)	21 (6.0%)	16 (6.2%)
Parkinson's disease dementia	28 (2.6%)	22 (2.7%)	9 (1.5%)	15 (3.3%)	12 (3.4%)	8 (3.1%)
Dementia with Lewy bodies	37 (3.5%)	26 (3.2%)	15 (2.6%)	16 (3.5%)	13 (3.7%)	12 (4.6%)
Other/Unspecified	24 (2.2%)	16 (1.9%)	9 (1.5%)	17 (3.7%)	12 (3.4%)	10 (3.9%)

Note: Numbers of participants at T2 and T3 in both groups include those missing pet data at these time points.

Table 2. Mean scores, standard deviation, and sample size for study measures by pet status

	No pet at T1			Has a pet at T1		
	T1 (n=1070)	T2 (n=821)	T3 (n=587)	T1 (n=462)	T2 (n=352)	T3 (n=259)
Addenbrooke's Cognitive Examination-III	67.91 (13.50); 1041	64.59 (16.82); 770	60.42 (20.12); 542	70.16 (13.39); 454	67.56 (16.78); 330	64.40 (20.88); 246
Self-rated QoL-AD	37.03 (5.75); 953	37.20 (5.68); 718	37.03 (5.59); 495	36.30 (6.28); 416	36.40 (6.31); 317	36.72 (5.76); 215
Informant QoL-AD	33.99 (5.83); 813	32.82 (5.85); 656	31.94 (5.99); 501	32.82 (5.88); 349	32.34 (5.98); 273	31.22 (5.97); 215
Self-rated WHO-5 Well-being Index	61.76 (20.28); 1052	61.18 (20.35); 778	61.69 (20.44); 540	59.15 (21.08); 455	59.92 (21.51); 340	60.25 (22.26); 236
Informant WHO-5 Well-being Index	50.25 (20.46); 857	48.47 (20.08); 373	46.28 (21.11); 514	48.16 (20.44); 857	48.18 (21.21); 966	47.15 (21.32); 226
Self-rated Satisfaction with Life Scale	26.47 (5.88); 1041	26.68 (5.71); 767	26.76 (5.87); 521	25.27 (6.44); 449	25.28 (6.83); 333	25. 28 (7.07); 235
Informant Satisfaction with Life Scale	21.10 (6.92); 857	20.49 (7.06); 672	19.61 (7.35); 515	20.27 (6.91); 369	19.78 (6.97); 284	19.99 (7.21); 226
Self-rated Functional Activities Questionnaire^	9.32 (7.60); 1032	11.05 (8.45); 699	12.43 (9.13) 502	10.26 (7.87); 447	11.29 (8.19); 296	11.86 (8.75); 231
Informant Functional Activities Questionnaire^	17.91 (8.69); 821	21.26 (8.56); 663	23.27 (8.59); 504	17.69 (8.38); 358	20.13 (8.53); 278	22.54 (8.84); 226
Geriatric Depression Scale-10	2.54 (2.21); 947	2.34 (2.19); 746	2.32 (2.07); 518	2.92 (2.46); 416	2.64 (2.38); 320	2.66 (2.27); 231
Loneliness	1.33 (1.47); 996	-	1.41 (1.55); 435	1.41 (1.55); 435	-	1.43 (1.56); 237

Note: Numbers of participants at T2 and T3 in both groups include those missing pet data at these time points. Values represent mean (SD), sample size.
QoL-AD, Quality of Life in Alzheimer's Disease Scale; WHO, World Health Organization. ^ Higher score indicates poorer functional ability.

