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The original cohort

The Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) is a harmonized sister study to the United States Health and Retirement Study (HRS).[1] HAALSI is an ongoing multidisciplinary population-based study with longitudinal data on social, economic, biological, physical and mental health factors in a cohort of 5059 individuals, aged 40+, in a rural community in Agincourt, South Africa.[2] Established in 2015, HAALSI has completed two waves of data collection (wave 1:2014–15, wave 2:2018–19) with a third wave under way (commencing in June 2021) and estimated to be completed by December 2021.

The HAALSI study is a collaboration among experts in the USA (Harvard University) and South Africa (University of the Witwatersrand) with extension to the Agincourt

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Key Features

- The Health and Aging in Africa Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) is a harmonized sister study to the US Health and Retirement Study (HRS). Established in 2015, it includes 5059 individuals aged 40 and over, in a rural community in Agincourt, South Africa.
- In light of the projected rise of dementia burden in sub-Saharan Africa, the HAALSI Dementia study was launched in 2019 to investigate the prevalence, incidence and risk factors of cognitive decline and dementia in South Africa.
- The HAALSI Dementia sample includes 635 individuals, 50 years and older, of whom 99 also participated in an ancillary magnetic resonance imaging (MRI) sub-study.
- The HAALSI Dementia study encompasses a comprehensive, culturally sensitive cognitive battery with multidomain psychometric scales, informant interviews and neurological evaluations, and has sufficient overlap with international Harmonized Cognitive Assessment Protocol (HCAP) and HRS studies to enable cross-calibration.
- For new collaborative projects and data sharing, please contact Darina Bassil [dbassil@hsph.harvard.edu].

Health and Socio-Demographic Surveillance System (HDSS),[3] and allows for cross-national comparisons with HRS sister studies worldwide, including ELSA in the UK,[4] SHARE in Europe,[5] CHARLS in China,[6] MHAS in Mexico[7] and LASI in India.[8]

What is the reason for the new data collection?

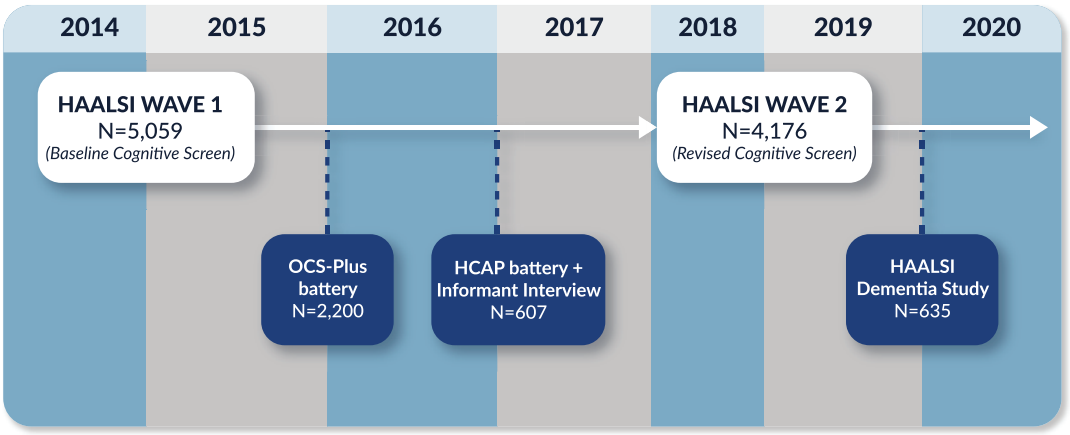
Populations of sub-Saharan African countries are rapidly aging. The number of people aged over 60 years is projected to increase more than 2-fold between 2015 and 2050,[9] despite rising rates of non-infectious diseases.[10,11] It is estimated that nearly 3.5 million people across sub-Saharan Africa will have dementia by 2030, increasing to 7.6 million in 2050.[12] Currently, there are few population-based studies of cognitive aging or dementia prevalence in sub-Saharan African countries,[13–17] with just a few reporting figures from South Africa.[18,19]

