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Review

Dementia risk and prevention in low and middle-income country settings – focus on Tanzania Mainland

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Abstract

As a result of an increasing population of aged people in sub-Saharan Africa, dementia is predicted to surge up to 90% by 2030. This review is set to assess the prevalence of dementia, for 65+ aged population in sub-Saharan states and particularly in Tanzania. Subsequently, the review will identify the possible risks factors – age, gender, level of education, cardiovascular problems, diabetes and mild cognitive impairment – and will lay out the challenges of reducing the dementia burden in Tanzania. Additionally, the review explores the current approaches in solving dementia disorders, including a general view on the public understanding of dementia. Also, the review recognises the gaps in government funding to mental health, a barrier to service access and the need for further research on Alzheimer's and other dementias. Lastly, the review links the sustainable development goals (SDGs) addressed and appreciate the impact of coronavirus pandemic on the fight against dementia.

Keywords: Dementia, prevalence, Tanzania, sustainable development goals

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Review

Introduction – the general outline of the context of Tanzania

Over two decades ago, Kilonzo and Simmons (1998) published an insightful paper in which they described the evolution of mental health in Tanzania. However, the evidence reviewed failed to account for any reported measures of risk of dementia in Tanzania. Following the World Health Report (World Health Organization, 2001) and *The Lancet*'s first global mental health series (Patel et al., 2018), the earliest studies were conducted in Tanzania by a group of researchers from Northumbria Healthcare NHS Foundation Trust and Newcastle University from 2009 to examine the prevalence and nature of dementia in rural Tanzania. Over time, the basic inherent features surrounding dementia and mild cognitive impairment in Tanzania have been unravelled to enable appropriate health services to be directed to the aged population.

The current Tanzania population is estimated to be 56.7 million; population with 60+ years old (both male and female combined) increased by 28.5% from 1,952,041 in 2002 to 2,507,568 in 2012 (Ministry of Health, 2020; National Bureau of Statistics, 2003). Moreover, in twenty years, the Tanzania population aged 65+ (both male and female combined) was projected to increase by 82.2% from 867,253 in 2000 to 1.58 million in 2020 (United Nations Department of Economic and Social Affairs Population Division, 2019). At birth, the sex ratio is 102.7 males per 100 females born (Chao, Gerland, Cook, & Alkema, 2019; Ministry of Health, 2020). Life expectancy at birth is projected to 75 and 83 years old by 2035 for males and females, respectively (National Bureau of Statistics & Ministry of Finance and Planning, 2018). Domestic government expenditure on health (non-communicable diseases) is 0.42% of the gross domestic product (GDP, $63.2 billion in 2019) (World Health Organization, 2020). Increasing aged population brings about the need to further work in reducing the risks and burden caused by dementia.

The epidemiology and dementia burden in Tanzania

The prevalence of dementia in Tanzania is as high as that recorded in other places worldwide. In rural Tanzania, the prevalence of dementia was calculated to be 6.4% (95% confidence interval, 4.9 to 7.9) (Longdon et al., 2013). In this study, which was undertaken in Hai, the rural northern part of Tanzania enrolled 1198 people with 70 or more years of age. One hundred and eighty-four people tested positive for probable dementia, and 104 tested positive for possible dementia using the Community Screening Instrument for Dementia (CSID). Moreover, higher prevalence was significantly associated with increasing age (Longdon et al., 2013).

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Furthermore, sub-types of dementia, Alzheimer's (ADD) and vascular dementia (VAD) are present in Tanzania. A different study by the Northumbria Healthcare Foundation Trust and Newcastle University research group demonstrated that in a group of 78 dementia cases, they recorded 38 (48.7%) and 32 (41.0%) ADD and VAD cases respectively (Paddick, Longdon, Kisoli, et al., 2014).

While there are no recent research studies conducted to determine the changes in prevalence, the most recent survey in Tanzania looked at the out-patients neurological conditions in a private institution and found that 3.5% of the observed cases (41/1186) had Alzheimer's disease (31.7%) and vascular dementia (43.9%) (Adebayo et al., 2020). Also, in another study to diagnose the presence of delirium in 506 patients admitted in a hospital in Tanzania, 18.7% (95/506) had dementia (Paddick et al., 2018). Although the frequencies reported in these studies do not reflect the prevalence in the general population, they are useful in assessing the evidence-based information on the effect of various combinations of neurocognitive disorders.