Table 3. Mixed effects models showing associations between having a pet (compared to not having a pet) at T1 and the intercept and slope of scores on longitudinal measures

Outcome	T1: Has a Pet	Slope: No Pet	Interaction: Has a Pet x Slope
Linear model	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)
Self-rated Quality of Life in Alzheimer's Disease Scale	-0.50 (-1.15, 0.15)	-0.32 (-0.66, 0.03)	0.23 (-0.12, 0.59)
Informant Quality of Life in Alzheimer's Disease Scale	-0.91 (-1.64, -0.19)*	-1.45 (-1.83, -1.07)*	0.21 (-0.19, 0.61)
Self-rated WHO-5 Well-Being Index	-0.86 (-3.09, 1.38)	-1.57 (-2.91, -0.23)*	0.37 (-1.03, 1.77)
Informant WHO-5 Well-Being Index	-1.91 (-4.39, 0.57)	-3.84 (-5.13, -2.54)*	1.45 (0.12, 2.79)*
Self-rated Satisfaction with Life Scale	-0.67 (-1.34. -0.01)*	-0.09 (-0.46, 0.28)	0.13 (-0.25, 0.52)
Informant Satisfaction with Life Scale	-0.50 (-1.32, 0.32)	-1.31 (-1.79, -0.83)*	0.65 (0.15, 1.15)*
Addenbrooke's Cognitive Examination-III	1.29 (-0.22, 2.81)	-6.33 (-7.27, -5.40)*	0.70 (-0.28, 1.67)
Non-linear model	RR (95% CI)	RR (95% CI)	RR (95% CI)
Self-rated Functional Activities Questionnaire	1.10 (0.99, 1.21)	1.21 (1.14, 1.28)*	0.93 (0.87, 0.99)*
Informant Functional Activities Questionnaire	1.02 (0.94, 1.11)	1.22 (1.17, 1.27)*	0.98 (0.94, 1.01)
Geriatric Depression Scale-10	1.07 (0.99, 1.15)	0.98 (0.94, 1.02)	0.98 (0.94, 1.03)
Loneliness	1.00 (0.93, 1.06)	0.99 (0.95, 1.04)	0.98 (0.94, 1.03)

* For linear models, 95% CI do not cross 0. For non-linear models 95% CI do not cross 1. The interaction is the difference in slope compared to the slope for 'No pets'. Models were adjusted for age, sex, and dementia type. RR, rate ratio; CI, confidence intervals. WHO, World Health Organization

Table 4. Mixed effects models showing associations between having and caring for a pet (compared to not having a pet or having a pet but no involvement in its care) and the intercept and slope of scores on longitudinal measures

Outcome	T1: Cares for Pet	Slope: No Pet Care	Interaction: Cares for Pet x Slope
Linear model	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)
Self-rated Quality of Life in Alzheimer's Disease Scale	0.58 (-0.14, 1.30)	-0.30 (-0.64, 0.04)	0.20 (-0.19, 0.59)
Informant Quality of Life in Alzheimer's Disease Scale	0.19 (-0.62, 1.00)	-1.42 (-1.80, -1.04)*	0.05 (-0.38, 0.49)
Self-rated WHO-5 Well-Being Index	0.81 (-1.67, 3.28)	-1.55 (-2.88, -0.22)*	0.39 (-1.13, 1.92)
Informant WHO-5 Well-Being Index	1.61 (-1.18, 4.41)	-3.54 (-4.82, -2.25)*	-0.03 (-1.51, 1.44)
Self-rated Satisfaction with Life Scale	-0.28 (-1.02, 0.45)	-0.13 (-0.50, 0.24)	0.49 (0.07, 0.91)*
Informant Satisfaction with Life Scale	0.61 (-0.32, 1.53)	-1.21 (-1.69, -0.73)*	0.23 (-0.32, 0.78)
Addenbrooke's Cognitive Examination-III	3.34 (1.68, 5.01)*	-6.28 (-7.20, -5.35)*	0.58 (-0.48, 1.65)
Non-linear model	RR (95% CI)	RR (95% CI)	RR (95% CI)
Self-rated Functional Activities Questionnaire	0.92 (0.83, 1.03)	1.20 (1.13, 1.27)*	0.95 (0.88, 1.01)
Informant Functional Activities Questionnaire	0.87 (0.80, 0.95)*	1.21 (1.17, 1.26)*	1.02 (0.98, 1.07)
Geriatric Depression Scale-10	0.97 (0.89, 1.05)	0.98 (0.94, 1.02)	0.99 (0.94, 1.04)
Loneliness	0.94 (0.87, 1.01)	0.99 (0.95, 1.03)	0.98 (0.93, 1.03)

* For linear models, 95% CI do not cross 0. For non-linear models 95% CI do not cross 1. The interaction is the difference in slope compared to the slope for 'No pet care'. Models were adjusted for age, sex, and dementia type. RR, rate ratio; CI, confidence intervals. WHO, World Health Organization

Table 5. Mixed effects models showing associations between having a dog (compared to not having a dog) at T1 and the intercept and slope of scores on longitudinal measures.

