

BMJ Open Observational cohort study investigating cognitive outcomes, social networks and well-being in older adults: a study protocol

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ABSTRACT

Introduction Social networks play a role in slowing the development of dementia. However, there is a need for further investigation of the effects of improving social networks on health-related quality of life and cognitive performance. Targeted community aged care services are a central strategy for supporting older adults to initiate and maintain their social engagement with other individuals at all stages of later life. This protocol describes a prospective observational cohort study aimed at (1) characterising interpersonal relationships in older adults receiving community care services, (2) assessing the relationship social networks and health-related quality of life and cognition and (3) identifying the association between community care use, social networks and cognition. The findings will contribute to our understanding of how specific social network structures and social support services can maintain cognitive function in community-dwelling older adults.

Methods and analysis This is a prospective, observational cohort study of 201 older Australians residing in the community and receiving care services from one of three aged care organisations. Clients with a history of neurological injury will be excluded. Participants will undergo baseline measures of social networks, health-related quality of life and cognitive function, and a follow-up at 6 months. Service use and sociodemographic variables will also be collected. The primary outcome is cognitive function, and secondary outcomes include social networks and health-related quality of life. Multivariable linear regression will test the hypothesis that increased social networks are associated with an increase in cognitive function.

Ethics and dissemination Approval of the study by Macquarie University Research Ethics Committee (reference number 5201831394062) has been obtained. This work will be disseminated by publication of peer-reviewed manuscripts, presentations in abstract form at scientific meetings and results will be made available to home and community-based care older adults and care staff of the involved organisations.

Trial registration number ACTRN12618001723279; Pre-results.

INTRODUCTION

Background and rationale

Dementia affects 47.5 million people globally and is projected to double in prevalence every

Strengths and limitations of this study

- This study will be the first comprehensive investigation of health-related quality of life, aged care service use and cognitive impairment in older adults receiving home and community-based care services.
- Our longitudinal design will allow us to take into account any baseline differences in participants' clinical and contextual characteristics (eg, activity levels and cognitive function) when assessing the association between use of social services and changes in outcomes of interest.
- Our results will identify individuals who may benefit most from social support intervention strategies.
- The inclusion of different aged care service provider organisations will increase external validity of the findings.
- The primary limitations of this study are: (1) lost to follow-up and missing data points, which poses a potential threat to internal validity and (2) its observational design, which can only describe associations, not causation.

20 years,¹ representing a major community and public health challenge. The increase in longevity will create an even greater strain on the healthcare system through increased use of services and rates of hospitalisation.¹ Over the last decade, interest in the role of social networks as a protective factor in the development of dementia has increased, with a number of longitudinal studies reporting associations between different social lifestyles and dementia.²⁻⁶

The critical component of social networks in providing protection against the progression of dementia is largely unknown. An individual's social environment is composed of the number, frequency, degree and quality of interactions with other individuals, as well as the type of interaction (eg, intergenerational, activity based). Networks are often classified as being poor, limited, moderate or extensive

based on assessment of these characteristics.⁷ To date, there has been no systematic evaluation of these elements and their association with cognitive function in older populations.

New approaches to address the healthcare needs of older people have started to focus on the social support resources inherent in social relationships (eg, emotional assistance, companionship, advice). Some studies have shown that high levels of social engagement, social support, social contact, social networks and social activities enhance cognition in older adults,²⁻⁴ whereas others have found no associations.⁸⁻¹⁰ Across a 20-year follow-up of over 2800 French older adults, a rich social network was associated with better cognition at baseline but had no impact in further age-related activities.¹¹ A recent systematic review reported that the degree of social engagement, rather than network size, may have a protective effect on dementia onset, though the results varied between studies.⁵ More definitive evidence of the impact of social networks on memory outcomes for older adults is thus required.

The provision of targeted community care services is a central way of supporting older adults to maintain their social engagement and networks in their lives. To date, there has been no strong methodological evaluation of how effective these services are at supporting older adults' networks and their cognitive performance. Prior to the planning of any interventional studies, it is important to first investigate the current state of social support networks in older adults receiving home and community-based care. Therefore, the aims of this study are to: (1) characterise the quality and quantity of interpersonal relationships in older adults in community aged care; (2) to assess the relationship between social network structures and cognitive function and (3) to identify the association between community care use, social networks and cognitive function.

