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SPECIAL ISSUE

How can population-based studies best be utilized to reduce the global impact of dementia? Recommendations for researchers, funders, and policymakers

Blossom C. M. Stephan[1] | **Mario Siervo**[2] | **Carol Brayne**[3]

[1] Institute of Mental Health, Division of Psychiatry and Applied Psychology, School of Medicine, University of Nottingham, Innovation Park, Nottingham, UK

[2] School of Life Sciences, Queen's Medical Centre, The University of Nottingham Medical School, Nottingham, UK

[3] Department of Public Health and Primary Care, Cambridge Institute of Public Health, University of Cambridge, Cambridge, UK

Correspondence
Prof. Carol Brayne, Department of Public Health and Primary Care, Institute of Public Health, Forvie Site, University of Cambridge, Cambridge CB2 2SR, UK.
Email: cb105@medschl.cam.ac.uk

Abstract

In the last two decades, there has been in-depth investigation into understanding the pathogenesis, epidemiological profiling, and clinical characterization of dementia. However, these investigations have not led to successful interventions to prevent, delay, or reverse the pathological processes underlying dementia. Recent findings of a decrease in dementia risk in high-income countries such as the UK, USA and the Netherlands highlight that dementia, at least in some cases, is preventable. This article includes a synthesis of current knowledge on dementia epidemiology, biological underpinnings, risk factors, and current prevention programs, with the aim to set the path for research, funding, and policy initiatives to address the global public health challenge of how to prevent dementia or reduce risk within the framework of population-based studies. We advocate for development of novel approaches for intelligent data synthesis that go well beyond single approaches to enable powerful risk stratification analyses. An integrated approach is needed where researchers, funders, policymakers, and stakeholders contribute to and work together to formulate effective strategies for the global monitoring and development of population-based risk reduction, treatment, and prevention programs for dementia.

KEYWORDS
brain aging, cardiovascular disease, epidemiology, guidelines, public health, risk reduction, prevention

1 | INTRODUCTION

The world's population is aging. This changing age demographic is linked to significant negative consequences on health and economic systems including an increase in the global burden of age-associated conditions (eg, dementia) and their risk factors, including, for example, cerebrovascular (eg, stroke) and cardiometabolic (eg, hypertension, heart disease, and diabetes) diseases. Numerous studies have highlighted the associations between low education and poor midlife health and lifestyle status (eg, cardiometabolic disease and physical inactivity) and later life risk for cognitive impairment and dementia.[1–3] These risk factors are known to be strongly related to socioeconomic and life-course inequality. However, despite the knowledge of risks, the specific biological mechanisms and the best strategies for reducing dementia risk remain poorly understood. Therefore, the first aim of this article is to briefly highlight the global problem of dementia including

its epidemiology, biological underpinnings known to date, risk factors, potential for risk reduction, and availability of informative and comprehensive data sets. Second, based on this knowledge we make recommendations to researchers, policymakers, and funders on the key next steps needed to reduce dementia risk. The focus is on population-based studies and their importance within this context.

RESEARCH IN CONTEXT

1. **Systematic review:** This perspective piece draws on previous analytical research experience, systematic reviews and expert opinion of the author team to highlight the importance of population-based studies in dementia risk reduction and prevention research.
2. **Interpretation:** There is an urgent need for concerted efforts to tackle the projected increases in dementia cases globally. Use of existing population-based data resources should be maximised to create opportunities for big-data analyses and adoption of novel approaches (i.e. machine learning, artificial intelligence) to advance data synthesis and inform the design and testing of dementia prevention and risk reduction strategies. New resources are need incorporating novel technologies and expanding research into often neglected groups (e.g. minorities).
3. **Future direction:** Researchers, funders and policy makers must work together to focus research efforts toward a more multi-factorial perspective into ageing and dementia risk with greater emphasis on life course determinants of health, particularly in ethnic minority groups and low- and middle-income countries.