In an effort to contribute to this under-researched area in sub-Saharan Africa, and South Africa in particular, we launched the HAALSI Dementia study. This study focuses on the epidemiology of dementia and cognitive decline in a rural community in South Africa, a country undergoing complex epidemiological and demographic transitions. The growing burden of chronic conditions, including chronic HIV infection, combined with low socioeconomic resources and educational attainment, makes South Africa especially important for investigating cognitive risk trajectories. The main aim of HAALSI Dementia is to identify the incidence and prevalence of dementia, particularly Alzheimer's Disease and Related Dementias (ADRD), and biological and social correlates, determinants and risk factors associated with age-related cognitive decline and dementia in a population-based cohort of older adults living in Agincourt, South Africa.

What will be the new areas of research?

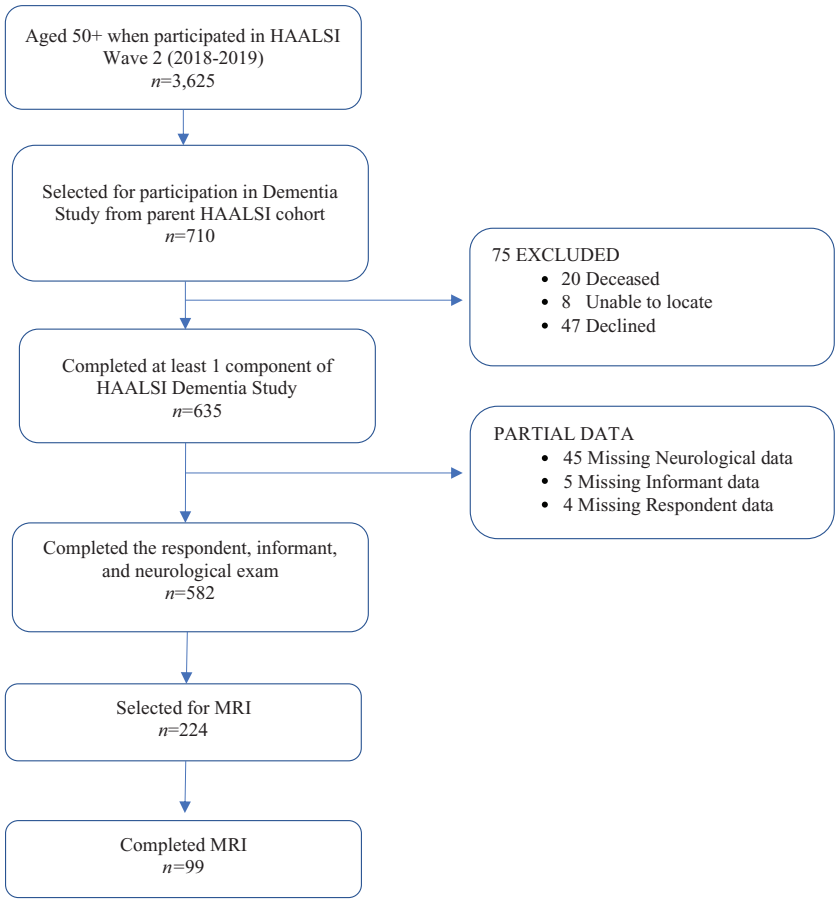
HAALSI Dementia collects detailed neuropsychological and functional assessments, informant interviews, and neurological and clinical evaluations on a sub-sample of HAALSI individuals aged 50 years and older. Given high levels of illiteracy in this region, a key challenge in assessing cognitive function and dementia in the HAALSI cohort is selecting cognitive assessments that minimize the education and culture bias associated with common neuropsychological instruments used in high-income countries. To optimize accurate dementia diagnosis in the HAALSI Dementia cohort, we designed a cognitive battery using elements from well-known diagnostic protocols, including the Harmonized Cognitive Assessment Protocol (HCAP)[20] and 10/66 Diagnostic Protocol,[21] as well as measures that were successfully implemented in similar cohorts. We previously assessed cognitive function in the entire cohort during the first two waves of HAALSI: a brief cognitive screen on the baseline cohort of 5059 participants in 2014–15 and a revised cognitive screen on the remaining HAALSI cohort ($n = 4176$) during HAALSI Wave 2 (Figure 1; Supplementary Material Part 1, available as Supplementary data at *IJE* online). Further, we administered the Oxford Cognitive Screen (OCS) Plus tablet battery[22] on a sub-sample of 2200 participants in 2015 and the HCAP battery on sub-sample of 607 participants in 2016–17. The comprehensive cognitive battery for the HAALSI Dementia Study was informed by our experience assessing cognitive function in the cohort, whereby we selected measures with the best psychometric properties, sensitivity and face validity. New measures were added to round out cognitive domain areas that were lacking in previous versions (Supplementary Material Part 1).