METHODS AND ANALYSIS

Study design

This is a prospective, observational cohort study involving three community aged care providers in New South Wales, Australia between 1 October 2018 and 30 September 2019 (see our design schematic in [figure 1](#)). In Australia, there are two major types of government-subsidised aged community care that assist older adults to remain

independent for as long as possible in their home: the 'Commonwealth Home Support Programme' (CHSP); and 'home care packages' (HCPs). The CHSP provides entry-level, low-care support (eg, planned respite), while HCPs provide coordinated services for older adults with ongoing higher level complex care needs (eg, personal services, nursing or other clinical services).¹² In this study, providers will be delivering social support services as well as standard aged care services to older adults. The study population will, therefore, be using either one or more type of services (social support or otherwise).

Social support services

One type of aged care service is social support which includes assistance in the home or community to meet an older adult's need for social contact and to help them participate in community life. This type of service helps older adults maintain an active social life by, for example, one-to-one visits in a client's home, arranging visits and outings in the community and helping clients to access support groups and recreational activities.¹³ Older adults may also attend structured group activities in a centre which are designed to develop, maintain or support capacity of independent living and social interaction.

Other services

Other aged care services include personal or practical assistance, such as transport and personal care, meals on wheels or domestic cleaning. However, it may also involve rehabilitation by health professionals such as nurses, occupational therapists and physiotherapists.

Study population

Study providers and participants will enter the cohort after they meet inclusion/exclusion criteria (see [table 1](#)), and that both providers and participants have provided consent. The sample will comprise 201 participants from a minimum of three providers, who will be assessed at baseline and after 6 months. At the time of enrolment, we will record the following data: baseline demographic factors, medical history, aged care service use prior to enrolment, cognitive function, social networks and health-related quality of life. Following baseline assessment, monthly service use data will be collected for 6 months. All participants will receive a 6-month follow-up assessment which will collect the same outcome variables. Study participants will be identified with a study number only.

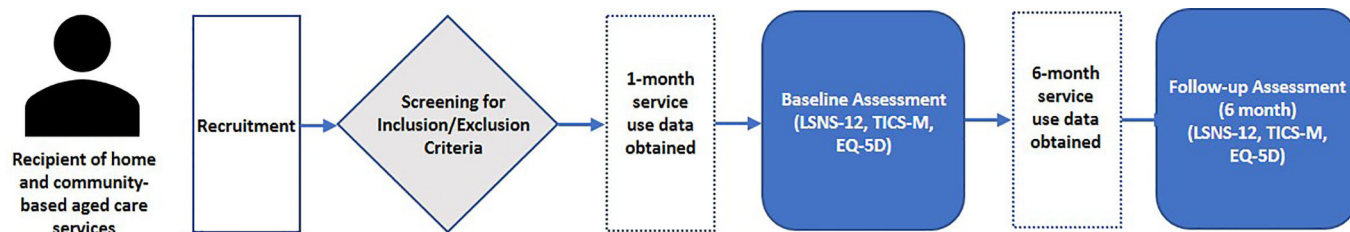


Figure 1 Schematic of study design. EQ-5D, European Quality of Life Scale with five dimensions; LSNS-12, Lubben Social Network Scale-12; TICS-M, Telephone Interview for Cognitive Status-Modified.

Table 1 Inclusion and exclusion criteria

	Provider	Participant
Inclusion criteria	<ul style="list-style-type: none"> ▶ Providing aged care services subsidised by the Australian Government which include services that provide home care packages, transition care, short-term restorative care. ▶ Located in New South Wales. 	<ul style="list-style-type: none"> ▶ ≥55 years of age. ▶ Receiving home and community-based social support aged care services from an aged care provider.
Exclusion criteria	<ul style="list-style-type: none"> ▶ Not fluent in English. ▶ Unable to provide a letter agreeing to participate in the study. 	<ul style="list-style-type: none"> ▶ Advanced cognitive impairment or unable to follow simple commands.* ▶ Primary neurological injury (eg, anoxic injury, stroke or traumatic brain injury). ▶ Not fluent in English. ▶ Requiring institution-based rehabilitation or nursing home placement. ▶ Terminally ill. ▶ No capacity to provide consent at any time point of the study.

