Optimising function and well-being in older adults: protocol for an integrated research programme in Aotearoa/New Zealand

Sue Lord1*, Ruth Teh2, Rosie Gibson3, Moira Smith4, Wendy Wrapson5, Murray Thomson6, Anna Rolleston7, Stephen Neville1, Lyn McBain8, Silvia Del Din9, Lynne Taylor2, Nicola Kayes1, Andrew Kingston10, Rebecca Abey-Nesbit10,11, Ngaire Kerse2 and On behalf of the AWESSoM Project Team

Abstract

Background: Maintaining independence is of key importance to older people. Ways to enable health strategies, strengthen and support whānau (family) at the community level are needed. The Ageing Well through Eating, Sleeping, Socialising and Mobility (AWESSOM) programme in Aotearoa/New Zealand (NZ) delivers five integrated studies across different ethnicities and ages to optimise well-being and to reverse the trajectory of functional decline and dependence associated with ageing.

Methods: Well-being, independence and the trajectory of dependence are constructs viewed differently according to ethnicity, age, and socio-cultural circumstance. For each AWESSoM study these constructs are defined and guide study development through collaboration with a wide range of stakeholders, and with reference to current evidence. The Compression of Functional Decline model (CFD) underpins aspects of the programme. Interventions vary to optimise engagement and include a co-developed whānau (family) centred initiative (Ngā Pou o Rongo), the use of a novel LifeCurve™ App to support behavioural change, development of health and social initiatives to support Pacific elders, and the use of a comprehensive oral health and cognitive stimulation programme for cohorts in aged residential care. Running parallel to these interventions is analysis of large data sets from primary care providers and national health databases to understand complex multi-morbidities and identify those at risk of adverse outcomes. Themes or target areas of sleep, physical activity, oral health, and social connectedness complement social capital and community integration in a balanced programme involving older people across the ability spectrum.

Discussion: AWESSoM delivers a programme of bespoke yet integrated studies. Outcomes and process analysis from this research will inform about novel approaches to implement relevant, socio-cultural interventions to optimise well-being and health, and to reverse the trajectory of decline experienced with age.

Trial registration: The At-risk cohort study was registered by the Australian New Zealand Clinical Trials registry on 08/12/2021 (Registration number ACTRN 12621001679875).

Keywords: Older adults, Well-being, Dependency, Function, Māori, Pacific, Co-morbidity, Mixed-methods design

Background

Those aged over 75 years will make up 12.5% (currently 5%) of the New Zealand (NZ) population by 2051, and it is estimated that the proportion over age 85 years will quadruple over the next 20 years. Diversity of the ageing...
population is also increasing. The majority Pakeha (European) population aged 65 and over will fall in proportions from 88 to 75% from 2013 to 2038 with increases for Asian (5 to 16%), Māori (6 to 10%) and Pacific people (2 to 4%) [1, 2]. Associated with this is an increase in age-related burden, manifesting as functional decline and attenuated quality of life. Understanding the cause of functional decline and age-related burden is challenging, and although progress has been made the evidence for mitigating risk factors is inconsistent [3, 4]. The need for improved outcomes through many pathways is emphasised, and specific strategies for Māori and Pacific peoples in NZ have been developed. The Ageing Well through Eating, Sleeping, Socialising and Mobility (AWESSoM) programme has two broad aims: firstly to enhance knowledge of risk factors for functional decline especially for populations with scant extant data, and secondly to improve function, health and well-being in older adults. It does so via an inclusive research protocol, drawing on the essential nature of community development, Kaupapa Māori approaches to health, consideration of strengthening of social capital, and broadening of primary health care. The AWESSoM programme delivers five studies that subscribe to an interconnected understanding of function, health and well-being: 1) Māori health and well-being; 2) Pacific elders health and well-being; 3) older community dwellers at risk of functional decline; 4) complex multi-morbidity analyses, and 5) aged residential care. Common themes or target areas for investigation connect these studies and include sleep, physical activity and mobility, oral health, and social connectedness. These themes are explicitly investigated throughout the programme in all sector groups to a greater or lesser degree, as discussed below (Fig. 1).

**AWESSoM: Māori health & well-being (Nga Pou o Rongo)**

Growth in the population of older Māori (indigenous people of Aotearoa/New Zealand) is predicted to be double that expected for non-Māori. Social, economic and environmental factors impact health and political, cultural and historical factors add to these as recognised factors related to health disparities for Māori in NZ. Older Māori are more likely to experience disadvantage and hardship at a level which is three-to-four times that of non-Māori. Higher levels of complex co-morbidities, disability yield differences in longevity between Māori and non-Māori of 8.6 and 7.9 years for men and women respectively [2]. Māori share robust whānau networks; a collective societal responsibility and whakawhānaungatanga (process of establishing relationships, relating well to others). The rate of admission to residential care (termed care homes in this proposal) is lower for Māori than non-Māori [5] and as a result Māori with high levels of disability are cared for at home [2]. Clusters of conditions for Māori differ from those for non-Māori [6] suggesting that ethnic-specific understandings of disease processes are needed.

**AWESSoM: Pacific elders health & well-being (Pacific elders)**

Seven percent of NZers identify with at least one Pacific ethnic group, an increase of 11% since 2006 [1]. In
particular, the Pacific population aged 65 plus is increasing faster than non-Pacific people, and health outcomes for Pacific peoples lag behind those of non-Pacific people in all domains of health [7]. The Healthy Pacific Grandparents (HPG) Study, a participatory action research project developed in collaboration with elder members of Vaka Tautua, a ‘by Pacific for Pacific’ health and social service provider [2] investigated whether the current social and health system environments meet Pacific elders’ needs. Key findings included a recognition by Pacific elders of the importance of taking responsibility for one’s own health and wellbeing but also identified key issues limiting optimal health and well-being and the barriers Pacific elders face in overcoming these. The HPG study also identified a role for technology to enable communication, provide entertainment and leisure options, however limited expertise and lack of exposure impacted on uptake.