Furthermore, there are currently no population-based normative data for our population. Defining impairment



HAALSI: The Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa, OCS-Plus battery: Oxford Cognitive Screen Plus tablet battery, HCAP: Harmonized Cognitive Assessment Protocol

Figure 1 Timeline and overview of all cognition data collected in HAALSI



HAALSI: The Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa, MRI: Magnetic Resonance Imaging

Figure 2 Flowchart of participation in HAALSI dementia study

thresholds without aid of appropriate norms for these data is challenging. A number of researchers recommend using expert panel consensus for dementia diagnosis.[23] Thus, to improve diagnostic reliability and accuracy in our sample, we assembled a multidisciplinary panel of expert US and South African neurologists, neuropsychologists and

geriatricians with clinical and research experience in dementia, to assign dementia diagnoses based on neuropsychological, neurological and informant data.

We additionally collect brain magnetic resonance imaging (MRI) for a sub-sample of participants. Brain imaging data allow for characterization of structural changes associated with cognitive change.

Who is in the cohort?

This study was approved by the University of the Witwatersrand Human Research Ethics Committee (ref. M190443), Harvard T.H. Chan School of Public Health Institutional Research Ethics Board (ref.18–1459,19–1396) and Mpumalanga Provincial Research and Ethics Committee.

The HAALSI Dementia sample was drawn from 4176 participants enrolled in the second wave (2018–19) of HAALSI. Due to low probability of dementia at younger ages, the sample was restricted to those aged 50 years and older at Wave 2, leaving 3625 participants eligible for selection (Figure 2). Participants who completed any of the cognitive screening from the main HAALSI battery were stratified based on cognitive performance into four risk categories: Highest, Moderate, Low and Lowest. Risk levels were assigned based on predicted probabilities of dementia, calculated using previously collected pilot data with consensus diagnoses as the gold standard outcome.

Based on power analysis and precision estimates from multiple simulations, 690 HAALSI participants were invited to take part in the study, including a random sample of 207 individuals (30%) each from the Lowest, Low and Moderate risk groups, and 69 (10%) from the Highest Risk group. We additionally recruited 20 participants who required a proxy in HAALSI Wave 2, assuming high likelihood of dementia among these participants. To ensure the sample included enough dementia cases to estimate prevalence in the HAALSI sample, we oversampled participants categorized as higher risk for dementia based on HAALSI Wave 2 cognitive screening scores.

HAALSI Dementia fieldwork

From September 2019 to January 2020, we conducted standardized neuropsychological assessments, informant interviews and neurological examinations in a cohort of 635 older adults (aged 50+) in Agincourt, South Africa. Of the 635 Dementia study participants, a total of 229 had previously completed the OCS-Plus battery, 66 completed HCAP and 39 completed both HCAP and OCS-Plus (Supplementary Table S1, available as Supplementary data at *IJE* online).

Computer-Assisted Personal Interviewing (CAPI) software, built on Samsung galaxy tablets, was used for all assessments and simultaneous data capture. All study assessments were translated to the local Shangaan language and back-translated. Local versions were pilot tested in 55 older adults who were not part of the HAALSI study. All data were quality-checked weekly, ensuring timely management of data discrepancies.

The data collection team consisted of local nurses and fieldworkers trained in study protocol, consent, data collection and management. Training was led by research team specialists with experience in neuropsychological testing and geriatric and neurological examinations.