Outcome	T1: Has a Dog	Slope: No Dog	Interaction: Has a Dog x Slope
Linear model	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)
Self-rated Quality of Life in Alzheimer's Disease Scale	-0.91 (-1.70, -0.13)*	-0.31 (-0.65, 0.03)	0.47 (0.04, 0.89)*
Informant Quality of Life in Alzheimer's Disease Scale	-1.16 (-2.02, -0.30)*	-1.44 (-1.82, -1.07)*	0.28 (-0.18, 0.76)
Self-rated WHO-5 Well-Being Index	-1.78 (-4.45, 0.90)	-1.43 (-2.75, -0.11)	-0.85 (-2.53, -0.81)
Informant WHO-5 Well-Being Index	-3.56 (-6.51, -0.61)*	-3.76 (-5.03, -2.48)	2.01 (0.43, 3.59)*
Self-rated Satisfaction with Life Scale	-0.87 (-0.45, -0.08)*	-0.09 (-0.45, 0.28)	0.27 (-0.45, 0.27)
Informant Satisfaction with Life Scale	-0.58 (-1.56, 0.40)	-1.24 (-1.71, -0.76)*	0.57 (-0.02, 1.16)
Addenbrooke's Cognitive Examination-III	0.91 (-0.91, 2.73)	-6.32 (-7.24, -5.40)*	1.49 (0.32, 2.66)*
Non-linear model	RR (95% CI)	RR (95% CI)	RR (95% CI)
Self-rated Functional Activities Questionnaire	1.13 (1.00, 1.27)*	1.20 (1.13, 1.28)*	0.90 (0.84, 0.97)*
Informant Functional Activities Questionnaire	1.08 (0.99, 1.19)	1.22 (1.18, 1.27)*	0.95 (0.90, 0.99)*
Geriatric Depression Scale-10	1.12 (1.02, 1.22)*	0.98 (0.92, 1.02)	0.97 (0.92, 1.02)
Loneliness	1.01 (0.93, 1.10)	0.99 (0.95, 1.04)	1.00 (0.94, 1.06)

* For linear models, 95% CI do not cross 0. For non-linear models 95% CI do not cross 1. The interaction is the difference in slope compared to the slope for 'No dog'. Models were adjusted for age, sex, and dementia type. RR, rate ratio; CI, confidence intervals. WHO, World Health Organization

Supplementary Tables

Supplementary Table 1. Participants' demographic and clinical characteristics by involvement in pet care at T1

