Prevalence estimates of dementia in older adults in rural Kilimanjaro 2009–2010 and 2018–2019: is there evidence of changing prevalence?

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Abstract

Introduction: Although limited, existing epidemiological data on dementia in sub-Saharan Africa indicate that prevalence may be increasing; contrasting with recent decreases observed in high-income countries. We have previously reported the age-adjusted prevalence of dementia in rural Tanzania in 2009–2010 as 6.4% (95% confidence interval [CI] 4.9–7.9) in individuals aged ≥70 years. We aimed to repeat a community-based dementia prevalence study in the same setting to assess whether prevalence has changed.

Methods: This was a two-phase door-to-door community-based cross-sectional survey in Kilimanjaro, Tanzania. In Phase I, trained primary health workers screened all consenting individuals aged ≥60 years from 12 villages using previously validated, locally developed, tools (IDEA cognitive screen and IDEA Instrumental Activities of Daily Living questionnaire). Screening was conducted using a mobile digital application (app) on a hand-held tablet. In Phase II, a stratified sample of those identified in Phase I were clinically assessed using the DSM-5 criteria and diagnoses subsequently confirmed by consensus panel.

Results: Of 3011 people who consented, 424 screened positive for probable dementia and 227 for possible dementia. During clinical assessment in Phase II, 105 individuals met DSM-5 dementia criteria. The age-adjusted prevalence of dementia was 4.6% (95% CI 2.9–6.4) in those aged ≥60 years and 8.9% (95% CI 6.1–11.8) in those aged ≥70 years. Prevalence rates increased significantly with age.

Conclusions: The prevalence of dementia in this rural Tanzanian population appears to have increased since 2010, although not significantly. Dementia is likely to...
INTRODUCTION

Dementia is a global health priority with an estimated 47 million people affected, 58% of whom live in low and middle-income countries (LMICs). The prevalence of dementia varies across world regions and a degree of this variation is attributed to potentially modifiable risk factors.

Evidence from some, but not all world regions, especially high-income countries, suggests that the age-adjusted prevalence of dementia may be falling, a change attributed to better management of dementia risk factors, such as hypertension.

In sub-Saharan Africa (SSA), epidemiological data on dementia have been limited and only recently have sufficient data been available to allow meta-analysis of prevalence with acceptable precision. However, it is not clear to what extent this reflects refinements of research methodology and culture-specific dementia assessment. Demographic transition and population ageing estimates indicate that the SSA population aged ≥60 years will increase from 43 million in 2010 to 67 million by 2025. Alongside this, there have been rapid increases in the prevalence of vascular risk factors for dementia in much of SSA and a gap in healthcare provision, particularly for non-communicable diseases (NCDs).

In a study conducted in 2009–2010 we have reported the community prevalence of dementia in rural Tanzania to be 7.5% (6.4% age-adjusted) in individuals aged ≥70 years using a two stage door-to-door study design. We aimed to repeat a community-based dementia prevalence estimate in the same setting using a similar methodology to assess whether prevalence has increased in this setting during the intervening 9 years.

MATERIALS AND METHODS

Setting

The study was conducted in the Hai demographic surveillance site (DSS), located in the Kilimanjaro region of Tanzania. Tanzania is a low-income country (Gross National Income: $1020 in 2018) where life expectancy at birth is 64 years and 3% of the population are aged 65 years and over. The Hai DSS is a well-demarcated area with a highly organised village structure facilitating epidemiological research and follow-up. There is substantial local experience in NCD research and regular census completion since 1994. The main languages spoken are Kiswahili (official language of Tanzania) and Kichagga (a local tribal language) and the economy is based around subsistence farming, with cash crops, such as coffee and tomatoes, grown by those with more fertile land. Levels of illiteracy are high in older adults reflecting a previous lack of available schooling, and levels of population mobility are low, with most of the population being lifelong residents of Hai.