Interviews and clinical examinations were generally conducted at participants' homes. When cognitive impairment prohibited participation, proxy consent was obtained from a family member able to make decisions on the participant's behalf. An informant interview and neurological examination (if possible) were still performed for these participants. Participants with low literacy consented verbally in the presence of a witness. A subset of participants who completed aforementioned assessments were invited to complete an MRI scan at Kiaat hospital in Nelspruit, 105 km away.

HAALSI Dementia participants, informant selection and imaging (including response rates)

In total 635 participants completed at least part of the study, including 183 (28.8%) Lowest Risk, 189 (29.8%) Low Risk, 182 (28.7%) Moderate Risk, 64 (10.1%) Highest Risk and 17 (2.7%) participants who required a proxy in HAALSI main.

The overall refusal rate was 6.6% (47/710 declined participation); 28 participants were excluded as they were deceased (3%) or not locatable (1%). Overall, 582 participants completed all study components: cognitive battery, informant interview and neurological examination. The remaining 53 participants had partial data; four missed the cognitive battery, four had no informant available, 44 refused neurological examination and one missed both informant and neurological examination. Response rates were similar across age, sex and risk stratum (Supplementary Table S2, available as Supplementary data at *IJE* online).

Of 582 who completed all study components, a random sample of 224 was invited to participate in the MRI sub-study (Figure 2). Due to heightened health risks for participants and staff associated with COVID-19 pandemic, we terminated the MRI sub-study early and only 127 participants were approached, of whom 99 participants (78%) completed an MRI.

Table 1 Demographic characteristics of informants in HAALSI dementia

Informant characteristics	Total ($n = 630$)
% Female	68
Mean age (SD)	44 (18.11)
% Caregiver	54
Mean years known the participant (SD)	32 (14.08)
Informant-participant relationship (%)	
Child	243 (39)
Spouse/partner	174 (28)
Sibling	27 (4)
Other, relative (including grandchild)	153 (24)
Other, non-relative	33 (5)
Frequency informant sees participant (%)	
Lives with participant	400 (63)
Daily	180 (29)
Several times a week	48 (8)
Less than once a month	2 (<1%)

HAALSI: The Health and Aging in Africa: a Longitudinal Study of an INDEPTH community in South Africa.

Informant interviews were completed for 630 participants. Table 1 presents informant demographic characteristics. Informants were mainly female (68%) with mean age of 44 years [standard deviation (SD) = 18.11]. Most informants were participant's spouse/partner (28%) or child (39%), lived with participant (63%) and had known the participant for 32 years (SD = 14.08).

What has been measured?

Cognitive battery

We leveraged previous work using HCAP to develop a comprehensive multidomain cognitive battery that is culturally sensitive for our unique cohort and sufficiently overlaps with international sister studies to enable cross-calibration; see Supplementary Material Part 1 for a summary of our cognition research, which provided guidance on culture-sensitive neuropsychological assessments to estimate dementia prevalence, incidence and progression of ADRD. Prior to beginning fieldwork, an expert panel of neurologists and neuropsychologists met on multiple occasions to review the previously collected data and design the final battery, which incorporated new measures to provide better coverage of language, executive function and visuospatial ability.

We used several measures that were part of HCAP: Subjective Cognitive Function, Mini Mental State Examination (MMSE), Telephone Interview for Cognitive Status (TICS), Community Screening Interview for Dementia (CSID), Word recall: Immediate, Delayed and Recognition, from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) and Logical Memory (story recall): Immediate, Delayed and Recognition. For Logical Memory, the first story 'Anna Khosa', using the Wechsler Memory Scale (WMS-IV), was modified for cultural relevancy. The second story, 'Brave man story', was adapted from HCAP. Semantic Fluency (Animal Naming Test), Raven's Standard Progressive Matrices and Constructional Praxis: Immediate and Delayed from CERAD, as well as Center for Epidemiological Studies Depression (CESD) scale, were also included (Table 2).