	No pet care at T1			Pet care at T1		
	T1 (n=1204)	T2 (n=917)	T3 (n=648)	T1 (n=328)	T2 (n=256)	T3 (n=198)
Age (mean, sd; N)	77.4 (8.09); 1204	78.2 (7.97); 917	78.8 (8.01); 648	72.7 (9.08); 328	73.6 (8.85); 256	73.7 (8.63); 198
Age group (N, %)						
<65 (43-64)	85 (7.1%)	53 (5.8%)	34 (5.3%)	49 (14.9%)	35 (13.7%)	31 (15.7%)
65-69	112 (9.3%)	78 (8.5%)	42 (6.5%)	65 (19.8%)	50 (19.5%)	29 (14.65%)
70-74	195 (16.1%)	142 (15.5%)	110 (17.0%)	64 (19.5%)	50 (19.5%)	49 (24.8%)
75-79	295 (24.5%)	218 (23.77%)	135 (20.8%)	70 (21.3%)	50 (19.5%)	37 (18.7%)
80+ (80-98)	518 (43%)	426 (46.5%)	327 (50.5%)	90 (24.4%)	72 (27.7%)	52 (26.3%)
Female (N, %)	526 (43.7%)	394 (43.0%)	287 (44.3%)	146 (44.5%)	116 (45.3%)	86 (43.4%)
Male (N, %)	678 (56.3%)	523 (57.0%)	361 (55.7%)	182 (55.5%)	140 (54.7%)	112 (56.6%)
Alzheimer's disease (AD)	665 (55.2%)	513 (55.9%)	375 (57.9%)	184 (56.1%)	142 (55.5%)	110 (55.6%)
Vascular dementia	118 (9.8%)	77 (8.4%)	51 (7.9%)	51 (15.5%)	38 (14.8%)	31 (15.7%)
Mixed AD/vascular dementia	271 (22.5%)	221 (24.1%)	157 (24.2%)	52 (15.9%)	42 (16.4%)	28 (14.1%)
Frontotemporal dementia	37 (3.1%)	27 (2.9%)	21 (3.2%)	17 (5.2%)	12 (4.7%)	10 (5.1%)
Parkinson's disease dementia	37 (3.1%)	28 (3.1%)	13 (2.0%)	6 (1.8%)	6 (2.3%)	4 (2.0%)
Dementia with Lewy bodies	46 (3.8%)	32 (3.5%)	19 (2.9%)	7 (2.1%)	7 (2.7%)	8 (4.0%)
Other/Unspecified	30 (2.5%)	19 (2.1%)	12 (1.83%)	11 (3.4%)	9 (3.5%)	7 (3.5%)

Supplementary Table 2. Mean scores, standard deviations, and sample size for study measures by involvement in pet care

	No pet care at T1			Pet care at T1		
	T1 (n=1204)	T2 (n=917)	T3 (n=648)	T1 (n=328)	T2 (n=256)	T3 (n=198)
Addenbrooke's Cognitive Examination-III	67.75 (13.47); 1169	64.36 (16.98); 859	60.84 (20.08); 599	71.60 (13.19); 326	69.46 (15.83); 241	64.31 (21.33); 189
Self-rated QoL-AD	36.70 (5.87); 1075	36.87 (6.12); 294	36.78 (5.77); 547	37.21 (6.12); 294	37.24 (5.90); 237	37.37 (5.20); 163
Informant QoL-AD	33.62 (5.87); 922	32.54 (5.90); 741	31.64 (6.07); 561	33.67 (5.85); 240	33.20 (5.85); 188	32.06 (5.71); 716
Self-rated WHO-5 Well-being Index	61.06 (20.29); 1182	60.73 (20.31); 869	61.14 (20.93); 597	60.62 (21.51); 325	61.04 (22.08); 249	61.61 (21.29); 179
Informant WHO-5 Well-being Index	49.20 (20.64); 976	47.95 (20.32); 765	45.96 (21.35); 577	51.21 (19.75); 254	50.03 (20.75); 201	48.61 (20.45); 163
Self-rated Satisfaction with life	26.26 (5.99); 1168	26.33 (5.99); 858	26.42 (6.11); 577	25.54 (6.35); 322	26.01 (6.49); 242	25.92 (6.91); 179
Informant Satisfaction with Life	20.75 (6.97); 973	20.27 (7.12); 760	19.52 (7.37); 576	21.25 (6.72); 253	20.32 (6.72); 196	20.47 (7.08); 165
Self-rated Functional Activities Questionnaire^	9.78 (7.78); 1160	11.39 (8.50); 777	12.76 (9.16); 559	8.98 (7.34); 319	10.16 (7.88); 218	10.63 (8.32); 174
Informant Functional Activities Questionnaire^	18.44 (8.60); 937	21.46 (8.50); 747	23.46 (9.11); 567	15.54 (8.18); 242	18.86 (8.51); 194	21.59 (9.11); 163
Geriatric Depression Scale-10	2.68 (2.28); 1066	2.46 (2.28); 832	2.42 (2.13); 571	2.60 (2.29); 1363	2.33 (2.15); 234	2.43 (2.16); 178
Loneliness	1.37 (1.48); 1120	-	1.46 (1.49); 577	1.31 (1.54); 311	-	1.30 (1.50); 181

Note: Numbers of participants at T2 and T3 in both groups include those missing pet data at these time points. Values represent mean (SD), sample size.
QoL-AD, Quality of Life in Alzheimer's Disease Scale; WHO, World Health Organization. ^ Higher score indicates poorer functional ability.