Ethics and consent

A favourable ethical opinion was received from the Tanzanian National Institute of Medical Research and the Kilimanjaro Christian Medical University College Research Ethics Committee in Tanzania. For each participant, verbal information was provided about the aims of the study and the implications of taking part. An information sheet was read aloud, and written information made available for those preferring written materials. Participants were also given the opportunity to ask questions. Consent was then obtained by signature or thumbprint, depending on literacy status. Where capacity to consent was in doubt due to cognitive impairment, assent was sought from a close relative and assessments completed if the participant appeared willing to do so. Onward referral, and access to treatment (cognitive stimulation therapy and/or carer education) for those identified as having dementia was a key element of the study protocol.

Study design

We conducted a census-based two-stage door-to-door community prevalence study using a similar (but not identical) design to that used for our 2009–2010 study. Eligible participants aged ≥60 years underwent screening for dementia in phase I and a subsequent sample, stratified for screening performance, underwent detailed clinical examination for dementia by DSM-5 criteria in phase II. In contrast to the 2010 study (where participants were aged ≥70 years), a cut-off of ≥60 years was selected to ensure that...
younger-onset cases were not missed and to allow comparability with other studies.

2.4 | Recruitment and timing

Twelve villages were randomly selected from the 80 within Hai DSS, with stratification for high zone, middle zone and low zone (depending on their position on the slopes of Mount Kilimanjaro). Soil is generally more fertile in high zone villages and this may result in a slightly higher economic status due to availability of cash crops. This stratification helped ensure that the selected villages were representative of the wider DSS. The census was conducted by enumerators with support from Hai District Medical Office. Enumerators are people resident within individual village communities trained and experienced in collecting census and epidemiological research data. Within the DSS, villages are organised into 10-household groups (balozi) with an elected leader holding office for 5 years and reporting to the village committee. Census data are collected with assistance from the balozi leader identifying all locally-resident individuals.

Phase I screening data were collected between 9th March and 28th July 2018 and phase II clinical assessment data between 13th March 2018 and 26th April 2019.

3 | PHASE I COGNITIVE SCREENING

3.1 | Data collection and management

Census and Phase I cognitive screening data were collected during a single visit using a mobile digital application (app) developed in Open Data Kit (ODK) software on a hand-held tablet device. People identified as aged ≥60 years, and who consented to screening, were assigned an identification number and underwent cognitive screening in their homes or at a local health facility, according to their mobility status. As part of the census, demographic data (age, sex, occupation and education level) were collected. Determination of age is recognised to be challenging in rural SSA elders who may lack formal identification documents. Age was calculated from year of birth and triangulated using a table of historical events, alongside ages at marriage and of first child (see online materials for table used). This method is well-validated in SSA.19–21

Data from the tablets were uploaded weekly to a secure, encrypted server, held locally at the Kilimanjaro Clinical Research Institute. Weekly data quality checks were conducted (William K. Gray, Jane Rogathi). Prior to study commencement, enumerators were trained in administration of the dementia screening measures at a 2-day workshop organised by our team. Training included practical sessions with the opportunity to obtain support and feedback. The screening forms had a full translation of all instructions and options for data collection in English or Kiswahili, with modifications made following the initial workshop in response to feedback on the clarity of the instructions. All enumerators spoke both Kiswahili and Kichagga and translated verbally to participants who had Kichagga as a first language.

Screening was overseen and organised by senior research clinicians experienced in previous Hai DSS surveys and resident in the local area (John Kissima, Aloyce Kisoli) with one-to-one support offered for initial visits where necessary (usually for those lacking confidence in computer tablet use).

3.2 | Cognitive screening

Those who consented, were screened using the IDEA cognitive screen, previously validated in low-literacy populations in Tanzania and elsewhere in LMIC countries.22–25 The screen was developed from the community screening instrument for dementia (CSI-D)26 alongside a version of the CERAD 10-word list, extensively validated in LMIC settings27 and a matchstick construction task previously validated in Nigeria.28

A brief version of the IDEA instrumental activities of daily living questionnaire (IDEA-IADL) for Tanzania was also administered.29,30 The brief questionnaire has three questions that are asked to an informant who knows the participant well. Each question is scored as 0 (cannot do), 1 (can do with assistance) and 2 (can do easily), giving a total possible score of six in those with no IADL problems.