Several new measures were added based on recommendations from the expert panel. From the Harmonized Diagnostic Assessment of Dementia for the Longitudinal Aging Study in India (LASI-DAD),[24] we incorporated a Days of the week task (originally from the Hindi MMSE),[25] Go/No Go, Clock Drawing and Token Test. We also developed an electronic version of the Symbol Cancellation that was previously used in MHAS and LASI.[7,24] To assess executive function and visual spatial ability, we deployed the motor sequencing and spatial working memory components of the INECO Frontal Screening Battery.[26] To add depth to the language domain, we administered a 15-item version of the Boston Naming Test after pilot testing picture stimuli and a Phoneme Fluency task. Open-ended questions from the semi-structured Clinical Dementia Rating (CDR) scale were used to evaluate global cognitive status (Table 2). We supplemented our battery with a home-grown reading test to provide an objective assessment of literacy outside self-reported education. A modified questionnaire on history of traumatic brain injury (TBI), adapted from HRS, was also included.

Many of the included measures in Table 2 address multiple domains, but we categorized them by the domain with the strongest association.

The full HAALSI Dementia battery took participants between 1.5 and 2 h to complete. General details, scoring and references for the HAALSI Dementia cognitive battery are in Supplementary Table S3, available as Supplementary data at *IJE* online.

Informant interview

Participants identified a reliable informant able to report on their cognitive status, functional ability and personality. Informants were required to be at least 18 years old, have frequent contact with participant (2–3 times/week) and have known the participant for at least 5 years. We fully adapted the HCAP informant battery which included the following validated instruments: Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE),[27] Blessed Dementia Rating Scale,[28] CSI-D Cognitive Activities Questionnaire,[29] 10/66 Dementia Research Group Informant Questionnaire[30] and HRS Activities Questionnaire to measure participant's

Table 2 HAALSI dementia cognitive battery

Domain	Measure	Previous administration in HAALSI cohort?	Previous administration in HRS/Sister studies?
General Cognitive Status	Mini Mental Status Exam (MMSE)[a]	✓	✓
	Days of the week	–	✓
	Telephone Interview for Cognitive Status (TICS)	✓	✓
	Community Screening Interview for Dementia (CSID)	✓	✓
	Clinical Dementia Rating semi-structured interview	–	–
Episodic Memory	CERAD Word List Learning—Immediate[b]	✓	✓
	CERAD Word List—Delayed[b]	✓	✓
	CERAD Word ListRecognition[b]	✓	✓
	Logical Memory (story recall)—Immediate[c]	✓	✓
	Logical Memory (story recall)—Delayed[c]	✓	✓
	Logical Memory (story recall)—Recognition[c]	✓	✓
Language	Boston Naming Test	–	–
	Token Test	–	✓
	Semantic Fluency (Animal Naming Test)	✓	✓
	Phoneme Fluency	–	–
Executive Function and Attention	Motor Sequences	–	✓
	Go/No Go	–	✓
	Raven's Standard Progressive Matrices	✓	✓
	Similarities and Differences	–	✓
Visuospatial/Spatial Memory	CERAD Constructional Praxis—Immediate	✓	✓
	CERAD Constructional Praxis—Delayed	✓	✓
	Spatial Working Memory	–	–
	Symbol Cancellation	–	✓
	Clock Draw	–	✓
Additional Measures			
Depression	Center for Epidemiological Studies Depression (CES-D) scale	✓	✓
Literacy test	Reading Assessment	–	–
History of traumatic brain injury (TBI)	Modified Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID) model	–	✓

HAALSI, Health and Aging in Africa: a Longitudinal Study of an INDEPTH community in South Africa; HCAP: Harmonized Cognitive Assessment Protocol; LASI-DAD, harmonized Diagnostic Assessment of Dementia for the Longitudinal Aging Study in India; HRS, Health Retirement Study.

[a]A licence to administer MMSE was obtained from Psychological Assessment Resources (PAR), Inc.

[b]A licence to administer was obtained from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) through Duke University.

[c]A licence to administer the WMS-IV Logical Memory (Immediate, Delayed, Recognition) was obtained from Pearson Education, Inc.

engagement in leisure (reading, watching TV, etc.) and everyday (shopping, using public transportation) activities. We further included open-ended questions based on the CDR semi-structured interview. Informant interviews took approximately 45 min to complete.