**AWESSoM: improving functional decline in older community dwellers (at-risk cohort)**

The first target area to be examined in the At-risk cohort is *oral health*, which is a largely unrecognized but major health issue. Demographic and oral epidemiological changes (and associated health issues) among older NZers present an unprecedented situation: poor oral health is considered one of the ‘geriatric giants’ [8]. Dental caries remains the major oral health problem in older age, exacerbated by multimorbidity and associated polypharmacy which can compromise saliva flow, leading to higher rates of dental caries, along with problems eating, chewing, speaking and swallowing [9, 10]. The second target area is *sleep*, which is a problem for over a quarter of older adults [11]. Sleep disturbances are bidirectional, acting both as a precursor to and exacerbating comorbid diseases. For example, sleep disturbances are strongly associated with cardiovascular disease [12], and mental and neurological problems (e.g. depression and/or cognitive impairment), as well as external factors such as social isolation and grief [13]. The third area relates to *function*, which manifests as the ability to perform activities of daily living (ADL) [14] in home and community settings (community ADLs are instrumental or extended activities of daily living: IADLs) [15]. ADLs and IADLs attenuate in a certain order and operate in a hierarchy of functional domains, described by the Lifecurve hierarchy (see Fig. 2) [17]. The fourth focus area is *physical activity and mobility*. Epidemiological evidence that habitual activity benefits longevity, cardiovascular health and wellbeing for older people is overwhelming, and this is no less apparent in NZ [18]. Physical activity (or exercise) improves functional status, sleep, health status and life.
satisfaction for older people [19] and is effective in the treatment of cardiovascular disease, diabetes mellitus, falls and cognitive decline. Despite this, levels of physical activity remain low in older people, and behavioural change strategies are challenging to implement; this is even more so for people with compromised mobility. The final targeted area for the At-risk community cohort is socialisation. It is clear that social participation and social support networks are key to long-term outcomes and psychological wellbeing [20]. While the exact mechanisms by which social ties and contacts influence psychological morbidity is debated [21], it is clear that social issues contribute to depression and loneliness [22].

**AWESSoM: aged residential care (care home)**

Accommodation and health care is provided for our most vulnerable population in aged residential care facilities, termed “care homes” which include rest home, hospital-level and dementia-level care for older people in NZ. Over 60% of NZ and Australian care home residents have memory problems [23] or dementia. AWESSoM takes advantage of NZ’s universal comprehensive geriatric assessment (the international Residential Assessment Instrument, interRAI) [24] to enable identification of individuals with aspects of health relevant to this study, particularly in respect to oral health, sleep, and cognitive decline. Oral health in residential care is a particularly vexing issue, with neither the care sector nor the dental profession prepared for the steadily increasing number of residents entering care with disproportionately high levels of tooth decay, their own teeth, and accompanying risk of aspiration pneumonia [25]. Similarly, sleep has been identified as a complex issue within care homes. This is due to an increase of sleep disorders with ageing and cognitive impairment alongside the impact of living and sleeping in a different environment with different schedules and exposures [26].

**AWESSoM: multimorbidity**

Multimorbidity may be defined as the presence of two or more chronic conditions with equal predominance [27, 28]. Prevalence of multimorbidity is high in older adults, resulting in poor outcomes, polypharmacy [29] and uncertainty about management. People with multimorbidity are 3.5 times more likely to have problems with ADLs and 6 times more likely to have physical function limitations than those without after adjusting for socioeconomic status and depression [30]. Health care costs are 2.5 times higher for those with multimorbidity than for people with a single disease [4]. Guidelines call for individualised treatment, but empirical evidence identifies a lack of understanding of what constitutes individualised care [28]. Patterns of conditions (clusters) may be more relevant for identifying key areas of need and outcomes than a simple count of the number of conditions an individual has [6]. For example, cardiovascular clusters lead to the greatest decline in ADLs, while mental health/neurological clusters lead to a decline in IADLs [31]. Inconsistency in the choice of diseases included in studies and statistical methods provides challenges in describing patterns of multimorbidity.