4 | PHASE II ASSESSMENT

4.1 | Stratification for dementia assessment

Screening performance was stratified according to the combined performance in the IDEA cognitive screen and the IDEA-IADL questionnaire in those with an informant (score 0–10: classified as impaired ‘probable dementia’, score 11–13: classified borderline ‘possible dementia’, score 14–21: classified normal ‘no dementia’).29 In those without an informant, stratification was based only on performance in the IDEA cognitive screen (score 0–7: ‘probable dementia’, score 8–9: ‘possible dementia’, score 10–15: ‘no dementia’) (22,24). A list of all those screening as impaired or ‘probable dementia’, a random sample of 50% screening as borderline or ‘possible dementia’ and a random sample of 10% screening as normal or ‘no dementia’ was produced using a random number generator. We aimed to see as many people on the list as possible. The phase II assessment team were given the list in numerical order by village, with no indication which screening category participants fell into and blind to the screening score.

4.2 | Data collection

Data for full clinical dementia assessments were collected by Marcela Yoseph (a Tanzanian doctor) and Robyn Barber and Aoife Colgan (UK medical students) locally supervised by Damas Andrea (a Tanzanian psychiatrist). Phase II assessment was based on the
DSM-5 criteria and included a repeat paper-and-pencil IDEA cognitive screen, structured informant history, bedside cognitive examination, neurological examination, 15-item Geriatric Depression Scale and structured mental state examination previously used in other Tanzanian studies.31 Blood pressure was measured with the participant sitting after 5 min rest and three measures taken using an automated cuff. Hypertension was defined as a mean systolic BP of ≥140 mmHg systolic or ≥90 diastolic. Clinicians also documented free-text responses to clinical questioning to exclude non-dementia causes of cognitive impairment and produced a written case summary indicating provisional diagnosis and reasoning. A selection of individuals was reviewed clinically by DA, to confirm provisional diagnoses, and complete case summaries were subsequently reviewed (Stella-Maria Paddick, Richard W Walker and Catherine Dotchin) to confirm that the DSM-5 criteria had been met in those with a provisional dementia diagnosis.

4.3 Statistical analysis

Statistical analyses were supported by IBM SPSS for Windows version 21 (IBM Corp) and SAS (SAS Institute Inc). Descriptive statistical analysis used standard summary measures depending on the nature of the data. Prevalence was calculated using the reciprocal of the proportion of all participants seen within each of the three screening strata (no dementia, possible dementia, probable dementia) and multiplying this by the number of cases actually diagnosed in the stratum. These were then summed to give an estimated number of cases. Dividing by the total population aged 60 years and over, gave the prevalence estimate. The process was repeated for males and females, for 5-year age bands and for educational level (no formal education, 0–4 years of primary school, 5–7 years of primary school and secondary school/higher education) to estimate prevalence within each of these sub-groups. Age standardisation was by the direct method to the 1995/2003 WHO standard population, allowing direct comparison with our previous prevalence study and other published research.32 Confidence intervals (CIs) were calculated using the PROC SURVEYMEANS protocol in SAS, with stratification for the sampling fraction using the jack-knife method.

Multivariable logistic regression modelling was used to investigate factors associated with the presence of dementia in those assessed in Phase II. Age band, sex and education were included in the model. Data for occupation are presented, but not included in the model as not having an occupation was thought likely to be as much an effect of dementia as a cause. The model robustness and validity was assessed by investigation of residual patterns, eigenvalues and tolerance.

5 RESULTS

The census population of the 12 selected villages was 28,236, of whom 3122 (11.1%) were aged ≥60 years. Villages selected included one selected for the 2009/2010 study and one newly-created village within the boundaries of a second village included in 2009/10. Of these, 3011 (96.4%) consented and were screened for dementia. Of those screened, 1337 (44.4%) had an informant. The median age of those with an informant was 72 years (IQR 65 to 80) and of those without an informant was 69 years (IQR 64–76); this difference was significant (z = 6.302, p < 0.001). Of those with an informant, 783 (58.6%) were female and of those without an informant 943 (56.3%) were female; this difference was not significant (X2 [1] = 1.514, p = 0.219).