Combination of dementia with neuropsychological problems increases mortality rate in Tanzania aged population. Evidence suggests that for people living with dementia (PwD), a combination of age and neuropsychiatric disorders increase mortality. The sampled population of rural northern Tanzania by Longdon *et al*. (2013) was followed to assess their mortality for a period of four years, with mortality rates being recorded and compared against different levels of dementia severity. Their age- gender- education-adjusted results reported the hazard ratio of 6.33 (95% CI 3.19–12.58) for dementia and 3.57 (95% CI 1.64–7.79) for mild cognitive impairment respective to people without an impaired cognitive state. Mortality rates were also highly recorded in subjects with vascular dementia (Paddick, Kisoli, et al., 2015). The same study laid out a set of frequencies of neuropsychiatric disorders from 78 study participants. Of 78 PwD, 69 (88.4 per cent) reported at least one present behavioural and psychological symptoms, with 40 (51.3 per cent) having three or more symptoms, and anxiety (47.4 per cent), agitation/aggression (38.5 per cent), night-time behavioural illness (34.6 per cent), irritability (33.3 per cent) and depression being the most common symptoms reported (33.3 per cent) (Paddick, Kisoli, et al., 2015).

Generally, the prevalence of dementia in Tanzania corresponds to results from high-income countries (HICs) reported by the 10/66 research group (Fig.1).

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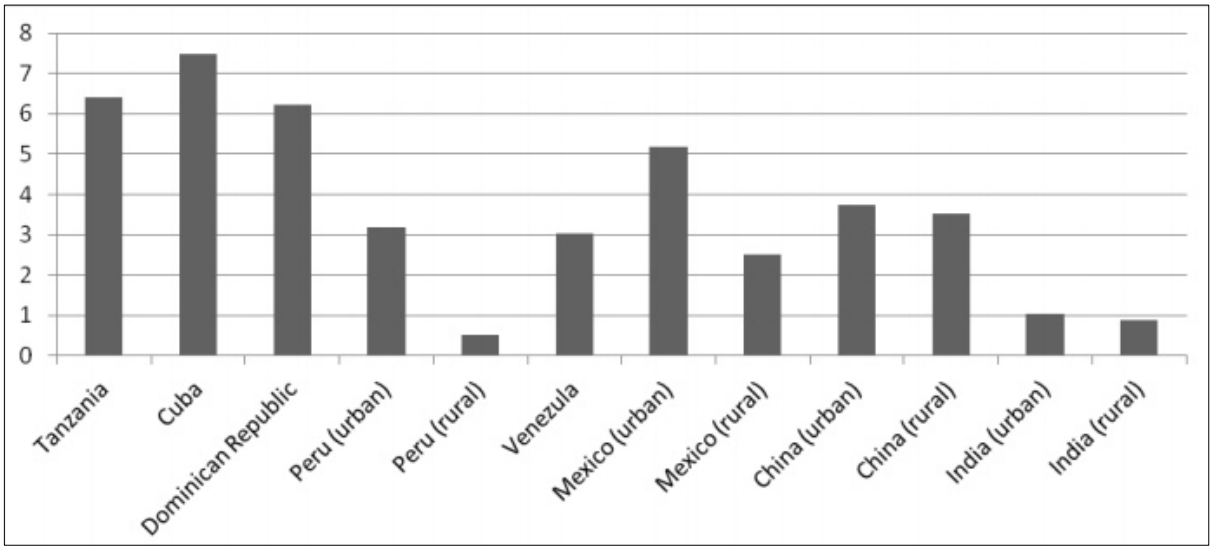
Figure 1.

Age-standardised prevalence of Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) dementia in Hai, rural Tanzania compared to results from the 10/66 dementia research groups.



Note. Data reproduced from studies (Paddick, Kisoli, et al., 2015; Piovezan et al., 2020).

The disability-adjusted life years (DALYs) of Alzheimer's disease and other dementias, in Tanzania, for 65+ aged population, are estimated to contribute to 2.19% of the disease burden 2019 (Global Burden of Disease Collaborative Network, 2020). Moreover, in evaluating the burden in caregivers' terms, a survey has reported caregivers declared burdens of caring (Mushi et al., 2014).