**Methods/design**

**Theoretical framework and study design**

Models of health, well-being and functional independence underpin the AWESSoM programme. These models vary according to ethnicity, socio-cultural practice, and health/functional status but in essence all lead to an understanding about predictors of functional decline and strategies to mitigate it. Three of the five studies (Māori, At-risk cohort and Care Home studies) trial an intervention. For the Māori study researchers adapted previously trialled participatory action research techniques to develop and refine the intervention [32]. Co-design principles including group discussions, interviews and personal testimonies foster culturally safe practice and demonstrate cultural competence. This practice conforms to Mātauranga Māori - a cultural system of knowledge that reflects a unique Māori worldview. Pacific elders’ data are gathered via individual face-to-face interviews incorporating closed and open-ended questions, and focus group talanoa (conversations) to share views and arrive at common aims and understandings. The compression of functional decline model (CFD) model guides the At-risk study design. The CFD poses that decline in activities of daily living (ADLs) and instrumented activity of daily living (IADLs) is best compressed into the shortest possible time in order to extend the health span and thereby optimize ageing [33]. Decline in ADLs and IADLs occurs in a specific order, as described by the hierarchy of functional loss [17]. Longitudinal studies suggest the trajectory of loss can be reversed or at least remain static. The At-risk study examines this by trialling a novel intervention using a pre-post design. The Care Home and Multi-morbidity studies draw on the National Health Index (NHI) linked interRAI database contains data from standardised assessments of over 300,000 community-dwelling people and 200,000 residential care residents since 2012 with baseline and repeated assessments [24]. The assessment covers function, health conditions, aspects of oral health, nutrition, and mental health as well as indicators of sleep disturbance and function [34]. Finally the Multimorbidity studies also uses a second large extant datasets from primary health, the Compass Health Primary Care Organisation (PCO) dataset (Table 1).
| Study | Key concepts | Aims | Research Design | Outcomes |
|-------|--------------|-----|----------------|----------|
| Māori older adults | Exercise, nutrition, traditional well-being practices within Te Ao Māori, meditation, stress management, sleep, oral health | Modify and extend a family (whānau-based) lifestyle management strategy (Nga Pou o Rongo) | Conforms to Mātauranga Māori principles: whānau co-design, culturally safe & relevant, local, timely, affirmative, responsive to individual need | Well-being, physical and social activity & health |
| Pacific elders | Factors associated with ageing well | Investigate how Pacific elders are faring across various dimensions of health | Collaborative design with Pacific community partner | Interactions between sleep, oral health, physical activity, sedentary behaviour, socialisation and oral health on function and well-being |
| At-risk cohort | Innovative technology, health promotion, behavioural change, hierarchy of function, trajectory of functional decline, independent & combined effects of physical activity, sedentary behaviour, socialisation and oral health on function, health & well-being | Adapt a behavioural change tool (LifeCurve™ App) to optimise locality in 2 urban sites | Mixed methods design. Co-design to modify and develop LifeCurve™ App for Pacific elders | Interactions between sleep, oral health, physical activity, social connectedness, function, health & well-being |
| Residential care | Novel interventions to improve oral health, cognition and sleep | Design and implement innovative strategies to improve oral health and cognition including introduction of a dental hygiene and cognitive stimulation therapy programme | Pre-post design with 3 month follow up | Changes in oral health, cognition, sleep and health status |
| Multi-morbidity | Patterns of multi-morbidity associated with functional decline and high burden of care. | Discern patterns of multi-morbidity associated with trajectory of dependence and high health services utilization | Descriptive design. Multi-morbidity clusters modelled for each setting and for Māori, Pacific, & European using 2 extant data sources: Compass Health PHO and InterRai. Associations will be examined with hospital outcomes and burden of care. | Identify patterns of comorbidities of older adults living in New Zealand. |

**Abbreviations:** P population, NEADL Nottingham Extended Activities of Daily Living scale, PHO Primary Health Organisation
Development

The development phase for each study indicates a strong commitment to collaborative and co-participatory research processes (Table 2). For the Māori and Pacific elder studies, this included consultation to ensure culturally appropriate methods to realise AWESsOM aims. For the At-risk cohort it included modification of the LifeCurve™ App to reflect NZ socio-cultural norms and national identity. Local and national resources for the App are embedded within it to ensure that all participants have access to appropriate resources to guide their self-management journey. Embedded themes (oral health, social connectedness, physical activity and sleep) were refined by the research team and integrated to ensure prescription and attainment of common study aims while obtaining novel and relevant findings. The meta-assessment form for non-Māori and non-Pacific participants was trialled and revised accordingly on three occasions over a period of 6 months.

Setting, study population and recruitment

Study populations are described in Table 1. All settings are in NZ. Māori, Pacific elders and the At-risk cohort studies are based in community settings, while the Care Home study is sited in two large aged residential care facilities run by the same organisation. The Māori study (Ngā Pou o Rongo) aims to enrol up to 40 whānau using the Manawa Ora Centre for Health (MCH) extensive community networks. Each whānau will be centered around a key individual who is an older person (Māori over 60 years) and comprised of between 2 and 7 whānau members. All participants will sign informed consent forms and attend an introductory whānau hui (meeting). The Pacific Island Grandparents study works with a large Pacific provider in South Auckland to identify people from Samoan, Tongan and Cook Island Māori groups to undertake health assessments and work towards health promotion focused strategies. Included in the At-risk cohort are community dwelling adults (aged at least 60 for Māori and Pacific, and at least 75 for non-Māori) who present with early signs of functional decline as indicated by 1–2 self-identified functional deficits on the LifeCurve™ App trajectory. Excluded from the sample are those who are not able to interact with the App, those lacking capacity to give signed consent, and those living in care homes or in palliative care. The study is located at two convenient study sites. Health services personnel in Tauranga (Bay of Plenty) are members of the AWESsOM research group and Howick (Auckland) is a research site with established research relationships with Easthealth Primary Health Organisation and local stakeholders working with older adults. Both sites participated in the Staying Upright and Eating Well (SUPER) trial, a nutrition study for pre-frail older adults and successfully used general practices to contact adults over 75 years (60 years for Māori) [35]. Older adults from Tauranga and Howick will be contacted and invited to participate using multiple approaches. Older adults will also access the study independently through the web-based platform which is linked to local health services. Other strategies to achieve recruitment targets include a series of planned workshops in both centres, local and national advertisements, medical practices, national organization supports, social media etc. Prior to data collection, all participants will sign informed consent forms compliant with national and ethical regulations. The multimorbidity project uses existing data and matches this with hospitalisations and mortality and aged residential care (ARC) placement data routinely collected.