Four hundred and ten (13.6%) people scored as probable dementia and 227 (7.5%) as possible dementia. The numbers falling into each screening category are summarised in Table 1. The crude prevalence of dementia in those aged ≥60 years was 6.1% (95% CI 4.4–7.9) and the age-adjusted prevalence 4.6% (95% CI 2.9–6.4). The crude prevalence in those aged ≥65 years was 7.9% (95% CI 5.8–10.0), 6.0% (95% CI 3.9–8.1) age-adjusted and in those aged ≥70 years prevalence was 10.2% (95% CI 7.4–13.1), 8.9% (95% CI 6.1–11.8) age-adjusted.

The prevalence of dementia generally increased with age and was higher in females and those with lower educational level (Table 2). However, for those seen in Phase II, only age remained significantly associated with dementia in multivariable logistic regression modelling (Table 3). Of the 610 people seen in stage 2, 483 (79.2%) had their blood pressure taken. Of these, 270 (55.9%) had hypertension of whom 46 (17.0%) had dementia. In contrast of the 213 without hypertension 25 (11.7%) had dementia. After adjusting for the effects of age band, sex and education level in a logistic regression model the presence of hypertension at the time of assessment was not significantly associated with the presence of dementia (OR 1.391, 95% CI 0.792–2.441, p = 0.251).

The populations aged ≥70 years screened in 2009–2010 and 2018–2019 are compared in Table 4. As expected, the proportion of oldest-old (those aged ≥85 years) increased from 2009–2010 (18.0%) to 2018–2019 (22.6%). The proportion with no formal education reduced from almost half (49.3%) in 2009–2010 to just over a third (36.1%) in 2018–2019. Table 5 compares our results with other community-based dementia prevalence studies conducted in SSA since 2009 and utilising similar methodology.

6 DISCUSSION

We report a prevalence of dementia of 6.1% (4.6% age-adjusted) in those aged ≥60 years and 10.2% (8.6% age-adjusted) in those aged ≥70 years in rural Kilimanjaro. This is an increase, although not a statistically significant one, from the previously reported crude prevalence estimate of 7.5% (95% CI 6.0–9.0) and 6.4% age-adjusted (95% CI 4.9–7.9) in those aged ≥70 years in 2009–2010. As in 2009–2010, age is the most significant predictor of dementia and, although dementia is associated with female sex and low/no education, these are no longer significant after controlling for age.

Our prevalence estimate is substantially higher than other rural and semi-urban studies in Nigeria21,38 and Benin,33 but similar to
those conducted in urban francophone west Africa; see Table 5. In contrast, a single-stage study conducted in South Africa, and another in rural Uganda (published but non-peer reviewed) report substantially higher prevalence (up to 20%), but used only the brief CSI-D to diagnose dementia, without confirmatory diagnosis. The brief CSI-D was developed through modelling on LMIC populations but with little data from SSA, and has not been specifically validated in this setting. This is therefore likely to be an overestimate, since other conditions that could affect performance in cognitive function tests (e.g., depression) cannot easily be distinguished from dementia during a brief screen. Indeed, our own screening, using a tool validated for use in SSA identified 13.6% of those screened as probable dementia.

Similarly, other SSA dementia prevalence estimates using screening without confirmatory diagnosis report high prevalence: 10.1% in Nigeria, similar to that reported for cognitive impairment (9%) in Botswana. Use of the full CSI-D in our 2009–2010 study indicated a similarly high level of screen positives (15.4% probable dementia, 8.7% possible dementia), with major reasons for false positive results after comprehensive clinical assessment for dementia by DSM-IV criteria being educational bias and inclusion of conditions such as depression.

It is important to consider that different screening and diagnostic methods were used in our 2009/2010 and 2019/2019 studies, reflecting developments in practice. Specifically, the DSM-5 dementia criteria were used in place of the DSM-IV criteria. Since DSM-5 removes the need for the cognitive domain of memory to be significantly affected as a key criterion, it is possible we detected a small number of individuals with dementia but without significant memory impairment who might have been missed in the previous study using DSM-IV. We also utilised the IDEA screen in place of the CSI-D. The IDEA screen was developed from the CSI-D and validated within the Kilimanjaro region, and appears to have less false positives and educational bias in this population. Therefore, we do not expect this change to have adversely affected the accuracy of our results.