Possible risks factors and challenges

The first risk factor observed in the Tanzanian context is age. As age progresses, the risk of Alzheimer's disease, vascular dementia and many other dementias rises drastically (Adebayo et al., 2020; Paddick et al., 2018; Paddick, Gray, et al., 2015; Paddick, Longdon, Kisoli, et al., 2014; Paddick, Mkenda, et al., 2015).

The second risk factor is gender. Females are at higher risk than males (Gureje, Ogunniyi, Kola, & Abiona, 2011; Heward et al., 2018; Paddick et al., 2013; Paraïso et al., 2011).

The third risk factor is the level of education. Evidence indicates that low literacy levels were substantially correlated with higher chances of having probable dementia (Heward et al., 2018; Mushi et al., 2014; Paddick, Longdon, Gray, et al., 2014).

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The fourth risk factor is a cardiovascular problem related to high blood pressure and diabetes. Through data gathered and analysed in Tanzania, it was reported that higher systolic blood pressure could be potentially preventive against dementia (Gray et al., 2017). Moreover, diabetes has been linked to increased chances of having vascular dementia (Paddick, Longdon, Kisoli, et al., 2014).

The last risk factor is mild cognitive impairment. It has been established that human immunodeficiency virus (HIV)–associated neurocognitive disorder (HAND) is triggered when individuals are socially isolated (Eaton et al., 2020). More on the subject, the recent study by Paddick et al. (2020) accounted for HAND prevalence in Tanzania. Their research has conclusively shown that there has been a reduction in HAND prevalence of 62% in 2018 and 54% in 2019 for combination antiretroviral therapy-treated patients.

The recognisable risk factors aid in structuring the interventions that can be employed in reducing the dementia burden. For instance, focusing assistance on female aged population with cardiovascular and mild cognitive disorders because they are positively affected compared to their male counterparts. In most cases, preventive strategies of dementia depend on avoidable risk factors. This is possible since it has been reported that, the avoidable risk factors contribute to high risk of dementia in LMIC as compared to the global average (Mukadam, Sommerlad, Huntley, & Livingston, 2019). Nevertheless, in the contexts of presented risk factors, Tanzania is faced with various limitations. First, the limited 65+ aged population size with limited local settings in available evidence-based results. All studies mentioned above only sampled less than 1,500 study participants in a limited number of hospitals or local settings. Second, the conditions studied upon might be inadequately represented in a country with 1.6 million 65+ aged population. Therefore, devised mental health interventions might not be useful under these circumstances (Lloyd-Sherlock & Amoakoh-Coleman, 2020).

Current services and approaches in place to dealing with dementia in Tanzania

In system governance, there is a legally endorsed mental health policy plan, approved in 2016, containing specified indicators and targets against which its implementation can be monitored. The elements of the public wellbeing initiative include, first, the transfer of care and funding from mental hospitals to neighbourhood mental health facilities. Second, the incorporation of programs for mental health into primary care. A dedicated law on mental health, introduced in 2008, exists and recently amended. Other regulations also cover legal requirements for mental health (World Health Organization, 2018).

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In financing systems, mental health expenditures by the government are 4% of the total health budget (World Health Organization, 2018).

In mental health care, Table 1 and 2 show the available mental services and workforce.

Table 1.

Mental health facilities in Tanzania.

	Total number of facilities	Population (per 100,000)
Mental health out-patient facilities	124	0.28
Day treatment facilities	1	0.002
Psychiatry beds in general	662	1.47
Community residential facilities	Data not available	Data not available
Beds/places in community residential facilities	362	0.8
Mental hospitals	1	0.002
Beds in a mental hospital	700	1.55

Note. Data from 2017 Mental Health Atlas (World Health Organization, 2018).

Table 2.

The available mental health workforce in Tanzania.

	Health professionals working in the mental health sector (per 100,000)	Training of health professions in educational institutions (per 100,000)
Psychiatrists	0.06	0.0004
Medical doctors not specialised in psychiatry	0.01	0.78
Mental health nurse	0.36	4.62
Psychologists	0.01	0.01
Social workers	0.06	Data not available
Occupational therapists	0.02	Data not available
Other health workers	Data not available	Data not applicable

Note. Data from 2017 Mental Health Atlas (World Health Organization, 2018).