Data collection, assessment, intervention

As stated above, for older Māori (Ngā Pou o Rongo) Kaupapa Māori co-design research is used for data collection and assessment. Non-pharmacological interventions underpinned by Māori models of health addressing healthy eating, exercise and/or sleep will then be co-designed, incorporating the values, contexts and goals of the whole whānau, and trialled for 12 weeks, concluding with a post programme assessment and completion hui. Whānau will be supported by the research team with contact at fortnightly intervals. Outcome measures will include: Kaupapa Māori quality of life questionnaire, physical activity, functional status, health related quality of life, sleep health and oral health. Whānau will also have the opportunity to develop and include their own outcome measure/s. Sleep is measured objectively using actigraphy among case studies where sleep is identified as a problem from the data collection phase. For the Pacific study, participants undergo a face-to-face assessment to provide essential data on Pacific elders’ wellbeing. Participants in the At-risk study undergo baseline assessment in home, clinical, research, or community settings such as service clubs, community halls, etc. Participants receive training in using the LiveCurve App by the research team, and are then asked to use it for the following 12 months. Support from the research team is available but is not proactively offered in this ‘real-world’ study. App usage will be monitored. There are no specific strategies to enhance adherence, however, this will be evaluated at the end of the trial. All other usual care will continue. There are no specific criteria for discontinuing use of the App because it is a self-monitored, low-risk intervention. After 11 months, participants will be contacted to select a convenient assessment time for the 12 month assessment which is a repeat of
all baseline measures. A purposeful sample of App-users seeking diversity on a range of key characteristics (e.g. ethnicity, living situation, gender, baseline characteristics) will be invited to take part in semi-structured interviews at baseline and 12 months to explore their experiences and perspectives of well-being strategies, ageing well, and App use. Care home: oral health will be explored via standardised assessments and the introduction of a dental hygienist for 2 years at two care homes in Wellington region. Simultaneously, cognition and sleep will be measured prior to and after a 7 week trial of Cognitive stimulation therapy and chair yoga using standardised scales and actigraphy sleep monitoring. Interviews with care partners will also be incorporated to better understand the key themes throughout AWESSoM with regards to assessment and management. Assessment and outcome measures for all studies are metrically robust, and identified by expert teams using published evidence, expert experience and research knowledge (summarised in Table 3).

Adverse events
All AWESSoM studies are considered low-risk, however a Hazard and Risk Register and Hazard and risk Identification and resolution plan will be developed by the research team who will monitor adverse events 3 monthly. Incident forms will be available to all assessors and any reported incidents will be identified and relevant agencies informed. Any injury linked to the research is covered by NZ’s Accident Compensation Corporation (ACC) scheme which is detailed on the Participant Information Sheet as an ethical requirement.

Sample size calculation and data analysis
Estimates for sample size are considered formally for the At-risk cohort and the Multimorbidity study. The primary pre-post outcome for the At-risk cohort is functional status, measured by the Nottingham Extended Activities of Daily Living (NEADL). A power calculation based on data from a large longitudinal cohort examining health status in older Māori and non-Māori (LiLACS NZ) indicated a sample size of 150 participants is required to show a pre-post change of at least 5 points on the NEADL scale which is considered a clinically significant change [46]. The Life Curve™ hierarchy over 12 months will be described for the cohort and patterns of change in response to the App will be modelled. Associations between NEADL, LifeCurve data, independent predictors of health and well-being, and data from oral health, social connectedness, physical activity and sleep will be examined. Objective sleep monitoring will take place for participants with self-identified sleep problems from the Nga Pou o Rongo, At Risk, and Care Home studies wearing the Motionlogger actigraph (Ambulatory Monitoring) (http://www.ambulatory-monitoring.com/motionlogger.html) a small wrist-watch-like device containing an accelerometer for 7 days. Standard sleep variables will be calculated (e.g. sleep timing, efficiency, and duration) as well as non-parametric circadian rhythm variables (inter-daily stability, and intra-daily variability) which are valuable for documenting regulation of sleep. This data will be used alongside subjective measures of sleep and physical and mental health status to better understand the predictors and outcomes of sleep disturbances across the studies and the effect of the App on sleep patterns. Data on App usage (e.g. number of times accessed, duration of use, functions accessed, tasks and activities selected and patterns of use, when and where) will also be evaluated. Information Power [54] will be used to determine sample sufficiency for the qualitative component. Qualitative data will be analysed drawing on reflexive thematic analysis [55]. Data from each time point will be analysed independently before being synthesised as a whole to produce standalone insights regarding the experiences and perspectives of the App and engagement in well-being strategies. Two separate datasets will be used to examine multimorbidity. A large regional dataset of all primary care health records for over 50,000 patients and separately the national interRAI dataset. The occurrence of multimorbidity (≥2 conditions) and each condition will be described separately for Māori, Pacific, non-Māori/Pacific and by age bands. Using a person-centred approach, agglomerative hierarchical cluster analysis will be used to identify subgroups of patients based on groupings of co-existing conditions. For the clustering algorithm, Ward’s method will be used which sorts individuals into clusters containing a similar profile of conditions [2]. Descriptive statistics will be computed for each of the clusters. Multivariate regression models (linear or log-binomial regression) will be used to examine associations with hospitalisation outcomes. The primary care database will use NHI matching and has worked through the ethical issues to identify the two clusters with the highest impact burden. Similar analysis will be completed separately for inter-RAI data for community dwelling older adults using home care services.