Supplementary Table 3. Participants' demographic and clinical characteristics by dog status at T1

	No dog at T1			Has a dog at T1		
	T1 (n = 1265)	T2 (n = 974)	T3 (n = 694)	T1 (n = 267)	T2 (n = 199)	T3 (n = 152)
Age (mean, sd; N)	77.3 (8.16); 1265	78.1 (7.98); 974	78.6 (8.05); 694	72.1 (8.95); 267	72.6 (8.82); 199	72.9 (8.65); 152
Age group (N, %)						
<65 (43-64)	90 (7.1%)	55 (5.7%)	38 (5.5%)	44 (16.5%)	33 (16.6%)	27 (17.8%)
65-69	122 (9.6%)	91 (9.3%)	48 (6.9%)	55 (20.6%)	37 (18.6%)	23 (15.1%)
70-74	206 (16.3%)	153 (15.7%)	121 (17.4%)	52 (19.5%)	39 (19.6%)	38 (25.0%)
75-79	306 (24.2%)	222 (22.8%)	143 (20.6%)	59 (22.1%)	46 (23.1%)	29 (19.1%)
80+ (80-98)	541 (42.8%)	453 (46.5%)	344 (49.6%)	57 (21.4%)	44 (22.1%)	35 (23.0%)
Female (N, %)	565 (44.7%)	429 (44.1%)	315 (45.4%)	107 (40.1%)	81 (40.7%)	58 (38.2%)
Male (N, %)	700 (55.3%)	545 (55.9%)	379 (54.6%)	160 (59.9%)	118 (59.4%)	94 (61.8%)
Dementia diagnosis (N, %)						
Alzheimer's disease (AD)	713 (56.4%)	583 (56.8%)	409 (58.9%)	136 (50.9%)	102 (51.3%)	76 (50.0%)
Vascular dementia	135 (10.7%)	92 (9.5%)	62 (8.9%)	34 (12.7%)	23 (11.6%)	20 (13.2%)
Mixed AD/vascular dementia	277 (21.9%)	230 (23.6%)	161 (23.2%)	46 (17.2%)	33 (16.6%)	24 (15.8%)
Frontotemporal dementia	34 (2.7%)	24 (2.5%)	18 (2.6%)	20 (7.5%)	15 (7.5%)	13 (8.5%)
Parkinson's disease dementia	33 (2.6%)	25 (2.6%)	12 (1.7%)	10 (3.7%)	9 (4.5%)	5 (3.3%)
Dementia with Lewy bodies	45 (3.6%)	32 (3.3%)	21 (3.0%)	8 (3.0%)	7 (3.5%)	6 (3.9%)
Other/Unspecified	28 (2.2%)	18 (1.8%)	11 (1.6%)	13 (4.9%)	10 (5.0%)	8 (5.3%)

Supplementary Table 4. Mean scores, standard deviations, and sample size for study measures by dog status