### TABLE 1 Dementia screening and overall prevalence estimates

| Screening result | Screened population | Seen for diagnosis | Diagnosis of dementia in those seen | Scaling factor | Theoretical number of cases |
|------------------|---------------------|--------------------|--------------------------------------|---------------|-----------------------------|
| No dementia      | 2374                | 201 (8.5%)         | 4                                    | 11.811        | 47.2                        |
| Possible dementia| 227                 | 85 (37.4%)         | 7                                    | 2.671         | 18.7                        |
| Probable dementia| 410                 | 324 (79.0%)        | 94                                   | 1.265         | 118.9                       |
| Total            | 3011                | 610                | 105                                  |               | 184.8                       |
| Crude prevalence |                    |                    |                                      |               | 6.1% (4.4 to 7.9)           |
| Age-adjusted prevalence |            |                    |                                      |               | 4.6% (2.9 to 6.4)           |

### TABLE 2 Prevalence in demographic and educational sub-groups

| Age band          | Screened population | Seen for diagnosis | Diagnosis of dementia in those seen | Estimated prevalence (%) |
|-------------------|---------------------|--------------------|--------------------------------------|--------------------------|
| 60–64 years       | 775                 | 87                 | 1                                    | 1.5 (0.0 to 4.5)         |
| 65–69 years       | 622                 | 77                 | 3                                    | 0.8 (0.0 to 2.0)         |
| 70–74 years       | 513                 | 100                | 4                                    | 0.9 (0.0 to 1.8)         |
| 75–79 years       | 437                 | 93                 | 20                                   | 9.0 (3.8 to 17.3)        |
| 80–84 years       | 299                 | 104                | 31                                   | 22.5 (11.9 to 36.3)      |
| 85 years and over | 365                 | 149                | 46                                   | 16.7 (11.6 to 21.7)      |

| Sex               | Screened population | Seen for diagnosis | Diagnosis of dementia in those seen | Estimated prevalence (%) |
|-------------------|---------------------|--------------------|--------------------------------------|--------------------------|
| Female            | 1726                | 401                | 75                                   | 8.1 (5.3 to 10.9)        |
| Male              | 1285                | 209                | 30                                   | 3.2 (1.9 to 4.4)         |

| Educational level | Screened population | Seen for diagnosis | Diagnosis of dementia in those seen | Estimated prevalence (%) |
|-------------------|---------------------|--------------------|--------------------------------------|--------------------------|
| No formal schooling| 786                 | 278                | 70                                   | 13.6 (9.8 to 17.8)       |
| 0–4 years of primary school | 1033            | 193                | 24                                   | 5.7 (2.1 to 9.3)         |
| 5–7 years of primary school | 1050           | 132                | 11                                   | 1.4 (0.5 to 2.3)         |
| Secondary school and/or higher education | 142 (27 higher education) | 7                  | 0                                    | 0                        |

*Eight people who could not recall their education level were included in the no formal schooling group.*
Low education is an established potentially-modifiable risk factor for dementia.\(^{6}\) In this study, 36.1\% of those aged \(\geq 70\) had never been to school, substantially lower than in the 2009–2010 study of those aged \(\geq 70\) in the same setting. This is likely to be due to increased access to education over time, and of the 1397 aged 60–69, a much lower proportion (198 [14.2\%]) were uneducated. Despite this increase in overall education amongst older people in Hai over the past 10 years, prevalence of dementia has not reduced. The relationship between education and reduced cognitive reserve seen in other world regions may differ in settings where access to education was historically universally limited, as in Hai, compared to settings where lack of education was more clearly associated with childhood disadvantage. Our apparent finding that dementia has not reduced despite higher access to education may support this hypothesis.