1.1 | Dementia epidemiology and impact

Dementia affects 50 million people worldwide, with the greatest impact being in low- and middle-income countries (LMICs) where approximately two-thirds of people with dementia live.[4] The cost of dementia is significant, estimated at US$817 billion, and forecasted to rise to US$2 trillion by 2030.[4] Dementia is currently incurable. However, recent studies suggest that the risk of dementia can be reduced or deferred.[5,6] Indeed, findings from high-income countries including the United States, The Netherlands, and the United Kingdom suggest that in the most recent two decades dementia risk has declined.[6,7] However, it is not clear what is driving these changes. Decreased risk is hypothesized to be linked to increased educational attainment and improved population health including reduction in the prevalence and incidence of cerebrovascular (ie, stroke) and cardiometabolic (ie, heart disease and diabetes) diseases and their risk factors (eg, hypertension and obesity).[6] It is unknown whether similar trends are expected in LMICs where data on secular trends are currently not available.

1.2 | Mechanisms underlying dementia

Historically, much of the research into dementia has been on the amyloid hypothesis, with amyloid beta (Aβ) seen as key to the onset and progression of cognitive symptoms. In 2010,[8] with an update in 2013,[9] the sequence of Alzheimer's disease (AD) pathology was captured in a hypothetical biomarker model where first biomarkers of brain Aβ deposition show abnormalities (ie, cerebrospinal fluid [CSF] Aβ42, amyloid positron emission tomography [PET]) followed by measures of neurodegeneration (including progressive loss of neuron or neuronal functioning, ie, CSF tau, fluorodeoxyglucose [FDG]-PET, and atrophy on structural magnetic resonance imaging [MRI]), with progression of symptoms occurring over time. However, a key limitation of this model is that it ignored non-AD pathologies. Indeed, at least in population-based samples, as opposed to clinical or convenience samples, the frequency of pure dementia subtypes is low, with most autopsied individuals having mixed dementia including evidence of AD and vascular pathology.[10,11] It is notable that a recent update to the AD biomarker model has put vascular impairment as a key, early pathogenic step.[12]

The dementia syndrome (and clinically diagnosed AD) shares many risk factors with cardiovascular and metabolic diseases, including diabetes, obesity, and hypertension.[3,13] Recently the term "type-3 diabetes" has been proposed for AD because of the shared molecular and cellular features with diabetes associated with cognitive decline.[14] Indeed, the brain is heavily dependent on an efficient autoregulation of local blood flow as this allows it to maintain optimal cerebral perfusion via the dilation and constriction of cerebral arterioles. This cerebrovascular reactivity is connected to changes in neural activity and depends on a number of myogenic, metabolic, and neural mechanisms.[15] The endothelium plays a key role in maintaining brain perfusion by releasing vasoactive agents, such as nitric oxide (NO), and impaired endothelial function and decreased NO bioavailability have been associated with reduced cerebrovascular reactivity and cognitive decline.[16]

1.3 | Dementia risk factors

An individual's risk of dementia is a complex interplay between numerous factors that may or may not exert negative effects in any given person. These can include for example, biological (eg, age, genetics), environmental (eg, commercial settings, pollution, inequalities, availability, and access to healthcare and services), health (eg, cerebrovascular and cardiometabolic health) and behavioral (eg, poor dietary habits and physical inactivity) factors.

Recent analyses have identified nine modifiable risk factors, accounting for ≈35% of dementia cases worldwide, including low early life (ie, age <18 years) educational attainment, midlife (ie, age 45 to 65 years) hypertension, obesity and hearing loss, and later life (ie, age >65 years) smoking, depression, physical inactivity, diabetes, and social isolation [3,13]. Figure 1 shows the weighted population attributable