*As determined by aged care staff or from client's medical records.

Recruitment procedure

We will use a two-stage sampling process, first selecting the aged care provider, and then clients within the organisation.

Providers

The study will be promoted among all aged care providers offering home and community-based aged care services in New South Wales. To arouse interest and promote participation in the aged care sector, the study will be advertised in newspaper advertorials, and on social media outlets specific to aged care. Telephone and/or email contact will further direct providers to a dedicated website (<https://www.mq.edu.au/research/connections-matter>), a video and a phone number, from where detailed information could be gained and participation sought. On initial contact from the provider, information about the study will be supplied inviting them to participate. If no response is received after the initial contact, a follow-up email/phone call will be made to determine their level of interest. On agreement of participation, an information form will be provided and a letter from the organisation detailing that they agree to participate in the study will be obtained.

To ensure that our sample size will be achieved, at least three providers will be recruited.

Participants

The researchers will recruit participants via the aged care provider's support staff. During staff visits to clients for their routine assessment or service use, staff will ask potential clients if they would like further information on the research project, and if they would like to be involved in interviews on their health, cognition and social networks with the research team. They will be given the opportunity to discuss the project and their potential

involvement further with the researchers at a time suitable for them, either at the provider's site or via telephone. The research team will provide guidance to the support staff about how to select a representative sample of their clients during this process, so that the study population will represent clients with either no, some or severe cognitive impairment.

Patient and public involvement

Both providers and clients in this study were not involved in the development of the research question nor study design. However, this topic area was broadly presented at a University Consumer Forum and feedback from consumer representatives was integrated into the proposal. A consumer advisory group comprised aged care staff and clients will be established to provide input into recruitment and dissemination processes.

Outcomes

Table 2 provides an overview of the outcomes that will be measured.

Primary outcome

The primary outcome is cognitive function, which will be assessed by the Telephone Interview for Cognitive Status-Modified (TICS-M). The TICS-M is a 23-item interview that can be conducted either in person or over the phone to detect memory impairment. Items scored include name, date, age, phone number, ability to count backwards from 20 to 1, immediate recall of 10 words, counting backwards from 100 by 7, the naming of objects and concepts, repetition of phrases, the name of current political figures, tapping 5 times, naming opposites of common words and delayed recall of 10 words. The maximum score is 50 points. With various cut-off scores, the TICS-M has been used as a screening tool for possible

Table 2 Outcome measures

Outcome	Data collection instrument and scale	Time points
Primary outcome measure		
Cognitive performance	Telephone Interview for Cognitive Status-Modified. Below 27 indicates memory impairment, above 28 indicates no memory impairment.	T1, T2
Secondary outcome measures		
Social networks	Lubben Social Network Scale-12 item. Higher scores indicate better networks.	T1, T2
Health-related quality of life	European Quality of Life Scale with five dimensions (EQ-5D), which comprises the EQ-5D index and the EQ-5D Visual Analogue Scale (VAS). The EQ-5D index has five domains (mobility, self-care, activities, pain/discomfort and anxiety/depression) on a five-point scale ranging from no problems to being unable. The EQ-5D VAS measures total health status on a scale 1–100 where 100 is high.	T1, T2
Other measures		
Age	Years	T1
Gender	Female/male	T1
Marital status	Married/single/widowed/divorced or separated	T1
Living situation	Living alone/living together with someone	T1, T2
Level of education	Primary school/high school/1–3 years University/>4 years university	T1
Prior occupation	Level of seniority, type of work	T1
Current home-based assistance offered	Presence and frequency of home-based assistance	T0, T1–2
	Home help/nurse/occupational therapist/physiotherapist/mental health service/meals on wheels/supported socialisation/no assistance	T0, T1–2
Current community-based service	Type of institution-based service offered	T0, T1–2
	Day centre/social support/social activities/outings	T0, T1–2
Usage of services	Weekly hours	T0, T1–2

T0, one month prior to baseline assessment; T1, baseline assessment, T2, 6 months after baseline assessment and T1–2, monthly assessment during 6 months after baseline assessment.

cognitive impairment, or to attempt to classify individuals as having no or minimal cognitive impairment or possible mild cognitive impairment or moderate cognitive impairment.¹⁴

The TICS-M is strongly correlated with the Mini-Mental State Examination,^{15–17} a more widely used brief cognitive screening instrument. The TICS-M has been previously validated¹⁸ with strong psychometric properties.¹⁹ Prior studies have shown that the TICS-M has a high sensitivity in the detection of dementia^{20 21} but a low positive predictive value.¹⁸

Secondary outcomes

This study will include several secondary outcomes.