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Review

Public understanding of dementia in the general population

Tanzania public understanding on dementia is discussed according to the World Health Organisation (WHO) global action plan on the public health response to dementia (GAPD) 2017-2025; increasing dementia recognition and prioritisation, reducing the risk of dementia, diagnosis, prevention and care, assisting dementia caregivers, improving dementia information systems, and research and creativity (World Health Organization, 2017). There is a general lack of knowledge and comprehension of dementia that results in stigmatisation, diagnosis and treatment challenges, and physical, psychological and economic effects on patients, communities and populations.

Although mental health policy is incorporated in the national health plan, dementia is given less public priority (*id est* on 4% of the total health budget). As a result, Tanzanians view dementia as a regular part of the ageing process – "old people disease" and are not sure of the causes of dementia (Mushi et al., 2014). Also, there are neither public awareness campaigns nor programmes of raising awareness on dementia.

For reliable and straightforward dementia diagnosis in Tanzania settings, there is proposed use of CSID in East Africa for non-specialised personnel (Chen et al., 2010). The CSID has been proved to be highly effective in detecting dementia (Dotchin et al., 2014). Another study assessed 207 elderly individuals aged 60+ using Identification and Intervention for Dementia in Elderly Africans (IDEA) as another alternative for a cognitive screen test and reported its efficacy (receiver operating characteristic curve of 0.92) in detecting dementia (Paddick, Gray, et al., 2015). A different and more reliable diagnosis, dementia screening mobile application for non-specialist workers in rural Tanzania has been recently recommended (Paddick et al., 2020). The mobile app ideally incorporates IDEA cognitive screening functions. In contrast, dementia and cognitive disability screening in LMICs rely mainly on HIC-adapted tools; in these contexts, these frequently lack validation due to low literacy and preconceived cultural ideas (Magklara, Stephan, & Robinson, 2019).

Moreover, treatment and care for PwD has been highly dependent on traditional and spiritual healing. A study by Hindley *et al*. (2016) found three themes associated with traditional and spiritual wellbeing. First, healers' conceptualisation of dementia as a natural part of the course of ageing and little knowledge of dementia as a particular disorder. Second, PwD and carer reasons for seeking help and experiences of treatment and the role of prayers, plants and witchcraft in diagnosis and treatment. Lastly, the willingness to work with hospital allopathic programs. Traditional healers and PwD shared concern over the partnership with western healers. Similar beliefs were reported by (Mushi et al., 2014). Hence spiritual and

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traditional healers can be involved in recognising PwD (Hindley et al., 2016). Caregivers of PwD in Tanzania settings have reported their sufferings during the caring (Mushi et al., 2014; Paddick, Kisoli, et al., 2015).

What is the gap/need?

First, the government should increase the mental health funding on the total budget in health expenditure.

Second, there is a need to add more workforce in order to deal with the issue of limited specialised workforce (Patel et al., 2018). Despite the delayed progress, there have been some improvements in mental health professional workforce from 2011 to 2017 Mental Atlas reports; in terms of the psychiatrist, 0.01 to 0.06, mental health nurses 0 to 0.36, psychologists 0.001 to 0.01, and occupational therapist 0.009 to 0.02 (Table 2).

Third, further research is needed to devise the best possible models that can work in LMIC settings because models developed in HIC are evidenced to hardly work in LMIC (Stephan et al., 2020). The research should be expanded to more comprehensive Tanzania settings.

Lastly, for efficiently managing the challenging behaviour of PwD, new interventions, such as Cognitive Stimulation Therapy (CST), currently under research, should be considered for use. There is evidence from randomised trials in the U.K. that this may have a comparable effect on cognition enhancement with cholinesterase inhibitors; recently performed controlled CST study in Tanzania that found that this was possible and showed cognitive benefits (Stoner et al., 2020).

The SDGs addressed

According to the social determinants of global mental health addressed in *The Lancet*'s Commission on global mental health and sustainable development (Patel et al., 2018), the Tanzania dementia-related SDGs and targets apply SDG 3 – good health and wellbeing, target 3·8. They state that "*countries should achieve universal health coverage, including financial risk protection, access to quality essential healthcare services and access to safe, effective, quality and affordable essential medicines and vaccines for all*". This statement still aligns with the 2016 Tanzania Mental Health Policy. More implementations align with SDG 16: peace, justice and strong institutions reflecting human rights for PwD.