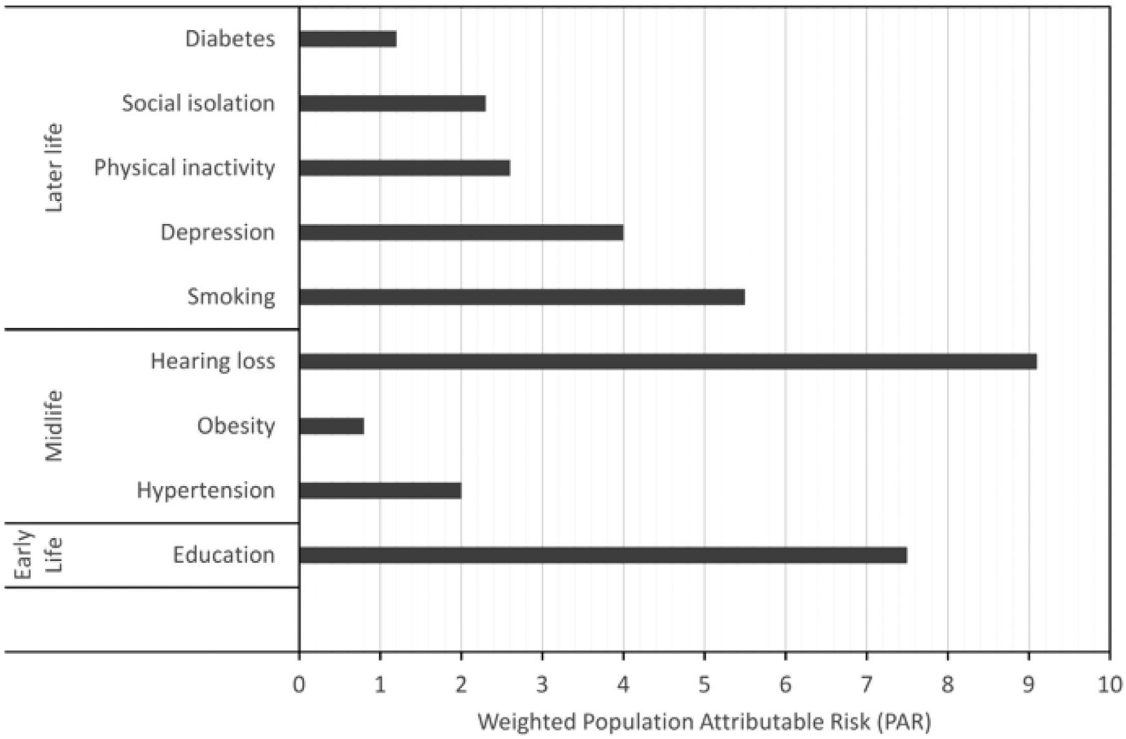

FIGURE 1 Weighted population attributable risk of each of the nine potentially modifiable risk factors for dementia (data taken from Livingston et al. 2017[3])

risk (PAR) or the relative contribution of each risk factor to the overall PAR for dementia globally. In LMICs, these risks combined account for 39.5% (95% confidence interval [CI]: 37.5-41.6) of dementia cases in China, 41.2% (95% CI: 39.1-43.4) of dementia cases in India and 55.8% (95% CI: 54.9-56.7) of dementia cases in Latin American.[17] Compensatory factors individually and societally can also play a role including, for example, reserve, coping strategies, societal stimulation, and support. It is notable that the profile of risk and protective factors highlight possible avenues for dementia risk reduction and primary prevention.

However, the associations between dementia onset and most risk factors are non-linear and modifiable, for example, by age and gender. Indeed, although obesity and poor cardiometabolic health in midlife are found to be significant risk factors for dementia later in life, the associations with dementia become weaker with aging.[18–22] This is likely due to survivor bias such as that seen with smoking, where surviving smokers are different from non-survivor smokers as because those who live longer are largely the fitter and healthier individuals, thus, weakening the associations between cardiometabolic risk factors and cognitive impairment as age progresses.[23] It could also be due to the occurrence of reverse causality, since it may be plausible that better cognitive function may mitigate the aging effects on cardiometabolic health by favoring the adoption and maintenance of active lifestyles and healthier diets. As such, intervention and prevention strategies need to take into account factors such as age or cardiometabolic health profiles to ensure greater impact. Furthermore, different strategies may be needed depending on culture, resources/infrastructure available (ie, high-income country vs LMIC), and the specific health systems in place for the care of dementia patients.