Both our 2009–2010 and 2018–2019 estimates are substantially higher than estimates from Nigeria, where the great majority of previous epidemiological studies of dementia in SSA have taken place. Reviews of these West African epidemiological data suggest that dementia prevalence remains consistently low, but that there has been no evidence of a decline over time, in contrast to studies of African-Americans using similar methodology.\(^{7,10}\) It is not yet clear why the prevalence in Tanzania appears higher than in Nigeria, given that prevalence appears similar to that reported in other SSA settings.\(^{35–37,45}\) Vascular risk factors such as hypertension (highly prevalent in Tanzania, and present in 55\% of those assessed in this study) may contribute and although age is the largest risk factor, the influence of secular trends on dementia and other NCDs over the lifetime are well established\(^{2}\). The high prevalence of measured hypertension

### TABLE 3  Demographic risk factors for dementia

|                        | Seen for diagnosis | Dementia | No dementia | Unadjusted odds ratio (95% CI) | Adjusted odds ratio (95% CI) |
|------------------------|-------------------|----------|-------------|-------------------------------|------------------------------|
| Age band               |                   |          |             |                               |                              |
| 60–69 years            | 164               | 4        | 160         | 1 (reference)                 | 1 (reference)                |
| 70–79 years            | 193               | 24       | 169         | 5.68 (1.93 to 16.73)          | 5.06 (1.68 to 15.26), \(p = 0.004\) |
| 80 years and over      | 253               | 77       | 176         | 17.50 (6.26 to 48.91)         | 14.41 (4.98 to 41.66), \(p < 0.001\) |
| Sex                    |                   |          |             |                               |                              |
| Male                   | 209               | 30       | 179         | 1 (reference)                 | 1 (reference)                |
| Female                 | 401               | 75       | 326         | 1.37 (0.87 to 2.18)           | 1.09 (0.64 to 1.85), \(p = 0.746\) |
| Educational level\(^a\) |                   |          |             |                               |                              |
| 5 years or more        | 139               | 11       | 128         | 1 (reference)                 | 1 (reference)                |
| 0–4 years of primary school | 193 | 24   | 169         | 1.65 (0.78 to 3.50)           | 0.92 (0.41 to 2.06), \(p < 0.846\) |
| No formal schooling    | 278               | 70       | 208         | 3.92 (2.00 to 7.67)           | 1.71 (0.79 to 3.71), \(p = 0.173\) |
| Occupation\(^b\)       |                   |          |             |                               |                              |
| Employed or housework or working on own farm | 448 | 46 | 402 | 1 | 1 |
| Not working in any capacity | 162 | 59 | 103 | 5.01 (3.22 to 7.79) |

\(^a\)Eight people who could not recall their education level were included in the no formal schooling group.
\(^b\)Includes individuals with confirmed dementia still carrying out farming activities.

### TABLE 4  Comparison of 2010 and 2019 populations selected from Hai of those aged \(\geq 70\)

|                        | 2009–2010 | 2018–2019 |
|------------------------|-----------|-----------|
| Age band               |           |           |
| 70–74 years            | 443 (37.0\%) | 513 (31.8\%) |
| 75–79 years            | 356 (29.7\%) | 437 (27.1\%) |
| 80–84 years            | 183 (15.3\%) | 299 (18.5\%) |
| 85 years and over      | 216 (18.0\%) | 365 (22.6\%) |
| Sex                    |           |           |
| Female                 | 673 (56.2\%) | 905 (56.1\%) |
| male                   | 525 (43.8\%) | 709 (43.9\%) |
| Education              |           |           |
| No education           | 585 (49.3\%) | 580 (36.1\%) |
| 4 years or less of education | 461 (38.9\%) | 673 (41.9\%) |
| Over 4 years of education | 140 (11.8\%) | 355 (22.1\%) |