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The impact of the COVID-19 pandemic

The gaps discussed are still applicable during COVID-19 pandemic as numerous implementational and research activities are affected by the pandemic. Globally, cases and deaths due to COVID-19 seem to remarkably correspond to the burden of dementia (Azarpazhooh et al., 2020).

Although there is limited number of studies in Tanzania, reports on the impact of COVID-19 from LMICs have shown that governments need to focus their attention to geriatric populations in order to fix the impaired social cohesion (social and task relations, social unity, and emotions) (De Sousa, Mohandas, & Javed, 2020). Besides, in accessing caregivers experience, in India during the pandemic, relatives of PwD faced several specific challenges that specifically contribute to their position in providing care and another set of concerns that do not directly relate to their role in providing care (Vaitheswaran, Lakshminarayanan, Ramanujam, Sargunan, & Venkatesan, 2020).

Conclusion

In general, therefore, it seems that while dementia has a significant effect on cognitive capacity and functionality, there is a high burden on caregivers of behavioural and psychological symptoms, complex attitudes towards dementia within the population and may seem inconsistent at first glance. Many carers and community members regard dementia as a natural part of ageing and see the care they give as an inevitable part of caring for an elderly relative for their relative. However, if the disorder is followed by apparent behavioural abnormalities, some people interpret the illness in the light of conventional health beliefs such as witchcraft. In such instances, dementia, even with the whole family, is particularly stigmatising, and PwD are often concealed with no social interaction. Moreover, the current approaches in solving dementia disorders from the 2020 World Alzheimer's Report – designing for PwD (Fleming, Zeisel, & Bennett, 2020) could be employed for further changes.

Additionally, in raising public awareness of dementia, Tanzania should consider increasing the budget for mental health yearly, fund researchable interventions aiming at modelling strategies focusing on dementia disorders and seeking technical support from WHO and member states and international associations. There should be available dementia information systems with a shared database to promote research, although challenges in following up and accomplishing the plans are acknowledged widely. Interventions targeting caregivers, during the COVID-19 pandemic of PwD should be sensible, practical and multi-

layered for the caregivers during the pandemic, and should consider both their immediate and long-term concerns (Vaitheswaran et al., 2020).

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References

Adebayo, P. B., Aziz, O. M., Mwakabatika, R. E., Makakala, M. C., Mazoko, M. C., Adamjee, S. M., … Aris, E. (2020). Out-patient neurological disorders in Tanzania: Experience from a private institution in Dar es Salaam. *ENeurologicalSci*, *20*, 100262. https://doi.org/10.1016/j.ensci.2020.100262

Azarpazhooh, M. R., Amiri, A., Morovatdar, N., Steinwender, S., Rezaei Ardani, A., Yassi, N., … Di Napoli, M. (2020). Correlations between COVID-19 and burden of dementia: An ecological study and review of literature. *Journal of the Neurological Sciences*, *416*, 117013. https://doi.org/10.1016/j.jns.2020.117013

Chao, F., Gerland, P., Cook, A. R., & Alkema, L. (2019). Systematic assessment of the sex ratio at birth for all countries and estimation of national imbalances and regional reference levels. *Proceedings of the National Academy of Sciences*, *116*(19), 9303–9311. https://doi.org/10.1073/pnas.1812593116

Chen, C.-H., Mizuno, T., Elston, R., Kariuki, M. M., Hall, K., Unverzagt, F., … Kalaria, R. N. (2010). A comparative study to screen dementia and APOE genotypes in an ageing East African population. *Neurobiology of Aging*, *31*(5), 732–740. https://doi.org/10.1016/j.neurobiolaging.2008.06.014

De Sousa, A., Mohandas, E., & Javed, A. (2020). Psychological interventions during COVID-19: Challenges for low and middle income countries. *Asian Journal of Psychiatry*, *51*, 102128. https://doi.org/10.1016/j.ajp.2020.102128