Genetic mutations play a significant role in early onset dementia, but they have a less-defined role in the pathogenesis of late-onset dementia. The candidate gene most strongly and consistently associated with a higher risk of developing late-onset dementia is the apolipoprotein E (*APOE*) gene, which codes for a protein involved in metabolism of fat and cholesterol.[24] Genome-wide association studies (GWAS) have also identified other genetic variants that may have a role in the risk of dementia such as *CLU*, *CR1*, *PICALM*, *BIN1*, *ABCA7*, *MS4A*, *CD33*, *EPHA1*, and *CD2AP*, which are thought to be involved in the regulation of inflammation and immunity, intermediate metabolism, or cell trafficking.[25,26]

Dementia is not a homogeneous condition. Across cases, there is large heterogeneity in the clinical and neuropathological presentation as well as in the distribution of risk and protective factors.[10] As such, it is unlikely that a single strategy can reduce risk or delay dementia progression. Multi-domain strategies targeting different biological, social, and behavioral factors are more likely to determine sustained changes and improve cognitive function. For example, the Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) trial, which included dietary counseling, promotion of physical and social activities, cognitive stimulation, and management of metabolic and vascular risk factors, observed a significant, albeit modest, improvement in cognitive outcomes.[27] Other similar studies such as the Prevention of Dementia by Intensive Vascular Care (preDIVA) and the Multidomain Alzheimer Preventive Trial (MAPT)

trials, which combined cognitive, lifestyle (diet, physical activity, smoking cessation), and pharmacological interventions, observed protective effects in individuals with elevated vascular or dementia risk.[28,29] The Healthy Aging Through Internet Counseling in the Elderly (HATICE) trial found that older people can reduce their risk of cardiovascular disease and dementia by improving their lifestyle and adopting healthier behaviors with the support of an online coach.[30]

Dementia risk reduction is a critical component of any policy, now that the evidence base is clear—both from risk profiles and from the population-age specific reductions seen in some countries such as the UK, USA and the Netherlands.[5] Indeed, in the UK, delaying dementia onset by 2 or 5 years could lead to a reduction in 19% and 33% of cases by 2050, respectively.[31] Yet, although pathological changes may occur, in some cases years or even decades before clinical symptoms appear, no cognitive assessment tools or biological markers currently exist that accurately capture these abnormalities during the prodromal or asymptomatic periods and can effectively and accurately predict a person's risk of developing dementia later in life.

Humans are social animals and dementia occurs within historical, cultural, social, and physical environments. It is increasingly clear that the risk and protective factors identified to date are clustered and linked in societies.[32,33] Without recognition that our context matters we will not formulate the appropriate public health responses. These will need to range from how we, as a society, support optimal health during gestation and optimal brain and mind development during early life, and how we support, enhance, and maintain our health including brain health throughout life and then into later life. Strong and compelling public health evidence on how health improves across time in whole populations and the globe demonstrates that without a doubt the best approaches to improving population health are changes at societal and population levels.[7] This does not mean that there should not be local and individual approaches as well, rather that our best bet for future generations is to seriously research and invest in whole population health and reduction of inequalities at the whole population level if we are to enhance later life health, including cognitive health, for all.

Effective early interventions for preventing or reducing risk of cognitive impairment and dementia through reduction of risk factors and enhancement of protective ones must be viewed through a life-course lens. Indeed, we already know enough about some risk factors to take action in populations. This relates to clusters of risk associated with social deprivation including educational attainment and ill health. In addition, there is an urgent need to expand and improve our understanding of the natural history and risk/protective factors in contemporary and varying populations, across all age groups. This underpins the need to identify where we have existing data, and where we need to create new data. Much effort is now directed at the need for prospective validation of putative risk factors and biomarkers to capture the course of clinically significant symptoms. This information can then be used to develop predictive algorithms, which have sufficient accuracy and external validity, for determining, in asymptomatic populations, who is at highest risk of future dementia. This will, as noted earlier, be only a partial response, as it is individually based and unlikely to lead to substantial population level difference. We also need to track the descriptive epidemiology in a wide variety of populations within and across countries, as it is now clear that although dementia's relationship with age is stable across populations, its absolute value can be different according to the background nature and health status of the population, including its survival into older ages.