Social networks

Social networks will be assessed using the Lubben Social Network Scale-12 (LSNS-12)²² which measures structural (eg, network size, composition), interactional (eg, frequency of contact, quality of exchange) and functional components (eg, purpose of support) of the client's contacts. The total score is calculated by finding the sum of all the items, with a higher score indicating more social engagement and better networks. For the LSNS-12, the score ranges between 0 and 60. The information

obtained from this scale will provide indicators on the degree centrality (ie, how closely related the network contacts are with other network contacts) and reciprocity (ie, how often they exchange resources). This scale has strong methodological qualities and has been developed for older adults in particular.²² This will also be administered over the phone at a mutually convenient time for the participant.

Quality of life

Quality of life will be measured using by the European Quality of Life Scale with five dimensions (EQ-5D). The EQ-5D is a brief generic instrument consisting of a self-administered health index and a Visual Analogue Scale (VAS), a 20 cm scale in which respondents are asked to rate their current health state.²³ It is a brief instrument, representing five dimensions of health-related quality of life,²⁴ as opposed to quality of life in general.²⁵ The EQ-5D-five levels contains five domains: mobility, self-care, pain/discomfort, usual activities and anxiety/depression. There are three levels per dimension: no problems, some problems or extreme problems. For the items measuring experience of pain and anxiety, the three ratings relate to the severity of symptoms. Utility scores will quantify

health-related quality of life along a continuum that ranges from -0.59 (worst health) to 1.00 (perfect health). Respondents will also mark their current health state on a 100-point VAS scale, with 100 representing the ‘best imaginable health state’ and 0 representing the ‘worst imaginable health state’. This will also be administered over the phone at a mutually convenient time for the participant.

EQ-5D data will be converted into health utility scores, providing a single evaluation, using the time trade-off method based on the tariff developed for the EQ-5D index in the UK.²⁶ This scale has high measurement properties, improved discriminatory power and establishing convergent and known-groups validity.²⁶

Proposed statistical methods

Sample size calculation

The proposed number of clients to be enrolled in the project is based on evaluating the primary quantitative outcome of interest, cognitive function. A sample size of 201 clients is needed to detect a meaningful change in memory scores between baseline and 6-month follow-up (with 80% power). This sample size estimate assumes a moderate correlation between prescores and postscores ($r=0.5$), and a meaningful change in mean TICS-M scores.^{17 18} The anticipated attrition rate is 10%, based on earlier work with the providers (unpublished data).

Statistical analysis and evaluation

Aim 1: Characterise quality and quantity of social networks in older adults

Analysis will include all participants who have complete baseline measures and service use data. Descriptive statistics will be used to quantify the size, frequency and diversity of social networks of clients at baseline. Mean (SD) and median values (IQR), or numbers and percentages will be reported.

Aim 2: Assess relationship between social networks, cognitive function and quality of life

To test the hypothesis that older adults with larger social networks have higher cognitive function, Pearson product moment and partial correlations, controlling for sociodemographic factors, will be used to examine respectively the zero order and unique bivariate associations between social network size, frequency and diversity, cognitive status (impaired or not impaired), quality of life and frequency and duration of aged care service use at baseline (see figure 2). Multivariate linear regression will be used to adjust for potential effect modifiers for the primary outcome, cognition. A selection of explanatory variables based on previous studies and theoretical considerations will be initially added to the model. Any significant variables, identified by Pearson’s correlation ($p<0.02$), will be further included into the multiple linear regression model.