Neurological examination

A standardized protocol was developed by a team of expert US and South African neurologists, neuropsychologists and geriatricians to assess specific neurological signs and symptoms that might complement or confound dementia diagnoses. The protocol included measures of motor skills, strength, balance and gait, hearing, visual acuity, blood pressure and pulse rate. Additional examination data included information on relevant treatments (antiretroviral therapy, hypertension and diabetes medications) and important observations noted during the visit (e.g. signs of tremor, poor comprehension, bradykinesia, incontinence). Neurological examinationss took about 1 h to complete (see Supplementary Table S4, available as Supplementary data at *IJE* online, for detailed measures of the neurological examination).

Neuroimaging (MRI)

The MRI acquisition protocol was designed to collect standard sequences that could be used to quantify key outcome measures that are relevant to ADRD, on a relatively low field strength system.[31] The protocol includes the following sequences: T1-weighted anatomical, T2-weighted fluid

Table 3 Demographic characteristics of the HAALSI Dementia sample by assigned HAALSI risk group

Demographic Characteristics (%)	Lowest risk ($n = 183$)	Low risk ($n = 189$)	Moderate risk ($n = 182$)	Highest risk ($n = 64$)	Proxy ($n = 17$)	Total ($n = 635$)
Age, years						
50–54	29 (16)	11 (6)	4 (2)	1 (2)	0 (0)	45 (7)
55–59	52 (28)	38 (20)	12 (7)	3 (5)	1 (6)	106 (17)
60–64	29 (16)	32 (17)	17 (9)	4 (6)	2 (12)	84 (13)
65–69	28 (15)	27 (14)	27 (15)	3 (5)	3 (17)	88 (14)
70–74	27 (15)	25 (13)	23 (13)	6 (9)	1 (6)	82 (13)
75 +	18 (10)	56 (30)	99 (54)	47 (73)	10 (59)	230 (36)
Gender						
Male	85 (46)	81 (43)	52 (29)	20 (31)	6 (35)	244 (38)
Female	98 (54)	108 (57)	130 (71)	44 (69)	11 (65)	391 (62)
Marital status[a]						
Never married	2 (1)	3 (2)	0 (0)	1 (2)	3 (17)	9 (1)
Married	88 (48)	90 (48)	56 (31)	15 (23)	2 (12)	251 (40)
Separated/divorced	24 (13)	18 (9)	24 (13)	3 (4)	1 (6)	70 (11)
Widowed	57 (31)	69 (36)	96 (53)	44 (69)	10 (59)	276 (43)
Missing	12 (7)	9 (5)	6 (3)	1 (2)	1 (6)	29 (5)
Educational attainment[a]						
No formal education	55 (30)	105 (55)	125 (69)	53 (83)	13 (76)	351 (55)
Some primary (1–7 years)	71 (39)	75 (40)	54 (30)	10 (16)	2 (12)	212 (33)
Secondary or higher (8+ years)	56 (30)	9 (5)	3 (1)	1 (1)	2 (12)	71 (11)
Employment status						
Employed (part- or full- time)	42 (23)	15 (8)	8 (4)	2 (3)	2 (12)	69 (11)
Not working	135 (74)	170 (90)	172 (95)	62 (97)	15 (88)	554 (87)
Homemaker	6 (3)	4 (2)	2 (1)	0 (0)	0 (0)	12 (2)
Household wealth quintile						
1 (poorest)	30 (16)	57 (30)	60 (33)	27 (42)	6 (35)	180 (28)
2	44 (24)	45 (24)	59 (32)	18 (28)	4 (23)	170 (27)
3	15 (8)	16 (9)	10 (6)	2 (3)	2 (12)	45 (7)
4	31 (17)	29 (15)	20 (11)	7 (11)	3 (18)	90 (14)
5 (richest)	63 (35)	42 (22)	33 (18)	10 (16)	2 (12)	150 (24)

HAALSI, Health and Aging in Africa: a Longitudinal Study of an INDEPTH community in South Africa.
[a]Variables with missing values. One participant is missing educational attainment; 29 participants missing marital status.