Key steps to maximize the success of these research strategies should aim to:

(1) Establish multi-disciplinary, collaborative "big data" initiatives working collectively on existing large epidemiological data sets, incorporating qualitative and complementary methodologies to maximize the value of the outputs to ensure that they are of relevance to the population to which they will be applied. In addition, create new (comparable) data sets to address unanswered questions around pathways to the onset and progression of cognitive and functional decline, secular trends (or cohort effects), and biological underpinnings of clinical symptoms in population representative samples from high-income countries as well as LMICs. High-throughput "omics" (ie, genomics and metabolomics) are data-driven methods that may provide an unbiased bulk of information (eg, cellular, molecular, and genetic) to unravel the complex pathogenesis of the underlying reasons for the dementia syndrome and other age-related dementias. Such data may be used to identify whether there are specific sub-populations with homogenous pathophysiological traits that could be targeted effectively to enhance the efficacy of clinical interventions[27]; and
(2) Translate the epidemiological findings into pilot clinical trials testing the feasibility and efficacy of novel interventions at the population-based (ie, development of public health approaches and social engagement strategies, eg, via social media to promote risk reduction) or individual (ie, personalized medicine) level. Such work needs to incorporate societal engagement so that findings are placed in context. The ultimate aim is to support communities and societies with the best possible evidence to establish approaches that work to reduce whole population risk and lower the prevalence and incidence of cognitive impairment and dementia globally.

1.4 | Data sources: population-based studies

Historically, dementia research has been undertaken at the individual study level, rather than in a collective way, with few examples of data pooling, which is a challenging exercise. Exceptions include large genetic and risk factor consortia. Although individual studies have much to offer, they are often constrained by their original hypotheses (and therefore the type of data collected), funding (that determines sample size, what can be collected, and length of study follow-up), location (ie, single-site vs multicenter), and sample representativeness (eg, sampling frame, participant selection methods, and response/drop-out rate). Within the field of neurodegeneration and brain aging, the potential and need to bring appropriate data together is frequently

stated; however, this tends to be a "rainbow into a bucket" approach—beautiful colors become brown. There is an urgent need to develop approaches for intelligent data synthesis that go well beyond these approaches. Such exercises, if done carefully, can enable more powerful risk-stratification analysis. This is needed to have a sufficient number of outcome events and a sample large enough to undertake validation studies, stratified by important confounders such as age, sex, ethnicity, genetic status, or cardiometabolic health.

Over the last decades, many studies have reoriented their focus to aging, and brain aging in particular, partly in response to the availability of large biomedical and data science funds raised against the alarm calls of tsunamis of AD. Examples are the European Prospective Investigation of Cancer (EPIC)-Norfolk[28] and the Honolulu Heart Program which later became the Honolulu Asia Aging Study (HAAS).[29] In both studies, although baseline midlife data collection did not include assessment of cognition function, over time and with additional funding subsequent follow-ups have included neuropsychological testing and dementia status. Pooling original midlife health and lifestyle data with later life cognitive status has the analytical advantages of allowing for longitudinal modeling in asymptomatic individuals (ie, with low risk of comorbid neuropathology linked to AD and vascular dementia) and for inclusion of time-varying coefficients in statistical modeling. The latter is particularly important given potential changes in the associations between some risk/protective factors and dementia across the life-course, particularly vascular risks (ie, obesity and hypertension), where midlife associations of increased risk are not always replicated in later life. There are, however, some limitations. First, because the original study was not focused specifically on the assessment of cognitive function, key risk factor data such as information on social engagement and social networks important for calculating early markers of cognitive reserve are missing.[34] Second, in the absence of baseline cognitive screening, it is not possible to determine the interplay between midlife cognitive status and later-life cognitive trajectories and risk of dementia.[35] Studies such as the UK National Survey of Health and Development, a unique birth cohort (1946) focused on health, social class, and education from birth, may be able to fill this gap by allowing for life-course analyses as it develops into an aging study.[36]

A second approach involves data pooling across different resources. Indeed, although numerous population-based cohort studies with detailed assessment of relevant exposure and outcome variables exist worldwide, risk factor analyses have been conducted mostly independently. Consequently, these data resources have contributed less than they could to the understanding of dementia pathogenesis and its risk factors. Bringing data together, regardless of research field, must be done very carefully to avoid brown sludge in the bottom of a bucket including, for example, loss of the original meaning of variables due to inconsistencies across studies in how key variables were assessed, differences in data quality, and variability in definitions due to cultural and country-specific norms leading to lack of equivalence in diagnoses. However, there are numerous advantages with data harmonization including increased statistical power (and ability to undertake individual patient meta-analyses, stratify analysis by subgroups such as age and gender, and reliably detect small to moderate effects[37]), ability to validate results (eg, splitting data into development and validation cohorts for risk model development and testing), improved generalizability, and better control of confounding factors.