Dotchin, C., Paddick, S.-M., Gray, W., Kisoli, A., Kisima, J., Mbowe, G., … Walker, R. (2014). VALIDATION OF A BRIEF DEMENTIA SCREENING INSTRUMENT IN 100 CONSECUTIVE ELDERLY INPATIENTS AND OUT-PATIENTS IN NORTHERN TANZANIA: THE IDEA (IDENTIFICATION AND INTERVENTIONS FOR DEMENTIA IN ELDERLY AFRICANS) STUDY. *Alzheimer's & Dementia*, *10*, P373–P374. https://doi.org/10.1016/j.jalz.2014.05.435

Eaton, P., Lewis, T., Kellett-Wright, J., Flatt, A., Urasa, S., Howlett, W., … Paddick, S. (2020). Risk factors for symptomatic HIV -associated neurocognitive disorder in adults aged 50 and over attending a HIV clinic in Tanzania. *International Journal of Geriatric Psychiatry*, *35*(10), 1198–1208. https://doi.org/10.1002/gps.5357

Fleming, R., Zeisel, J., & Bennett, K. (2020). *World Alzheimer Report 2010: Design, Dignity, Dementia: Dementia-related design and the built environment Volume 2: Case Studies*. London, England.

George-Carey, R., Adeloye, D., Chan, K. Y., Paul, A., Kolčić, I., Campbell, H., & Rudan, I. (2012). An estimate of the prevalence of dementia in Africa: A systematic analysis. *Journal of Global Health*, *2*(2). https://doi.org/10.7189/jogh.02.020401

Global Burden of Disease Collaborative Network. (2020). Global Burden of Disease Study 2019 (GBD 2019) Results. Retrieved January 8, 2020, from http://ghdx.healthdata.org/gbd-results-tool.

Gray, W. K., Paddick, S.-M., Collingwood, C., Dotchin, C., Kisoli, A., Mbowe, G., … Walker, R. (2017). SYSTOLIC BLOOD PRESSURE AND COGNITIVE IMPAIRMENT IN A TANZANIAN POPULATION: IS HYPERTENSION PROTECTIVE AGAINST DEMENTIA IN THE ELDERLY?

Alzheimer's & Dementia, *13*(7S_Part_22), P1048–P1048. https://doi.org/10.1016/j.jalz.2017.06.1489

Gureje, O., Ogunniyi, A., Kola, L., & Abiona, T. (2011). Incidence of and risk factors for dementia in the Ibadan study of aging. *Journal of the American Geriatrics Society*, *59*(5), 869–874.

Heward, J., Stone, L., Paddick, S.-M., Mkenda, S., Gray, W. K., Dotchin, C. L., … Walker, R. W. (2018). A longitudinal study of cognitive decline in rural Tanzania: rates and potentially modifiable risk factors. *International Psychogeriatrics*, *30*(9), 1333–1343. https://doi.org/10.1017/S1041610217002861

Hindley, G., Kissima, J., L. Oates, L., Paddick, S.-M., Kisoli, A., Brandsma, C., … Dotchin, C. L. (2016). The role of traditional and faith healers in the treatment of dementia in Tanzania and the potential for collaboration with allopathic healthcare services: Table 1. *Age and Ageing*. https://doi.org/10.1093/ageing/afw167

Kilonzo, G. P., & Simmons, N. (1998). Development of mental health services in Tanzania: A reappraisal for the future. *Social Science and Medicine*, *47*(4), 419–428. https://doi.org/10.1016/S0277-9536(97)10127-7

Lloyd-Sherlock, P., & Amoakoh-Coleman, M. (2020). A critical review of intervention and policy effects on the health of older people in sub-Saharan Africa. *Social Science & Medicine*, *250*, 112887. https://doi.org/10.1016/j.socscimed.2020.112887

Longdon, A. R., Paddick, S.-M., Kisoli, A., Dotchin, C., Gray, W. K., Dewhurst, F., … Walker, R. (2013). The prevalence of dementia in rural Tanzania: a cross-sectional community-based study. *International Journal of Geriatric Psychiatry*, *28*(7), 728–737. https://doi.org/10.1002/gps.3880

Magklara, E., Stephan, B. C. M., & Robinson, L. (2019). Current approaches to dementia screening and case finding in low- and middle-income countries: Research update and recommendations. *International Journal of Geriatric Psychiatry*, *34*(1), 3–7. https://doi.org/10.1002/gps.4969