attenuated inversion recovery (FLAIR), gradient echo (GRE) imaging, diffusion weighted imaging (DWI), magnetic resonance angiography (MRA) and a resting state blood oxygen level-dependent (BOLD) functional MRI sequence. MRI scan acquisition was performed by trained medical technicians on a 1.5 GE Tesla scanner (Optima MR450w) at Kiaat hospital. The imaging acquisition protocol took about 30–45 min to complete. After acquisition, scans were transferred to Columbia University for analysis via secure transfer protocols, without identifiers (see Supplementary Material Part 2, available as Supplementary data at *IJE* online, for MRI sequence parameters).

What has it found? Key findings and publications

Table 3 shows demographic characteristics of the sample by assigned HAALSI risk groups. Mean age was 69.87 (SD = 11.55). Study participants were in the majority female (62%), either married or widowed (40% and 43%, respectively), unemployed (87%) and without formal education (55%) (Table 3). Approximately 5% had a history of stroke, and 10% met criteria for history of TBI. Similar to previous studies in sub-Saharan Africa,[32] over 90% of participants had poor vision as based on administered vision tests. Mean score for IQCODE was 3.3 (SD = 0.44), with 6% and 20% of participants reporting impairment in at least one Activity of Daily Living (ADL) and Instrumental Activity of Daily Living (IADL), respectively.

In general, participants struggled with visuospatial tasks, especially those requiring drawing, (constructional praxis and clock draw), leading to high rates of missingness. We suspect high rates of missingness are related to unfamiliarity/uneasiness with holding a pen (or tablet stylus) among participants with low literacy, along with a high prevalence

Table 4 Means, standard deviation, range and missingness for all cognitive tests in HAALSI Dementia study ($n = 631$)

Cognitive measure	N	% missing	Mean (SD)	Min (%)	Max (%)	Scale range
TICS (sum of correct answers)[a]	631	0	2.74 (0.94)	0 (1)	4 (24)	0–4
Symbol Cancellation	534	16	15.54 (12.31)	0 (1)	54 (<1)	0–60
CSID (total score)[b]	631	0	3.71 (0.65)	0 (<1)	4 (79)	0–4
Similarities & Differences	631	0	3.21 (0.82)	0 (<1)	4 (33)	0–4
Days of the Week	631	0	11.6 (2.95)	0 (<1)	14 (47)	0–14
Go/No Go	631	0	13.09 (5.24)	0 (2)	20 (15)	0–20
Motor Sequence	616	2	2.54 (0.66)	0 (2)	3 (54)	0–3
Spatial Working Memory	596	5	1.95 (1.45)	0 (16)	7 (<1)	0–8
Token Test	631	0	3.46 (1.67)	0 (6)	7 (2)	0–7
Boston Naming Test	631	0	12.05 (3.52)	0 (3)	15 (28)	0–15
Raven's Progressive Matrices	603	4	7.40 (2.81)	0 (<1)	16 (<1)	0–17
Trial 1 Immediate Word Recall	631	0	3.20 (1.55)	0 (4)	8 (<1)	0–10
Trial 2 Immediate Word Recall	631	0	4.19 (1.68)	0 (2)	8 (2)	0–10
Trial 3 Immediate Word Recall	631	0	4.76(1.86)	0 (2)	10 (1)	0–10
Total Immediate Word Recall	631	0	12.15 (4.44)	0 (2)	24 (<1)	0–30
Total Delayed Word Recall	631	0	3.71 (1.98)	0 (6)	10 (<1)	0–10
Word Recognition	631	0	15.26 (3.03)	0 (<1)	20 (<1)	0–20
Logical Memory Immediate—Story 1	631	0	8.54 (4.18)	0 (4)	24 (<1)	0–24
Logical Memory Immediate—Story 2	631	0	5.84 (2.29)	0 (3)	10 (4)	0–10
Logical Memory Delayed—Story 1	620	2	6.98 (4.20)	0 (10)	18 (1)	0–24
Logical Memory Delayed—Story 2	620	2	4.88 (2.52)	0 (8)	10 (3)	0–10
Logical Memory—Recognition	631	0	8.95 (1.92)	0 (<1)	14 (1)	0–15
Constructional Praxis	480	24	5.27 (2.57)	0 (2)	11 (2)	0–11
Constructional Praxis Recall	483	23	2.94 (2.69)	0 (30)	11 (<1)	0–11
MMSE[c]	631	0	18.53 (5.17)	4 (<1)	29 (<1)	0–30
Semantic Fluency	631	0	10.79 (5.60)	0 (<1)	25 (<1)	0+
Phoneme Fluency	631	2	1.92 (2.55)	0 (47)	14 (<1)	0+
CESD Total Score[d]	631	0	13.66 (9.49)	0 (2)	50 (<1)	0–60
Clock Draw	361	43	1.45 (0.82)	0 (6)	3 (15)	0–3