Given this, numerous international consortia have been initiated that harmonize data from population-based studies with some examples including (1) COSMIC[38] (Cohort Studies in Memory in an International Consortium; http://www.cheba.unsw.edu.au/group/cosmic), with the aim of undertaking international comparisons of mild cognitive impairment (MCI) prevalence and predictability using a standardize assessment protocol; and (2) The Alzheimer Cohorts Consortium (ACC) with the aim of harmonizing findings on time trends and risk factors for dementia across different world regions.[39] It is important to note that to facilitate data sharing and the potential for harmonization there has been the development of new data information platforms including, but not limited to, the Gateway to Global Ageing Data (www.g2aging.org) and the Dementia Platform UK (www.dementiasplatform.uk). Each gives key details of included studies and provides secure access to data sets via virtual computer platforms to conduct statistical analyses in platform-independent environments. However, there is a considerable challenge beyond such meta-data to true harmonization, something that has been tried for decades and has yet to really provide major outcomes beyond what is already known as data structures re-emerge from data driven approaches (eg, rediscovery of the challenge of missing data, risk factor structures that reflect the original knowledge in the designs of the studies themselves).

1.5 | New data resources

Shifts in thinking around dementia and its subtypes beyond the amyloid hypothesis, the identification of novel risk factors and markers of symptom onset and progression, particularly in highly selected convenience/clinical samples, as well as evidence of changes in risk over time necessitate the collection of new data in current cohorts of mid-to-later life populations. However, these data should not be constrained to a single population (ie, high-income countries and LMICs, ethnic minorities, and clinical vs population based), research question or driving theory (ie, amyloid). Different data resources are needed to allow generalization to different populations. Ideally, new resources should contain a minimal data set to allow for cross study comparability and have the ability to be translated into resources for pilot testing of dementia intervention and prevention strategies at not only the individual level, but also population level.[1,40]

2 | RECOMMENDATIONS

A summary of the key areas of recommendation for policymakers, funding agencies, and researchers to develop, support, and advance dementia research are shown in Figure 2.