Mavrodaris, A., Powell, J., & Thorogood, M. (2013). Prevalences of dementia and cognitive impairment among older people in sub-Saharan Africa: a systematic review. *Bulletin of the World Health Organization*, *91*(10), 773–783. https://doi.org/10.2471/BLT.13.118422

Ministry of Health. (2020). Tanzania National Health Portal. Retrieved January 5, 2021, from https://hmisportal.moh.go.tz/hmisportal/#/dashboards/routine/hmisportal_hwJNMC3LrPd

Mukadam, N., Sommerlad, A., Huntley, J., & Livingston, G. (2019). Population attributable fractions for risk factors for dementia in low-income and middle-income countries: an analysis using cross-sectional survey data. *The Lancet Global Health*, *7*(5), e596–e603. https://doi.org/10.1016/S2214-109X(19)30074-9

Mushi, D., Rongai, A., Paddick, S.-M., Dotchin, C., Mtuya, C., & Walker, R. (2014). Social representation and practices related to dementia in Hai District of Tanzania. *BMC Public Health*, *14*(1), 260. https://doi.org/10.1186/1471-2458-14-260

National Bureau of Statistics. (2003). *The 2002 Population and Housing Census, General Report*. Dar es Salaam, Tanzania.

National Bureau of Statistics, & Ministry of Finance and Planning. (2018). *National Population Projections*. Dar es Salaam, Tanzania.

Paddick, S.-M., Kisoli, A., Longdon, A., Dotchin, C., Gray, W. K., Chaote, P., … Walker, R. (2015). The prevalence and burden of behavioural and psychological symptoms of dementia in rural Tanzania. *International Journal of Geriatric Psychiatry*, *30*(8), 815–823. https://doi.org/10.1002/gps.4218

Paddick, S., Holmes, S., Ranasinghe, S., Mukaetova-Ladinska, E., Gray, W. K., Urasa, S., … Walker, R. (2020). HIV-associated neurocognitive disorders (HAND) in a cART-treated cohort of adults aged 50 and over in Kilimanjaro, Tanzania: The first longitudinal follow-up study of HAND in an older population in sub-Saharan Africa. *Alzheimer's & Dementia*, *16*(S6). https://doi.org/10.1002/alz.041971

Paddick, S.M., Lewis, E. G., Duinmaijer, A., Banks, J., Urasa, S., Tucker, L., … Walker, R. W. (2018). Identification of delirium and dementia in older medical inpatients in Tanzania: A comparison of screening and diagnostic methods. *Journal of the Neurological Sciences*, *385*, 156–163. https://doi.org/10.1016/j.jns.2017.12.006

Paddick, Stella-Maria, Gray, W. K., Ogunjimi, L., Lwezuala, B., Olakehinde, O., Kisoli, A., … Ogunniyi, A. (2015). Validation of the Identification and Intervention for Dementia in Elderly Africans (IDEA) cognitive screen in Nigeria and Tanzania. *BMC Geriatrics*, *15*(1), 53. https://doi.org/10.1186/s12877-015-

0040-1

Paddick, Stella-Maria, Longdon, A., Gray, W. K., Dotchin, C., Kisoli, A., Chaote, P., & Walker, R. (2014). The association between educational level and dementia in rural Tanzania. *Dementia & Neuropsychologia*, *8*(2), 117–125. https://doi.org/10.1590/S1980-57642014DN82000006

Paddick, Stella-Maria, Longdon, A., Kisoli, A., Gray, W. K., Dotchin, C. L., Jusabani, A., … Walker, R. W. (2014). The Prevalence of Dementia Subtypes in Rural Tanzania. *The American Journal of Geriatric Psychiatry*, *22*(12), 1613–1622. https://doi.org/10.1016/j.jagp.2014.02.004

Paddick, Stella-Maria, Longdon, A. R., Kisoli, A., Dotchin, C., Gray, W. K., Dewhurst, F., … Walker, R. (2013). Dementia prevalence estimates in sub-Saharan Africa: comparison of two diagnostic criteria. *Global Health Action*, *6*(1), 19646. https://doi.org/10.3402/gha.v6i0.19646

Paddick, Stella-Maria, Mkenda, S., Mbowe, G., Kisoli, A., Gray, W. K., Dotchin, C., … Ogunniyi, A. (2015). Cognitive stimulation therapy (CST) as a sustainable intervention for dementia in low-resource settings: Results of a controlled trial in rural tanzania. *Alzheimer's & Dementia*, *11*(7S_Part_7), P322–P322. https://doi.org/10.1016/j.jalz.2015.07.463