Low education is an established potentially-modifiable risk factor for dementia.\(^6\) In this study, 36.1\% of those aged \(\geq 70\) had never been to school, substantially lower than in the 2009–2010 study of those aged \(\geq 70\) in the same setting. This is likely to be due to increased access to education over time, and of the 1397 aged 60–69, a much lower proportion (198 [14.2\%]) were uneducated. Despite this increase in overall education amongst older people in Hai over the past 10 years, prevalence of dementia has not reduced. The relationship between education and reduced cognitive reserve seen in other world regions may differ in settings where access to education was historically universally limited, as in Hai, compared to settings where lack of education was more clearly associated with childhood disadvantage. Our apparent finding that dementia has not reduced despite higher access to education may support this hypothesis.
| Author, year | Setting | Sample size | Population | Design | Screening tool | Stage 2 sampling method | Diagnostic criteria | Prevalence |
|-------------|---------|-------------|------------|--------|---------------|-------------------------|------------------|-----------|
| Guerchet, 2009 | Benin, rural | 502 | ≥65 years, 69.1% female, 96.6% no schooling | Two stage, community-based | community screening instrument for dementia (CSI-D; cognitive subscale only), 5 word test | Stratified sample including some screen negatives | DSM-IV criteria | 2.6% |
| Longdon, 2010 | Tanzania, rural | 1198 | ≥70 years, 56.2% female, 49.3% no schooling | Two stage, community-based | CSI-D | Stratified sample including some screen negatives | DSM-IV criteria | 7.5% |
| Guerchet, 2010 | Central African Republic, urban | 496 | ≥65 years, 56.1% female, 56.7% no schooling | Two stage, community-based | CSI-D (cognitive subscale only), 5 word test | Stratified sample including some screen negatives | DSM-IV criteria | 8.1% |
| Guerchet, 2010 | Congo, urban | 520 | ≥65 years, 61.9% female, 48.8% no schooling | Two stage, community-based | CSI-D (cognitive subscale only), 5 word test | Stratified sample including some screen negatives | DSM-IV criteria | 6.7% |
| Yusuf, 2011 | Nigeria, urban | 322 | ≥65 years, 60.2% female, 91.0% no schooling | One stage, community-based | CSI-D, stick design test, CERAD 10-word list, blessed dementia scale | All seen | ICD-10, DSM-IV criteria | 2.8% |
| Paraiso, 2011 | Benin, urban | 1139 | ≥65 years, 54.1% female, 45.9% no schooling | Two stage, community-based | CSI-D (cognitive subscale only), 5 words test | Only screen positives seen | DSM-IV criteria | 3.7% |
| Guerchet, 2013 | Central African Republic, rural and urban | 479 rural, 500 urban | Female 59%, no formal education 66% | Two stage, community-based | CSI-D | Only screen positives seen | DSM-IV criteria | 8.8% rural, 6.0% urban |
| Guerchet, 2013 | Congo, rural and urban | 529 rural, 500 urban | Two stage, community-based | CSI-D | Only screen positives seen | DSM-IV criteria | 6.1% |
| Ogunniyi, 2016 | Nigeria, semi-urban | 613 | ≥65 years, 69.7% female, 70.1% no schooling | Two stage, community-based | IDEA cognitive screen | Stratified sample including some screen negatives | DSM-IV criteria | 2.9% |
| De Jager, 2017 | South Africa, rural | 1382 | ≥60 years, 68.6% female, 69.8% no/minimal education | One-stage, community-based | Brief CSI-D (cognitive and informant) | None | None | 8% (11% aged ≥65 years) |
| Yoseph, 2019 | Tanzania, rural | 3011 | ≥60 years, 57.3% female, 26.1% no schooling | Two stage, community-based | IDEA six-item screen and IDEA IADL (brief version) | Stratified sample including some screen negatives | DSM-V criteria | 6.1% (10.2% aged ≥70 years) |
| Mubangazi, 2019 | Uganda, rural | 400 | ≥60 years, 59.5% female, 45.0% no schooling | One stage, community-based | Brief CSI-D (cognitive and informant) | None | None | 19.5% |

*Prevalence was calculated from estimated diagnostic accuracy of the brief CSI-D.

*Published online, creative commons 4.0. Research square preprint. Prevalence and correlates of Alzheimer’s disease and related dementias in rural Uganda: cross-sectional, population-based study. Vincent Mubangizi, Samuel Maling, Celestino Obua, Alexander C. Tsai Mbarara University of Science and Technology Listed as non-peer reviewed. Published date assumed 2019. Accessed 27/11/19.
in this study is broadly similar to that found in other studies within the same region, though the increased prevalence in those with dementia was non-significant. The relationship between dementia and hypertension is complex, as reported in other studies. Midlife hypertension may have a stronger relationship with dementia and in the oldest-old hypertension may be protective. Similarly within the same region we have found hypertension not to be associated with cognitive decline in elders. Hai also has a higher proportion of older people than Tanzania as a whole, for reasons that are not clear.