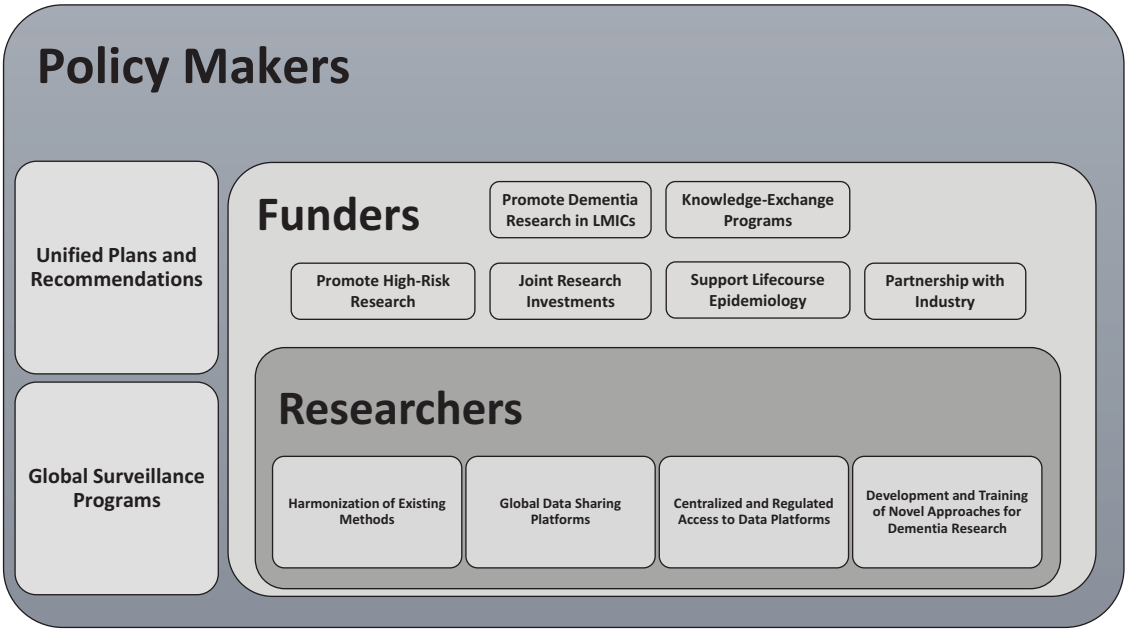

FIGURE 2 Key areas of recommendation for policymakers, funding agencies, and researchers to develop, support, and advance dementia research around the globe

2.1 | For researchers

1. The academic community needs to agree on a minimum set of common variables for collection in any new study. These need to be simple to obtain, valid, and accurate, as well as relevant to most populations. This will allow for minimal cross-study comparability. Examples of variables for the minimal data set include, but are not limited to, age, sex, ethnicity, educational attainment, global and domain specific (ie, memory and non-memory) cognitive function, physical function, and health status including vascular health. Determining how best to assess the different variables will require systematic reviews focused on the feasibility and validity of different screening tools (across different populations, ie, clinical vs population-based, and settings such as high-income countries vs LMIC), as well as consensus workshops to evaluate the results of the literature synthesis. The outcomes would be an agreed set of core variables in addition to full details on their measurement protocols, data handling, and interpretation. Current consortia of population-based studies could lead the way in discussions of what would constitute a minimum data set.
2. To maximize the use of data already available as well as to harmonize newly collected data, we propose the development of a global data sharing platform that encompasses studies from high-income countries as well as LMICs. It is notable that excellent data harmonization initiatives already exist (eg, COSMIC[38] and IALSA, or Integrative Analysis of Longitudinal Studies of Ageing) and these could be combined and expanded. Key considerations to be addressed include where data is hosted, how it is maintained (and by whom), how (or whether) use is monitored, and how to ensure data autonomy and minimize study interference and costs. Such an initiative was proposed as a key output from the Leon Thal Symposium 2010[40] and could be overseen by Alzheimer's Disease International.[41]
3. To achieve maximum impact, a memorandum of understanding needs to be developed focused on sharing resources and knowledge in an ethically appropriate manner as well as detailing protocols for creating and using the new global data-sharing platform. This would require a governing committee. How this could be achieved, as outlined in Khachaturian et al.[42] and Hachinski et al.,[1] is via a 2-year pilot program engaging different stakeholders (eg, government, non-government, private, and public) to determine the aims, objectives, as well as outline regulations and test feasibility.
4. Data analysis needs to use the most up-to-date and appropriate methodologies. New methodologies need to be developed that can take into account the contextual factors raised above. They also need to address life course, socioeconomic, and cultural aspects of how our brains age well and with frailty in their physical, emotional, psychological, and sociocultural environments. To achieve this will require further support as well as development of research groups focused on the promotion, development, and sharing of new statistical methods for aging research. An established example that could be expanded includes MELODEM (Methods for Longitudinal Studies in Dementia), which is focused on the challenges of participant selection, variable measurement, time-varying exposures and confounding in trajectory analysis, and the use of high dimensional data such as genomics and neuroimaging in dementia research.[43] A further example is the Alzheimer's Association Professional Interest Areas (PIAs) including the specific PIA on Design and Analytics. PIAs promote networking, collaboration, mentoring, and

knowledge sharing among members and therefore play an important role in skills development in early as well as later career academics. The impact of such groups could be increased by expanding their network and training opportunities to LMICs to further support high quality research in these settings.