Aim 3: Identify the association between community care use, social networks and cognitive function

To test the hypothesis that greater volume of social support service use is associated with an increase in social networks and cognitive function, descriptive analyses will be first used to quantify changes in clients’ networks, memory and quality of life at 6-month follow-up and service utilisation. Multilevel modelling techniques will then be used to determine whether engaging in social support services was associated with a change in cognitive function. This type of statistical modelling will allow for clustering at the provider level to account for the differences in social support services. We will first screen the covariates using the univariate association between cognitive function and social networks variables (size, frequency, diversity), quality of life and service use variables (type, frequency and duration) and selecting those

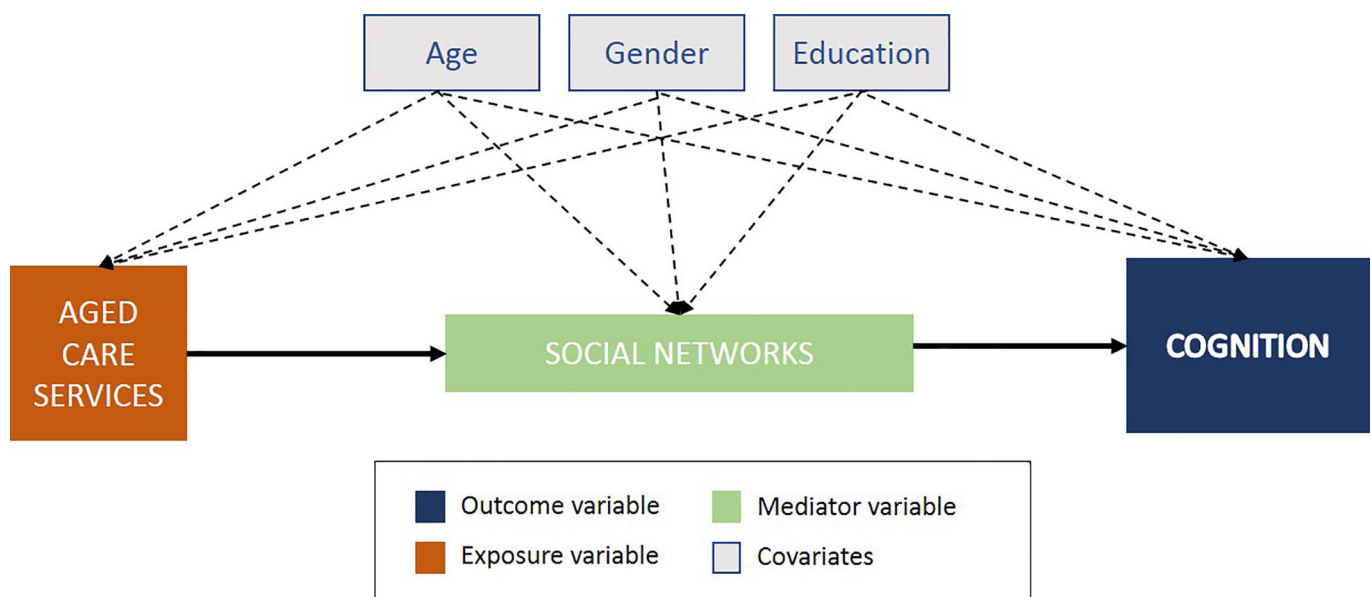


Figure 2 Causal diagram describing hypothesised relations among social networks, aged care service use and cognition.

with $p < 0.2$. Logistic regression analysis models will be used to determine the association between cognitive impairment and social network size at 6 months while adjusting for the variables selected. We will enter into the model only those covariates that are not multicollinear based on the variance inflation factor criterion.²⁷ Furthermore, subgroup-related differences in cognitive change will be investigated in stratified analyses by adding interaction terms such as age and gender to baseline cognitive functioning level (cognitively impaired (TICS < 27) vs cognitively intact (TICS-M ≥ 27)). Moderation analysis will also be conducted to determine whether social network size moderates the association between quality of life and cognitive function or cognitive change. These analyses will test for an interaction between quality of life and the cognitive function score and adjusted for all covariates (including baseline age and gender).

Missing data

We will conduct a missing value analysis to identify the patterns in missing variables, before determining whether the baseline characteristics differ between participants with and without missing data in terms of the response variables at the final measurement (6 months). Based on these analyses, we will infer whether missing values are likely to be missing at random (MAR), missing completely at random (MCAR) or missing not at random (MNAR). In the event of MCAR or MAR, we will use multiple imputation techniques and present the outcome of analyses with and without the imputed data. In the event of the MNAR data, we will not replace missing values and we will conduct case analysis when available.