Although the increase in our point estimate of prevalence was non-significant, dementia prevalence in Hai is at least as high as reported in 2009–2010. There is substantial evidence that in most world regions dementia incidence is declining or stabilising, but this does not appear to be the case in Tanzania and a similar pattern appears to be present in Nigeria. Unfortunately we were unable to conduct an incidence study, as the gradual onset of dementia means that establishing onset, particularly in rural SSA, is challenging. It is therefore unclear whether there is a trend towards increasing incidence or whether reduced mortality of those living with dementia is the main driver for our findings. Such changes reflect the general ageing of the population and suggest a greater proportion of the population are living long enough to develop dementia. The fact that those aged ≥85 years have increased from 18.1% to 22.6% of the total population aged 70 years and over supports this hypothesis.

6.1 | Strengths and limitations

To date, this is the largest research study of dementia prevalence conducted anywhere in SSA, where screening results were confirmed by formal assessment using gold standard diagnostic criteria. By conducting the study using similar methods to our previous study and within the same population, we are able to draw conclusions regarding the changing prevalence of dementia in Hai. Our team are experienced in epidemiological research in SSA and our methods are robust. As in 2009–2010 we conducted a two-stage prevalence study, allowing the most efficient use of resources. This method is acceptable provided a stratified sample of borderline and screen negative controls are assessed to avoid underestimate of prevalence.

A significant limitation was the delay (in some cases up to 12 months) between initial screening in Phase I and subsequent clinical assessment in Phase II. This was unavoidable due to severe weather conditions impeding transport and logistical difficulty in recruiting suitably qualified local medical clinicians. Some individuals may have presented differently in terms of cognitive performance between Phase I and Phase II. We attempted to mitigate this through repetition of the IDEA cognitive screen in Phase II and detailed questions on onset of cognitive impairment linked to well-known annual events and festivals to clarify duration of difficulties. It is possible however that some individuals with normal cognitive screen results may subsequently have developed dementia and been missed by not being assessed in Phase II, leading to a reduction in estimated dementia prevalence. Additionally, although less than half of participants had an informant at home in Phase I, we made significant efforts to trace suitable informants for those seen in Phase II. As noted in the Results, those without an informant in Phase I were significantly more likely to be younger and may have been less in need of care and support.

It would have been ideal to collect data on vascular risk factors on the entire screened population, but this was felt to be of limited utility given the well-known limitations of self-report and awareness of NCDs in this setting. Similarly, on clinical assessment determination of vascular and other risk factors through blood tests and other investigations (e.g., electrocardiograph) would have been ideal, but was not feasible given logistics and available resources. We were able to measure blood pressure in the majority (79%) but not all participants, again due to resources. Similarly, other potentially emergent risk factors such as air pollution were not measured. Available data are scarce but suggest Tanzania has lower levels of air pollution than other areas of SSA. Nevertheless, this is likely to be a potentially emergent public health factor to be examined in future studies.

Finally, we emphasise that our findings should be extrapolated beyond the narrow setting of Hai district with caution. Hai is known to have high rates of cardiovascular risk factors such as stroke and hypertension as discussed. Nevertheless, the district is similar to much of rural SSA, with traditional lifestyles predominating, food insecurity common and limited coverage of healthcare services.

7 | CONCLUSION

In contrast to some high-income settings, there is no evidence of a reduction in dementia prevalence in Kilimanjaro, Tanzania, since 2010 and prevalence may well be increasing. The population is generally older, with lower levels of illiteracy than seen in 2009–2010. Dementia is likely to continue to be a significant and growing issue in Tanzania and further studies on potentially-modifiable risk factors in this setting are needed.

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CONFLICT OF INTEREST

There were no conflicts of interest.
DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions. Permission to share data and approval of a data transfer agreement by the National Institute of Medical Research (NIMR) in Tanzania is required prior to transfer.

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