2.2 | For funders

1. All funding should take the population health/public health perspective of what can be gained from current knowledge to promote primary as well as secondary and tertiary prevention with a life-course focus. Indeed, there are several modifiable risk factors that have been linked consistently to dementia such as low education and poor midlife cardiometabolic health and lifestyle factors (physical and mental activity), and the development of strategies targeting these could lead to a significant reduction is dementia numbers.[3,13] Funders also need to consider where the gaps are in implementation science including, for example, collection of new data to influence legislation reform (eg, in reducing the prevalence and incidence of obesity) to reduction of environmental risks (eg, preventing disease by improving, air quality, social engagement, and civic cohesion).
2. Relative to other diseases (ie, cancer) dementia research is underfunded, and in recent years across the globe, fewer resources are available for life-course epidemiological work including cohort initiation and cohort maintenance. This has led to restriction in the ability to test new markers of disease and intervention/prevention strategies in real-life and generalizable samples. Furthermore, loss of investment in current cohorts means that data quickly become outdated, raising questions of utility over time. All funders must recognize the sustainable infrastructure required for individual studies, enabling contribution if such efforts are to bring in maximum data value. To do this, they must ring-fence budget for long-term investment into epidemiological research for dementia risk reduction and prevention.
3. Given the strong association between vascular health status and cognitive function (including risk of dementia), it is important that funding agencies, which have otherwise operated independently, link to advocate for joint research investments (eg, AD/dementia-focused associations vs stroke and vascular disease-focused associations). Such investments should target understudied populations including ethnic minorities and less-advantaged groups.
4. Globally, LMICs have the highest burden and risk of dementia (and cardiometabolic disease). Yet, in these settings, resources (eg, financial, workforce, research facilities), cultural factors (eg, views of aging, health, and cognitive decline), and training opportunities (eg, access to research infrastructure, high quality data for skills development, and expertise) limit research. As such, there is a paucity of data on dementia, its risk factors, and strategies for intervention/prevention in LMIC settings. Targeted investment, similar to initiatives such as the "Global Challenges Research Fund (GCRF)" in the UK, is essential to overcome disparities and reduce the global burden of disease associated with dementia.
5. Funders need to create a "pot" focused on high-risk research. Indeed, it is always difficult to fund high-risk studies, particularly those studies that are required to generate and test new hypotheses. Where new studies are to be undertaken, it is important to recognize disparities around the world in financial resources so costs and access to products and services are adjusted to reflect local economies.
6. Create new funding opportunities to allow for knowledge exchange, but more importantly as a way to reduce the gap between developed and developing countries by training new generations of researchers in dementia epidemiological research.
7. Finally, work with and not against industry partners (including the pharmaceutical industry) with the aim of mutual benefit by the discovery of new technology and products that may benefit individuals and populations as well as have worldwide commercial value for equal distribution around the world.

2.3 | For policymakers

1. There are numerous dementia-specific reports and action plans, both nationally and internationally, developed by academic communities (eg, outputs from Delphi consensus and consensus from workshops such as the Berlin Manifesto[1]), charities (eg, Alzheimer's Society), government (ie, UK Dementia Action Plan), and non-governmental organizations (eg, Alzheimer's Association, World Health Organization, United Nations, and Alzheimer's Disease International) focused on dementia intervention and prevention. These need to be summarized and plans monitored to assess impact and determine future edits. As highlighted, action plans should focus on whole populations and incorporate a life-course approach. Given disparity in resources (eg, health care, work force, and technology), it is likely that any action plans will need to be country specific.
2. Undertake surveillance to ensure the effectiveness of any proposed and implemented intervention, whether it is at the individual or population level. Surveillance programs need to be coordinated globally by a recognized organization (eg, Alzheimer's Disease International, World Health Organization, United Nations) and the protocol agreed. Funding also needs to be directed at investment into infrastructures to set up and sustain the surveillance programs with emphasis on the training of new generations.

3 | CONCLUSIONS

If we are to reduce the risk of dementia in the population there will first need to be a shift toward a more multifactorial perspective with greater emphasis on life-course health, social, and commercial determinants of health behaviors, context, and aging itself. Second, there needs to be greater research focus and investment into where we have limited

knowledge of risk/protective factors and course of disease, particularly in ethnic minority groups and LMICs, where there are large gaps. As highlighted, an integrated approach is needed where researchers, funders, policymakers, and stakeholders contribute to and work together to formulate effective strategies for the global monitoring and development of population-based risk reduction, treatment, and prevention programs for dementia.

CONFLICT OF INTEREST

The authors Blossom C. M. Stephan, Mario Siervo, and Carol Brayne report no conflicts of interest.

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