Data access and confidentiality
All research data will be stored in secure, lockable locations with participants identified only by a numeric ID. All data will have adequate password protection via a secure network drive hosted by the university or health service linked to each study. De-identified information may only be released to the central study coordinating...
| Study                  | Patient and Public Involvement (PPI)                                                                 | Co-funded partnerships                                                                 | Development                                                                                                      | Intervention                                                                                                      | Impact & Sustainability                                                                                     |
|-----------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Māori older adults    | Engagement with Māori elders, whānau                                                              | N/A                                                                                    | Participation research methods confirming to Mātauranga Māori knowledge and practice. Modification of LifeCurve™ App for Māori. | 12 week programme nutrition, sleep, physical activity. Trial of LifeCurve™ App. | Potential for broader adoption of intervention within Māori communities; adoption of the App. |
| Pacific elders        | Pacific elders                                                                                     | Vaka Tautua (national Pacific health and social service provider)                     | Engagement with Vaka Tautua                                                                                   | N/A                                                                                                             | Potential development of the LifeCurveApp for the Pacific community.                                          |
| At-risk cohort        | Māori community, Pacific elders; Age concern                                                      | ADL Smartcare BoP DHB; Age Concern: national charity representing older adults.        | Engagement with Māori and Pacific communities; Engagement with Age Concern and agencies. LifeCurve™ App modification to reflect NZ socio-cultural norms. Identification of broad range of national and regional health services, social & community services to list and describe on the App. Iterative pilot of the meta-assessment form for use with non-Māori, non-Pacific participants through discussion with each group. | Modification LifeCurve™ App for NZ socio-cultural conditions, embed national and local resources on App. Recruit participants, train in use of App. Self-identification of position on LifeCurve trajectory. Use of App for 12 months. Concurrent embedded studies physical activity, sedentary behaviour, socialisation, oral health. | Long term adoption of the LifeCurve™ App supported by the BoP DHB. Continued updating of the App to reflect local resources and referral availability. |
| Residential care      | Two facilities from a corporate Aged Residential Care organisation.                                 |                                                                                        | Engagement with staff and residents to identify key issues regarding oral care, sleep, cognition.                | Dental assessments, provision of dental hygienist service. Sleep health assessments. Cognitive stimulation therapy. | Development of appropriate resources for oral care, sleep disturbance, cognitive stimulation.               |
| Profiles of multi-morbidity | Compass Health: PHO > 500,000 patients enrolled; 2 primary care practices selected for data capture. | N/A                                                                                    |                                                                                                                 | N/A                                                                                                             | Identify support needs for clusters of individuals to improve management of co-morbidities and enable independent living for longer. |

**Abbreviations:** ADL: Activities of Daily Living scale, BoP: Bay of Plenty, DHB: District Health Board, PHO: Primary Health Organisation
office (University of Auckland) or designee. Data are collected using different platforms including the phone App, mobile tablets, and extant database platforms using specific data collection software and electronic data. Data access will be selectively organized by senior research team members and granted to research personnel according to relevance and research focus. A data monitoring committee has not been established.

Patient and public involvement
Engagement with older adults, service-users and citizen-led advocacy groups is critical to programme success and viewed as a key driver throughout planning, implementation and evaluation. As reported above, this is particularly pertinent for Māori, Pacific elders and At-risk cohort studies where co-design is a central feature.

Process evaluation
A process evaluation drawing on a critical realist framework is embedded within the At-risk cohort study to develop a rich and practical understanding of effectiveness with a focus on what works, for who and in what circumstances [56]. We will integrate all data sources (e.g. outcome and interview data, App analytics, and demographic details) across time points for each of the participants purposefully sampled to take part in the semi-structured interviews to inform case-specific context-mechanism-outcome (CMO) configurations [57]. CMOs will then be compared, contrasted, and synthesised across cases to produce an in-depth evaluative account of key processes relating to context and implementation to underpin an evidence-based framework for future implementation efforts optimising effectiveness and uptake. No formal economic evaluation is planned.

Table 3 AWESSoM measures with reference to populations

| Characteristic          | Measure                                                                                     | Population                                                                                     |
|-------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Personal characteristics | Ethnicity, sex, age, Living arrangement, Pension status, geographical location                | Community dwellers, Care home residents, Māori, Pacific                                           |
| Socioeconomic status    | NEADL                                                                                         | Community dwellers, Māori, Pacific elders                                                       |
| Functional status       | MoCA                                                                                          | Community dwellers, Pacific elders, Care home residents                                          |
| Cognition               | Menu list of medical diagnoses including: Cardiovascular disease, Chronic Obstructive Pulmonary Disease, Parkinson's disease, and all relevant diagnoses | Community dwellers, Māori, Pacific elders                                                       |
| Medical history         | SF-36 Physical and mental subscale scores                                                     | Community dwellers, Māori                                                                       |
|                         | Qual-AD [36]                                                                                   | Care home residents                                                                             |
|                         | Kaupapa Māori quality of life questionnaire                                                   | Māori                                                                                            |
| Well-being, Quality of  | Short Physical Performance Battery & Timed Up and Go (TUG) [37]                               | Community dwellers, Care home residents, Māori, Pacific elders                                    |
| life                    | 7 day accelerometry monitoring of physical activity, sedentary behaviour & gait parameters   | Community dwellers, Māori                                                                       |
|                         | CHAMPS activity questionnaire                                                                 | Community dwellers                                                                                |
| Physical performance    | Oral-health-related quality of life and self-reported oral health (OHIP-14 + Locker item and items on chewing ability), eating assessment tool (EAT-10, dysphagia), oral health assessment tool (OHAT) [38], summated xerostomia inventory (SXI; dry mouth) [39] | Community dwellers, Care home residents, Māori, Pacific elders                                    |
| Habitual activity       | UC UCLA loneliness questionnaire (3 items) [40], Lubben Social Network Scale [41]              | Community dwellers, Pacific elders, Māori                                                      |
| Oral health             | SCREEN II as a validated (in NZ) nutrition risk screening tool [42]                           | Community dwellers, Pacific elders, Māori                                                      |
| Social connectedness    | Actigraphic sleep monitoring                                                                  | Community dwellers, Pacific elders, Māori                                                      |
| Nutritional health      | PSQI, rMEQ and the STOP-Bang for sleep disordered breathing [43]                              | Community dwellers, Care home residents, and Māori identified as ‘problem sleepers’ by self-report and/or standard cut-off scores |
| Sleep health            | Richards-Campbell Sleep Questionnaire [44]                                                    | Community dwellers, Māori, Pacific elders (selected outcomes)                                    |
|                         | Semi-structured sleep interviews                                                              | Care home residents, Māori                                                                     |