	No dog at T1			Has a dog at T1		
	T1 (n = 1265)	T2 (n = 974)	T3 (n = 694)	T1 (n = 267)	T2 (n = 199)	T3 (n = 152)
Addenbrooke's Cognitive Examination-III	68.27 (13.48); 1233	64.80 (16.90); 911	60.70 (20.23): 643	70.10 (13.51); 262	68.74 (16.33); 189	65.94 (20.84); 145
Self-rated QoL-AD	37.02 (5.85); 1123	37.20 (6.17); 1123	37.01 (5.54); 582	35.82 (6.17); 246	35.82 (6.36); 179	36.63 (6.13); 128
Informant QoL-AD	33.89 (5.84); 956	32.81 (5.84); 767	31.85 (6.06); 588	32.43 (5.84); 206	32.02 (6.07); 162	31.15 (5.65); 128
Self-rated WHO-5 Well-being Index	61.59 (20.20); 1241	61.50 (20.37); 924	62.05 (20.52); 637	58.06 (21.93); 266	57.48 (21.99); 194	57.61 (22.84); 139
Informant WHO-5 Well-being Index	50.26 (20.56); 1012	48.69 (20.26); 798	46.55 (21.27); 606	46.64 (19.81); 218	46.93 (21.12); 168	46.51 (20.76); 134
Self-rated Satisfaction with Life	26.34 (5.98); 1225	26.57 (5.88); 909	26.59 (6.13); 616	25.00 (6.40); 265	24.75 (6.89); 191	25.01 (6.89); 140
Informant Satisfaction with Life	21.04 (6.91); 1009	20.42 (7.04); 792	19.70 (7.32); 606	19.99 (6.95); 217	19.59 (6.70); 164	19.82 (7.24); 135
Self-rated Functional Activities Questionnaire^	9.42 (7.68); 1219	11.07 (8.45); 825	12.27 (9.07); 600	10.50 (7.68); 260	11.36 (8.01); 170	12.19 (8.73); 133
Informant Functional Activities Questionnaire^	17.81 (8.68); 974	21.03 (8.15); 780	23.24 (8.54); 595	18.03 (8.16); 205	20.40 (8.15); 161	22.18 (9.19); 135
Geriatric Depression Scale-10	2.56 (2.21); 1116	2.35 (2.21); 888	2.34 (2.06); 612	3.11 (2.58); 247	2.81 (2.44); 178	2.77 (2.43); 137
Loneliness	1.33 (1.46); 1173	-	1.38 (1.44); 621	1.47 (1.63); 258	-	1.60 (1.69); 137

Note: Numbers of participants at T2 and T3 in both groups include those missing pet data at these time points. Values represent mean (SD), sample size.
QoL-AD, Quality of Life in Alzheimer's Disease Scale; WHO, World Health Organization. ^ Higher score indicates poorer functional ability.

Supplementary Table 5. Mixed effects models showing sensitivity analysis associations between having a pet at all time points in which they participated vs. not having a pet at any time point in which they participated and the intercept and slope of scores on longitudinal measures.

Outcome	T1: Has a Pet	Slope: No Pet	Interaction: Has a Pet x Slope
Linear model	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)
Self-rated Quality of Life in Alzheimer's Disease Scale	-0.61 (-1.35, 0.14)	-0.31 (-0.69, 0.08)	0.31 (-0.13, 0.76)
Informant Quality of Life in Alzheimer's Disease Scale	-1.18 (-1.98, -0.37)	-1.41 (-1.82, -1.01)	0.25 (-0.22, 0.72)
Self-rated WHO-5 Well-Being Index	-1.07 (-3.54, 1.41)	-1.46 (-2.87, -0.05)*	0.77 (-0.88, 2.42)
Informant WHO-5 Well-Being Index	-2.47 (-5.20, 0.27)	-3.66 (-5.01, -2.31)*	1.54 (0.00, 2.31)
Self-rated Satisfaction with Life	-0.69 (-1.43, 0.06)	-0.15 (-0.54, 0.23)	0.10 (-0.34, 0.55)
Informant Satisfaction with Life	-0.72 (-1.64, 0.21)	-1.20 (-1.71, -0.70)	0.79 (0.21, 1.37)*
Addenbrooke's Cognitive Examination-III	0.83 (-0.88, 2.54)	-6.20 (-7.19, -5.21)*	0.82 (-0.34, 1.98)
Non-linear model	RR (95% CI)	RR (95% CI)	RR (95% CI)
Self-rated Functional Activities Questionnaire	1.17 (1.05, 1.30)*	1.20 (1.13, 1.27)*	0.89 (0.83, 0.95)*
Informant Functional Activities Questionnaire	1.04 (0.95, 1.13)	1.22 (1.17, 1.26)*	0.97 (0.92, 1.01)
Geriatric Depression Scale-10	1.09 (1.00, 1.18)*	0.98 (0.93, 1.02)	0.96 (0.91, 1.01)
Loneliness	0.99 (0.92, 1.07)	0.98 (0.04, 1.03)	0.99 (0.93, 1.04)

* For linear models, 95% CI do not cross 0. For non-linear models 95% CI do not cross 1. The interaction is the difference in slope compared to the slope for 'No pets'. Models were adjusted for age, sex, and dementia type. RR, rate ratio; CI, confidence intervals. WHO, World Health Organization