Data storing and management

All data will be entered by principal investigators (PIs) or research assistants with data accuracy verified by the study PI. Data quality control measures will include queries to identify missing data, outliers and discrepancies. After enrolment, a unique identifier will be assigned to each study subject. Data will be stored on institutional network drives with firewalls and security measures in place. Hard copy records will be stored in a locked cabinet in a secure location. Study data will be de-identified and a master linking log with identities will be kept and stored separately from the data. Access to records and data will be limited to study personnel.

Dissemination and data sharing

To enhance reporting transparency, this study will be reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology Statement: Guidelines for Reporting Observational Studies.²⁸

Data and resources will be shared with other eligible investigators through academically established means. The datasets used/and/or analysed during the study will be available from the corresponding author on reasonable request. The results from this work will be published

in peer-reviewed manuscripts, presented at national meetings and summarised for the lay audience in report form.

Strengths and limitations

Strengths

Our longitudinal study design, in which parallel covariates are reliably and repeatedly measured, will allow us to look at changes over time in the same participant, defining the temporal sequence of changes and providing stronger evidence for causality than could be obtained from a cross-sectional design. Furthermore, the multicentre nature of the study will enhance external validity of the findings and allow us to track social networks as a potential function of cognitive function with more accuracy.

Limitations

The primary limitation of this study is lost to follow-up and missing data points that would challenge the internal validity of reported results. However, our research team has extensive experience in achieving high follow-up rates in similar studies.^{29–32} Efforts to minimise lost to follow-up will include respecting the time commitment of participants, formal tracking procedures including acquiring multiple contacts for arranging follow-up, strong interpersonal skills of study personnel and flexible hours for testing.

Significance

Increasing social networks of older adults presents a potentially effective way of improving quality of life and reducing healthcare demands and costs. Accurate assessment of social networks and improved understanding of outcomes associated with social network can help guide decision-making, improving client care and assist in the planning of future studies. Results from the current study will inform that future aged care programmes can be implemented in settings targeting improved outcomes relevant to older adults.

Contributors JS initiated the study, has led the work on research design and implementation of the study protocol and is the primary author of the manuscript. AG and JW have made substantial contributions to the conception of the study and implementation of the protocol. All authors contributed to the writing and critical review of the manuscript and approved the final version.

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Disclaimer The funding body did not influence the design of the study and collection, analysis and interpretation of data.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This study has been approved by Macquarie University Research Ethics Committee, reference number 5201831394062.

Provenance and peer review Not commissioned; externally peer reviewed.