CHAMPS: The Community Health Activities Model Program for Seniors physical activity self-report questionnaire [45], NEADL Nottingham Extended Activities of Daily Living Scale [46], MOCA Montreal Cognitive Assessment [47], PSQI Pittsburgh Sleep Quality Index [48], Qual-AD Quality of life in Alzheimer’s Disease [36], OHIP-14 Oral Health Impact Profile-1 [49], rMEQ Reduced Morning Eveningsness Questionnaire [50], RUDAS Rowland Universal Dementia Rating Scale, [51] SF36 Short Form 36 [52], SXI Summated Xerostomia Inventory [53]
Dissemination

A broad approach to dissemination will ensure throughout the 5-year period that stake-holders are informed about protocol development, process and outcomes for each study through hui (meetings), small group discussions, community workshops, conference presentations, seminars, media interviews and journal articles. Authorship eligibility will be considered with respect to guidelines published by and International Committee of Medical Journal Editors (ICMJE), and no professional writers will be used for dissemination purposes.

Discussion

The AWESSoM programme sets out to understand and influence the predictors of functional decline associated with aging and co-morbidity. Novel aspects to the study include the use of a phone App for those living in the community who are at-risk of functional decline, culturally embedded interventions for Māori and Pasifika people, a focus on oral health and dental hygiene, and analysis of co-morbidity data from two disparate populations. Results from this diverse but integrated programme will inform older adults and their carers, public sector groups, and health, social and community services about ageing, function, and well-being.

Abbreviations

ACC: Accident Compensation Corporation; ADL: Activities of daily living; ARC: Aged Residential Care; AWESSoM: Ageing Well through eating, sleeping, socialising and mobility; CFD: Compression of functional decline; CMO: Context-mechanism-outcome; HPG: Healthy Pacific Grandparents; IADL: Instrumented activities of daily living; interRAI: International Resident Assessment Instrument; NEADL: Nottingham extended activities of daily living; NHI: National Health Index; NZ: New Zealand; SUPER: Staying Upright and Eating Well.

Acknowledgements

Thanks to all members of the public who assisted with the development of the AWESSoM programme and preliminary testing of questionnaires, and protocols.

AWESSoM Project Team

Heather Ailore, Yale Program on Ageing Biostatistics Core, Yale University, USA. Karen Campbell, School of Population Health, Faculty of Medical and Health Sciences, University of Auckland. Stephanie Clare, Age Concern New Zealand, Wellington, New Zealand. Judith Davey, Institute of Governance and Policy Studies, University of Auckland.

Peter Gore, Population Health Sciences Institute, Faculty of Medical Sciences, Newcastle University, Newcastle Upon Tyne, UK. Carolyn Gellery, Canterbury District Health Board, Christchurch, New Zealand. Carol Jagger, Population Health Sciences Institute, Faculty of Medical Sciences, Newcastle.

Hamish Jamieson, Department of Medicine, University of Otago, Christchurch, New Zealand. Sarah Mitchell, Bay of Plenty District Health Board, Tauranga, New Zealand. Simon Moyes, School of Nursing, University of Auckland, New Zealand. Kathy Peri, School of Nursing, University of Auckland, New Zealand. Dan Tautolo, School of Clinical Sciences, Auckland University of Technology, Auckland, New Zealand.

Authors’ contributions

All authors co-developed the study concept, study design and methods of implementation in discussion with the wider AWESSoM project group: SL, RT, RG, MS, WW, MT, AR, SN, LB, SDD, LT, NK, AK, RA-N, NG. The following authors critically revised the manuscript: RT, RG, MS, WW, MT, AR, S, LMc, LT, NK, RA-N, NK. The manuscript was drafted by SL. The authors read and approved the final manuscript.

Funding

This project is funded by the National Science Challenge, Ministry of Business, Innovation and Employment (MBIE), NZ Govt, 15 Stout St, Wellington 6011, New Zealand and was externally reviewed as part of the funding application. MBIE has no designated role in any aspect of the AWESSoM programme of study. There are no financial interests to declare from any member of the research team.

Availability of data and materials

Individual participant data collected during the trial after de-identification will be available upon request to Professor Ngaire Kerse, University of Auckland, NZ, (n.kerse@auckland.ac.nz): Some restrictions are likely to be necessary given the sensitivity of Māori and Pacific data in particular. Access to data does not extend to the public. Requests for the full study protocol may also be submitted to the Professor Ngaire Kerse.

Declarations

Ethics approval and consent to participate

The Health and Disability Ethics Committee (HDEC), Ministry of Health, NZ granted ethical approval for AWESSoM (20/CEN/242). Locality authorization has also been approved for the Te Pou o Rongo study (ref: 20/SHT/206), the At-risk community cohort study (ref: 20/CEN/2442), the HDEC multimorbidity study (ref: 14/SHT/140/AM10), and the Pacific elders study (AUTEC 21/100). Locality authorisation for the Aged Residential Care study will be submitted at a later date. Signed, informed consent is required for the Te Pou o Rongo study, the At-risk community cohort study, the Pacific elders study, and the Aged Residential Care study.

Consent for publication

Not explicitly required.

Competing interests

None declared.