Supplementary Table 6. Mixed effects models showing sensitivity analysis for associations between having and caring for a pet at all time points in which they participated (compared to not caring for a pet at any time point in which they participated) and the intercept and slope of scores on longitudinal measures

Outcome	T1: Cares for Pet	Slope: No Pet Care	Interaction: Cares for Pet x Slope
Linear model	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)
Self-rated Quality of Life in Alzheimer's Disease Scale	0.62 (-0.22, 1.46)	-0.40 (-0.77, -0.02)*	0.46 (-0.03, 0.96)
Informant Quality of Life in Alzheimer's Disease Scale	-0.23 (-1.17, 0.70)	-1.36 (-1.77, -0.96)*	0.28 (-0.26, 0.83)
Self-rated WHO-5 Well-Being Index	1.74 (-1.12, 4.61)	-1.54 (-2.87, -0.21)*	0.71 (-1.06, -0.21)
Informant WHO-5 Well-Being Index	1.90 (-1.32, 5.11)	-3.28 (-4.62, -1.92)*	-0.10 (-1.89. 1.68)
Self-rated Satisfaction with Life	-0.31 (-1.16, 0.54)	-0.19 (-0.58, 0.21)	0.39 (-0.13, 0.91)
Informant Satisfaction with Life	0.33 (-0.75, 1.41)	-1.05 (-1.55, -0.54)	0.36 (-0.30, 1.02)
Addenbrooke's Cognitive Examination-III	3.28 (1.34, 5.22)*	-6.05 (-7.04, -5.06)*	1.33 (0.01, 2.64)*
Non-linear model	RR (95% CI)	RR (95% CI)	RR (95% CI)
Self-rated Functional Activities Questionnaire	0.95 (0.84, 1.08)	1.19 (1.12, 1.27)*	0.87 (0.80, 0.95)*
Informant Functional Activities Questionnaire	0.88 (0.80, 0.97)*	1.21 (1.17, 1.26)*	0.99 (0.95, 1.05)
Geriatric Depression Scale-10	0.98 (0.89, 1.08)	0.98 (0.93, 1.02)	0.94 (0.89, 1.01)
Loneliness	0.91 (0.83, 0.99)*	0.99 (0.95, 1.04)	1.01 (0.94, 1.07)

* For linear models, 95% CI do not cross 0. For non-linear models 95% CI do not cross 1. The interaction is the difference in slope compared to the slope for 'No pet care'. Models were adjusted for age, sex, and dementia type. RR, rate ratio; CI, confidence intervals. WHO, World Health Organization

Supplementary Table 7. Characteristics of people with dementia stratified by remaining or withdrawing at the next timepoint