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REFERENCES

1. *Keeping dementia front of mind: incidence and prevalence 2009-2050*: Access Economics Pty Limited, 2009.
2. Wang HX, Karp A, Winblad B, *et al.* Late-life engagement in social and leisure activities is associated with a decreased risk of dementia: a longitudinal study from the Kungsholmen project. *Am J Epidemiol* 2002;155:1081-7.
3. Holtzman RE, Rebok GW, Saczynski JS, *et al.* Social network characteristics and cognition in middle-aged and older adults. *J Gerontol B Psychol Sci Soc Sci* 2004;59:P278-84.
4. Barnes LL, Mendes de Leon CF, Wilson RS, *et al.* Social resources and cognitive decline in a population of older African Americans and whites. *Neurology* 2004;63:2322-6.
5. Kuiper JS, Zuidersma M, Oude Voshaar RC, *et al.* Social relationships and risk of dementia: A systematic review and meta-analysis of longitudinal cohort studies. *Ageing Res Rev* 2015;22:39-57.
6. Zhou Z, Wang P, Fang Y. Social engagement and its change are associated with dementia risk among chinese older adults: a longitudinal study. *Sci Rep* 2018;8:1551-51.
7. Fratiglioni L, Wang HX, Ericsson K, *et al.* Influence of social network on occurrence of dementia: a community-based longitudinal study. *Lancet* 2000;355:1315-9.
8. Arbuckle TY, Gold DP, Andres D, *et al.* The role of psychosocial context, age, and intelligence in memory performance of older men. *Psychol Aging* 1992;7:25-36.
9. Hertzog C, Hulstsch DF, Dixon RA. On the problem of detecting effects of lifestyle on cognitive change in adulthood: Reply to Pushkar *et al.* (1999). *Psychology and Aging* 1999;14:528-34.
10. Yoshitake T, Kiyohara Y, Kato I, *et al.* Incidence and risk factors of vascular dementia and Alzheimer's disease in a defined elderly Japanese population: the Hisayama Study. *Neurology* 1995;45:1161-8.
11. Marioni RE, Proust-Lima C, Amieva H, *et al.* Social activity, cognitive decline and dementia risk: a 20-year prospective cohort study. *BMC Public Health* 2015;15:1089.
12. ADoS S. Five steps to accessing a Home Care Package. 2015 https://www.dss.gov.au/sites/default/files/documents/07_2015/5-steps.pdf.
13. Care A. Social support and activities. 2018 <https://www.myagedcare.gov.au/help-home/social-support-and-activities>.
14. Knopman DS, Roberts RO, Geda YE, *et al.* Validation of the telephone interview for cognitive status-modified in subjects with normal cognition, mild cognitive impairment, or dementia. *Neuroepidemiology* 2010;34:34-42.
15. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975;12:189-98.
16. Plassman BL, Newman TT, Welsh KA, *et al.* *Properties of the telephone interview for cognitive status: Application in epidemiological and longitudinal studies*. US: Lippincott Williams & Wilkins, 1994:235-41.
17. de Jager CA, Budge MM, Clarke R. Utility of TICS-M for the assessment of cognitive function in older adults. *Int J Geriatr Psychiatry* 2003;18:318-24.
18. Welsh KA, Breitner JC, Magruder-Habib KM. *Detection of dementia in the elderly using telephone screening of cognitive status*. US: Lippincott Williams & Wilkins, 1993:103-10.
19. Buckwalter JG, Crooks VC, Petitti DB. A preliminary psychometric analysis of a computer-assisted administration of the Telephone Interview of Cognitive Status-modified. *J Clin Exp Neuropsychol* 2002;24:168-75.
20. Gallo JJ, Breitner JCS. *Alzheimer's disease in the NAS-NRC Registry of ageing twin veterans: IV. Performance characteristics of a two-stage telephone screening procedure for Alzheimer's dementia*. United Kingdom: Cambridge University Press, 1995:1211-9.
21. Beeri MS, Werner P, Davidson M, *et al.* Validation of the modified telephone interview for cognitive status (TICS-m) in Hebrew. *Int J Geriatr Psychiatry* 2003;18:381-6.
22. Lubben JE. *Assessing social networks among elderly populations*. Lippincott Williams & Wilkins, 1988:42-52.
23. Brooks R. EuroQol: the current state of play. *Health Policy* 1996;37:53-72.
24. EuroQol - a new facility for the measurement of health-related quality of life. *Health Policy* 1990;16:199-208.
25. Lawton MP. Assessing quality of life in Alzheimer disease research. *Alzheimer Dis Assoc Disord* 1997;11(Suppl 6):91-9.
26. Dolan P. Modelling valuations for health states: the effect of duration. *Health Policy* 1996;38:189-203.
27. Vittinghoff E, McCulloch CE. Relaxing the rule of ten events per variable in logistic and Cox regression. *Am J Epidemiol* 2007;165:710-8.
28. von Elm E, Altman DG, Egger M, *et al.* The Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Ann Intern Med* 2007;147:573-7.
29. Mumford V, Kulh MA, Hughes C, *et al.* Controlled pre-post, mixed-methods study to determine the effectiveness of a national delirium clinical care standard to improve the diagnosis and care of patients with delirium in Australian hospitals: a protocol. *BMJ Open* 2018;8:e019423.
30. Westbrook JI, Li L, Hooper TD, *et al.* Effectiveness of a 'Do not interrupt' bundled intervention to reduce interruptions during medication administration: a cluster randomised controlled feasibility study. *BMJ Qual Saf* 2017;26:734-42.
31. Westbrook JI, Li L, Georgiou A, *et al.* Impact of an electronic medication management system on hospital doctors' and nurses' work: a controlled pre-post, time and motion study. *J Am Med Inform Assoc* 2013;20:1150-8.
32. Georgiou A, McCaughey EJ, Tariq A, *et al.* What is the impact of an electronic test result acknowledgement system on Emergency Department physicians' work processes? A mixed-method pre-post observational study. *Int J Med Inform* 2017;99:29-36.