Author details

1 School of Clinical Sciences, Faculty of Health & Environmental Sciences, Auckland University of Technology, Akoranga Drive, Northcote, Auckland 0627, New Zealand. 2 School of Population Health, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand. 3 School of Health Sciences, Massey University, Wellington, New Zealand. 4 Department of Public Health, University of Otago, Wellington, New Zealand. 5 School of Population Health, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand. 6 School of Health Sciences, Massey University, Wellington, New Zealand. 7 Department of Public Health, University of Otago, Wellington, New Zealand. 8 AUT Public Health and Mental Health Research Institute, Auckland University of Technology, Auckland, New Zealand. 9 Department of Oral Sciences, University of Otago, Dunedin, New Zealand. 10 The Centre for Health, Tauranga, New Zealand. 11 School of Health Sciences, Massey University, Wellington, New Zealand. 12 School of Clinical Science, Newcastle University, Newcastle Upon Tyne, UK. 13 Population Health Sciences Institute, Faculty of Medical Sciences, Newcastle University, Newcastle Upon Tyne, UK. 14 Department of Medicine, Canterbury District Health Board, Christchurch, New Zealand.

Received: 29 September 2021 Accepted: 15 February 2022

Published online: 16 March 2022

References

1. Statistics New Zealand Census Population and Dwelling Counts. [https://www.stats.govt.nz/information-releases/2018-census-population-and-dwelling-counts]. Accessed 11 Dec 2021.
2. Kerse N, Teh R, Moyes SA, Broad J, Rolleston A, Gott M, et al. Cohort profile: Te Puawaitanga o Ngā Tapuwhae Kia Ora Tonu, life and living in
advanced age: a cohort study in New Zealand (LiLACS NZ). Int J Epidemiol. 2015;44(6):1823–32.

3. Mayo-Wilson E, Grant S, Burton J, Parsons A, Underhill K, Montgomery P. Preventive home visits for mortality, morbidity, and institutionalization in older adults: a systematic review and Meta-analysis. PLoS ONE [Electronic Resource]. 2014;9(3):e89257.

4. Picco L, Achilla E, Abdin F, Chong S, Vaingankar J, McCrone P, et al. Economic burden of multimorbidity among older adults: impact on healthcare and societal costs. BMC Health Serv Res. 2016;16:173.

5. Holdaway M, Isles J, Kerse N, Wu Z, Moyes S, Connolly MJ, et al. Predictive factors for entry to long-term residential care in octogenarian Māori and non-Māori in New Zealand. LiLACS NZ cohort. BMC Public Health. 2021;21(1):34.

6. Teh RO, Menzies OH, Connolly MJ, Doughty RN, Wilkinson TJ, Pillai A, et al. Patterns of multi-morbidity and prediction of hospitalisation and all-cause mortality in advanced age. Age Ageing. 2018;47(2):261–6.

7. Ministry of Health New Zealand. Aia Moi. Pathways to Pacific Health and Wellbeing 2014–2018. https://www.health.govt.nz/publication/alia-moui-pathways-Pacific-health-and-wellbeing-2014-2018. Accessed 11 Dec 2021.

8. van der Putten GJ, de Baat C, De Visschere L, Schols J. Poor oral health, nutrition and disease management in advanced age. Sleep Health. 2020;6(4):522–8.

9. Grandner MA, Alfonso-Miller P, Fernandez-Mendoza J, Shetty S, Shenoy S, Combs D. Sleep: important considerations for the prevention of cardiovascular disease. Curr Opin Cardiol. 2016;31(5):551–65.

10. Thompson M. Epidemiology of oral health conditions in older people. Gerodontology. 2014;31(1):17–24.

11. Thompson M. Dry mouth and older people. Aust Dent J. 2015;60(S1):54–63.

12. Gibbon, G. R. G. P., Pepa M, Moyes S, Kerse N. Self-reported sleep problems and their relationship to life and living of Māori and non-Māori in advanced sleep. Sleep Health. 2020;6(4):522–8.

13. Grandner MA, Alfonso-Miller P, Fernandez-Mendoza J, Shetty S, Shenoy S, Combs D. Sleep: important considerations for the prevention of cardiovascular disease. Curr Opin Cardiol. 2016;31(5):551–65.

14. Alvaro PK, Roberts RM, Harris JK. A systematic review assessing bidirectionality between sleep disturbances, anxiety, and depression. Sleep. 2013;36(7):1091–68.

15. Katz S, Ford A, Moskowitz R, Jackson B, Jaffe M. Studies of illness in the aged. The index of Adl: a standardized measure of biological and psycho-social function. JAMA J Am Med Assoc. 1963;185:914–9.

16. Lawton M, Brody E. Assessment of older people: self-maintaining and instrumental activities of daily living. The Gerontologist. 1969;9(3):179–86.

17. Gore P, Kerse N. Personal communication, 2021.

18. Kingston A, Collellott J, Davies K, Bond J, Robinson L, Jagger C. Losing the ability in activities of daily living in the oldest old: a hierarchy of disability scale from the New Zealand 85+ study. PLoS One. 2012;7(2):e31665.

19. Mace Firebaugh C, Moyes S, Jatana S, Rolleston A, Kerse N. Physical activity, function, and mortality in advanced age: a longitudinal follow-up (LiLACS NZ). J Aging Phys Act. 2018;26(4):583–8.

20. de Labra C, Guimaraes-Pinheiro C, Maseda A, Lorenzo T, Millán-Calenti JC. Effects of physical exercise interventions in frail older adults: a systematic review of randomized controlled trials. BMC Geriatr. 2015;15:154.

21. Burholt V, Winter B, Aartsen M, Constantinou C, Dahlberg L, Feliciano V, et al. A critical review and development of a conceptual model of exclusion from social relations for older people. Eur J Ageing. 2020;17(1):3–19.

22. Vicent C, Scambler S, Bond J, Bowling A. Being alone in later life: Loneliness, social isolation and living alone. Rev Clin Gerontol. 2000;10:407–17.

23. Mirza J, Jenkins R. Risk factors, prevalence, and treatment of anxiety and depressive disorders in Pakistan: systematic review. BMJ. 2004;328(7443):794–0.