	T1 (baseline)				T2			
	Total (n=1532)	Remained in study at T2 (n=1173)	Did not remain in study at T2 (n=359)	P-value	Total (n=1173)	Remained in study at T3 (n=846)	Did not remain in study at T3 (n=337)	P-value
Age years (mean, sd; N)	76.4 (8.5), 1532	76.09 (8.4), 1173	77.3 (9.0), 359	.017	77.2 (8.4), 1173	76.5 (8.5), 834	78.8 (8.0), 339	<0.001
Sex (n, %)								
Male	860 (56.1%)	663 (56.5%)	197 (54.9%)	.582	663 (56.5%)	468 (56.1%)	195 (57.5%)	0.659
Female	672 (43.9%)	510 (43.5%)	162 (43.5%)		510 (43.5%)	366 (43.9%)	144 (42.5%)	
Dementia diagnosis (N, %)				.045				0.006
Alzheimer's disease (AD)	836 (55.6%)	651 (55.5%)	185 (51.5%)		655 (55.8%)	482 (57.8%)	173 (51.0%)	
Vascular dementia	167 (10.9%)	115 (9.8%)	52 (14.5%)		115 (9.8%)	78 (9.4%)	37 (10.9%)	
Mixed AD/vascular dementia	329 (21.5%)	263 (22.4%)	66 (18.4%)		263 (22.4%)	184 (22.1%)	79 (23.3%)	
Frontotemporal dementia	58 (3.5%)	40 (3.4%)	18 (5.0%)		39 (3.3%)	31 (3.7%)	8 (2.4%)	
Parkinson's disease dementia	46 (3.0%)	36 (2.9%)	10 (2.8%)		34 (2.9%)	15 (1.8%)	19 (5.6%)	
Dementia with Lewy bodies	59 (3.9%)	40 (3.4%)	19 (5.3%)		39 (3.3%)	25 (3.0%)	14 (4.1%)	
Other/Unspecified	37 (2.4%)	28 (2.4%)	9 (2.5%)		28 (2.4%)	19 (2.0%)	9 (2.7%)	
Study measures								
QoL-AD (mean, sd; N)	36.8 (5.9), 1369	37.1 (5.9), 1054	35.9 (6.1), 315	0.003	37.0 (5.9), 1035	37.5 (5.7), 757	35.5 (6.0), 278	<0.001
WHO-5 Well-Being Index (mean, sd; N)	61.0 (20.6), 1507	61.5 (20.6), 1153	59.2 (20.4), 354	0.066	60.8 (20.7), 1118	61.8 (21.0), 810	58.2 (19.6), 308	0.009
Satisfaction with Life Scale (mean, sd; N)	26.1 (6.1), 1490	26.3 (6.1), 1138	25.4 (6.1), 352	0.012	26.3 (6.1), 1100	26.4 (6.2), 800	25.8 (5.9), 300	0.143
Addenbrooke's Cognitive Examination-III Total Score (mean, sd; N)	68.6 (13.5), 1495	70.02 (13.2), 1159	63.7 (13.4), 336	<0.001	66.4 (15.8), 1076	68.6 (15.8), 802	60.1 (16.2), 274	<0.001
Functional Activities Questionnaire (mean, sd; N)	9.6 (7.7), 1479	9.1 (7.5), 1132	11.2 (8.2), 347	<0.001	11.1 (8.4), 995	10.3 (8.0), 726	13.3 (9.0), 269	<0.001
Geriatric Depression Scale-10 (mean, sd; N)	2.7 (2.3), 1363	2.5 (2.2), 1048	3.0 (2.4), 315	<0.001	2.4 (2.3), 1066	2.3 (2.2), 767	2.7 (2.4), 299	0.009

Loneliness (mean, sd; N)	1.4 (1.5), 1431	1.3 (1.5), 1110	1.5 (1.5), 321	0.083	1.3 (1.5), 1113^	1.3 (1.5), 800^	1.4 (1.6), 313^	0.476^
Informant-rated measures								
QoL-AD (mean, sd; N)	33.6 (5.9), 1162	34.14 (5.7), 909	31.8 (5.9), 253	<.001	32.7 (5.9), 929	33.6 (5.6), 655	30.4 (5.9), 274	<.001
WHO-5 Well-Being Index (mean, sd; N)	49.6 (20.5), 1230	51.4 (20.2), 963	43.3 (20.3) 267	<.001	48.4 (20.4), 966	50.9 (19.8), 682	42.3 (20.6), 284	<.001
Satisfaction with Life Scale (mean, sd; N)	20.9 (6.9), 1226	21.2 (6.9), 965	19.5 (6.8), 261	<.001	20.3 (7.0), 956	20.8 (6.9), 678	19.0 (7.2), 278	<.001
Functional Activities Questionnaire (mean, sd; N)	17.8 (8.6), 1179	17.1 (8.5), 927	20.7 (8.3), 252	<0.001	20.9 (8.6), 941	19.6 (8.6), 666	24.1 (7.5), 275	<0.001

Note. There are 12 people who did not participate at T2 but returned at T3. Unpaired t-tests were used to compare continuous study measures, and Chi-squared tests to compare categorical study measures, with the aim of examining differences between those who remained in the study and those who dropped out at the next timepoint. QoL-AD, Quality of Life in Alzheimer's Disease Scale; WHO, World Health Organization.
^Loneliness was not recorded at T2, so the comparison for those who dropped out or remained at T3 are based on T1 data.