Paddick, Stella-Maria, Yoseph, M., Gray, W. K., Andrea, D., Barber, R., Colgan, A., … Walker, R. W. (2020). Effectiveness of App-Based Cognitive Screening for Dementia by Lay Health Workers in Low Resource Settings. A Validation and Feasibility Study in Rural Tanzania. *Journal of Geriatric Psychiatry and Neurology*, 089198872095710. https://doi.org/10.1177/0891988720957105

Paddick, Stella Maria, Kisoli, A., Dotchin, C. L., Gray, W. K., Chaote, P., Longdon, A., & Walker, R. W. (2015). Mortality rates in community-dwelling Tanzanians with dementia and mild cognitive impairment: A 4-year follow-up study. *Age and Ageing*, *44*(4), 636–641. https://doi.org/10.1093/ageing/afv048

Paraïso, M. N., Guerchet, M., Saizonou, J., Cowppli-Bony, P., Mouanga, A. M., Nubukpo, P., … Houinato, D. S. (2011). Prevalence of dementia among elderly people living in Cotonou, an urban area of Benin (West Africa). *Neuroepidemiology*, *36*(4), 245–251.

Patel, V., Saxena, S., Lund, C., Thornicroft, G., Baingana, F., Bolton, P., … UnÜtzer, Jü. (2018). The Lancet Commission on global mental health and sustainable development. *The Lancet*, *392*(10157), 1553–1598. https://doi.org/10.1016/S0140-6736(18)31612-X

Piovezan, R. D., Oliveira, D., Arias, N., Acosta, D., Prince, M. J., & Ferri, C. P. (2020). Mortality Rates and Mortality Risk Factors in Older Adults with Dementia from Low- and Middle-Income Countries: The 10/66 Dementia Research Group Population-Based Cohort Study. *Journal of Alzheimer's Disease*, *75*(2), 581–593. https://doi.org/10.3233/JAD-200078

Prince, M., Bryce, R., Albanese, E., Wimo, A., Ribeiro, W., & Ferri, C. P. (2013). The global prevalence of dementia: A systematic review and metaanalysis. *Alzheimer's & Dementia*, *9*(1), 63-75.e2. https://doi.org/10.1016/j.jalz.2012.11.007

Stephan, B. C. M., Pakpahan, E., Siervo, M., Licher, S., Muniz-Terrera, G., Mohan, D., … Prina, M. (2020). Prediction of dementia risk in low-income and middle-income countries (the 10/66 Study): an independent external validation of existing models. *The Lancet Global Health*, *8*(4), e524–e535. https://doi.org/10.1016/S2214-109X(20)30062-0

Stoner, C. R., Chandra, M., Bertrand, E., D.U., B., Durgante, H., Klaptocz, J., … Spector, A. (2020). A New Approach for Developing "Implementation Plans" for Cognitive Stimulation Therapy (CST) in Low and Middle-Income Countries: Results From the CST-International Study. *Frontiers in Public Health*, *8*. https://doi.org/10.3389/fpubh.2020.00342

United Nations Department of Economic and Social Affairs Population Division. (2019). *World Population Prospects: The 2019 Revision*.

Vaitheswaran, S., Lakshminarayanan, M., Ramanujam, V., Sargunan, S., & Venkatesan, S. (2020). Experiences and Needs of Caregivers of Persons With Dementia in India During the COVID-19 Pandemic—A Qualitative Study. *The American Journal of Geriatric Psychiatry*, *28*(11), 1185–1194. https://doi.org/10.1016/j.jagp.2020.06.026

World Health Organization. (2001). *The World Health Report 2001: Mental health: new understanding, new hope*. World Health Organization.

 doi:10.20944/preprints202106.0522.v1

World Health Organization. (2017). *Global action plan on the public health response to dementia 2017 - 2025*. *Geneva: World Health Organization*.

World Health Organization. (2018). *Mental Health Atlas 2017*. Geneva, Switzerland.

World Health Organization. (2020). World Health Organization Global Health Expenditure database. Retrieved January 8, 2021, from http://apps.who.int/nha/database