24. Boyd M, Broad JB, Kerse N, Foster S, von Randow M, Lay-Yee R, et al. Twenty-year trends in dependency in residential aged care in Auckland, New Zealand: a descriptive study. J Am Med Dir Assoc. 2011;12(7):535–40.

25. InterRAI New Zealand 2019/2020 Annual Report. https://www.interrai.co.nz/publications-and-resources/publications/. Accessed 11 Dec 2021.

26. van der Maarel-Wierink CD, Vanobbergen JN, Bronkhorst EM, Schols JM, de Baat C. Oral health care and aspiration pneumonia in frail older people: a systematic literature review. Gerodontology. 2013;30(1):3–9.

27. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet. 2012;380(9836):37–43.

28. Salisbury C. Multimorbidity: redesigning health care for people who use it. Lancet. 2012;380(9830):7–9.

29. Ferguson CA, Thomson WM, Smith MB, Kerse N, Peri K, Gribben B. Medication taking in a national sample of dependent older people. Res Social Adm Pharm. 2020;16(3):299–307.

30. Williams JS, Egede LE. The association between multimorbidity and quality of life, health status and functional disability. Am J Med Sci. 2016;352(1):46–52.

31. Jackson CA, Jones M, Tooth L, Mishra GD, Byles J, Dobson A. Multimorbidity patterns are differentially associated with functional ability and decline in a longitudinal cohort of older women. Age Ageing. 2015;44(5):810–6.

32. Rolleston AK, Doughty R, Poppe K. Pounamu: integration of kaupapa Māori concepts in health research: a way forward for Māori cardiovascular health? J Prim Health Care. 2016;8(1):116–20.

33. Gore PG, Kingston A, Johnson GR, Kirkwood TBL, Jagger C. New horizons in the compression of functional decline. Age Ageing. 2018;47(6):764–8.

34. Violán C, Fougert-Boreu Q, Flores-Mateo G, Salisbury C, Blom J, Freitag M, et al. Prevalence, determinants and patterns of multimorbidity in primary care: a systematic review of observational studies. PLoS One. 2014;9(10):e102149.

35. Teh R, Kerse N, Waters DL, Hale L, Pillai A, Leilua E, et al. Study protocol of a randomised controlled trial to examine the impact of a complex intervention in pre-frail older adults. Aging Clin Exp Res. 2019;31(10):1407–17.

36. Logsdon RG, Gibbons LE, McCurry SM, Teri L. Assessing quality of life in older adults with cognitive impairment. Psychosom Med. 2002;63:510–19.

37. Podsiadlo D. The timed ‘up & go’: a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142–8.

38. Chalmers JM, King PL, Spencer AJ, Wright FA, Carter KD. The oral health assessment profile—validity and reliability. Aust Dent J. 2005;50(3):191–9.

39. Thomson WM, van der Putten GJ, de Baat C, Ickee K, Matsuda S, Enoki K, et al. Pounamu: integration of kaupapa Māori concepts in health research: a way forward for Māori cardiovascular health? J Prim Health Care. 2016;8(1):116–20.

40. Hughes ME, Waite LJ, Hawkley LC, Cacioppo JT. A short scale for measuring loneliness in large surveys: results from two population-based studies. Res Aging. 2004;26(6):655–72.

41. Lubben J, Blozik E, Gillmann G, Iliffe S, von Rintel H, Beck J, et al. Performance of an abbreviated version of the Lubben social network scale among three European community-dwelling older adult populations. Gerodontology. 2006;44(4):503–13.

42. Keller HH, Goy R, Kane SL. Validity and reliability of SCREEN II (seniors in the community: risk evaluation for eating and nutrition, version II). Eur J Clin Nutr. 2005;59(10):1149–57.

43. Chung F, Subramanyam R, Liao P, Sasaki E, Shapiro C, Sun Y. High STOP-bang score indicates a high probability of obstructive sleep apnoea. Br J Anaesth. 2012;108(5):768–75.

44. Richards KC, O’Sullivan PS, Phillips RL. Measurement of sleep in critically ill patients. J Nurs Meas. 2000;8(2):131–44.

45. Stewart AL, Mills KM, King AC, Haskell WL, Ritter PL, CHAMPS primary care: a systematic review of observational studies. PLoS One. 2013;8(2):e53197.

46. Lord et al. BMC Geriatrics 2022;22:215

Page 11 of 12
51. Wong L, Martin-Khan M, Rowland J, Varghese P, Gray LC. The Rowland universal dementia assessment scale (RUDAS) as a reliable screening tool for dementia when administered via videoconferencing in elderly post-acute hospital patients. J Telemed Telecare. 2012;18(3):176–9.

52. Brazier JE, Harper R, Jones NM, O’Cathain A, Thomas KJ, Usherwood T, et al. Validating the SF-36 health survey questionnaire: new outcome measure for primary care. Bmj. 1992;305(6846):160–4.

53. Thomson WM, van der Putten GJ, de Baat C, Ikebe K, Matsuda K, Enoki K, et al. Shortening the xerostomia inventory. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2011;112(3):322–7.

54. Malterud K, Siensma VD, Guassora AD. Sample size in qualitative interview studies: guided by information power. Qual Health Res. 2016;26(13):1753–60.

55. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006;3(2):77–101.

56. Rycroft-Malone J, McCormack B, Hutchinson AM, DeCorby K, Bucknall TK, Kent B, et al. Realist synthesis: illustrating the method for implementation research. Implement Sci. 2012;7:33.

57. Shaw J, Gray CS, Baker GR, Denis JL, Breton M, Gutberg J, et al. Mechanisms, contexts and points of contention: operationalizing realist-informed research for complex health interventions. BMC Med Res Methodol. 2018;18(1):178.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.