HAALSI, Health and Aging in Africa: a Longitudinal Study of an INDEPTH community in South Africa.
[a]TICS, Telephone Interview for Cognitive Status.
[b]CSID: Community Screening Interview for Dementia.
[c]MMSE: Mini Mental State Examination.
[d]CESD: Center for Epidemiological Studies Depression.

of visual impairment (Table 4). Our literacy test proved to be an informative measure for assessing literacy and educational quality, as it identified imperfect relationships between self-reported education and objective reading level: 20% of participants with no formal education were able to read, whereas 23% reported exposure to formal education yet were unable to read on literacy testing.

We are currently analyzing completed MRI scans. Generally, demographic characteristics of participants enrolled in the MRI sub-study were comparable to those who refused (Supplementary Table S5, available as Supplementary data at *IJE* online). Data will be analyzed alongside composite scores from neuropsychological assessments, informant interviews and consensus diagnoses, to better understand the relationship between MRI correlates and diagnostic outcomes.

Upon completion of consensus diagnoses, the HAALSI Dementia sample diagnoses will be used as a 'gold standard' to develop diagnostic algorithms applicable to the entire HAALSI cohort (see Supplementary Material Part 3, available as Supplementary data at *IJE* online, for detailed consensus methods).

In-depth cognitive data from the HAALSI Dementia study, along with aggregated longitudinal HAALSI data, provide an ideal research infrastructure to define and compare dementia prevalence, incidence and risk profiles. In HAALSI, prevalence of cognitive impairment was approximately 8%, increasing with age to reach 24% in individuals aged 75+ years.[33]

The richness and frequency of data collection from alternating waves of HAALSI and HAALSI Dementia will allow for increased precision in estimating prevalence and incidence of dementia in evaluating cognitive change. Shorter intervals between waves allows the capture of abrupt cognitive function declines, providing important insight into the aetiology of cognitive impairment.

What are the main strengths and weaknesses?

HAALSI Dementia provides a unique opportunity to track cognitive trajectories and potential risk factors of dementia in the sub-Saharan African region. The parent HAALSI study offers a multitude of longitudinal data on potential risk factors of dementia and core measures of mental and cognitive health status. These data are supplemented with extensive cognitive and clinical data, including MRI, from HAALSI Dementia. Upon completing the third HAALSI wave, and in conjunction with our previous work using the OCS-Plus battery and HCAP, the parent HAALSI study and HAALSI Dementia Study will offer up to six waves of data collection suitable for estimation of dementia risk and investigation into associated biological and social risk factors.

Furthermore, HAALSI Dementia overlaps with the HRS/HCAP international sister studies,[20] enabling cross-national comparisons of dementia and cognitive impairment using tightly standardized assessments and diagnostic protocols across populations.

One limitation is that our cohort sample is not nationally representative. However, it is representative of the regional population from which the participants were drawn. Importantly, it provides population-based estimates for cognitive decline and dementia in a region where this research is limited. Another challenge is the absence of normative data for neuropsychological tests in the region, making cognitive scores difficult to interpret and generalize. However, data from all 635 participants will be reviewed by the consensus panel and assigned a final diagnostic outcome of normal, cognitive impairment no dementia (CIND) or dementia. These outcomes, along with sampling weights, will be a pillar in the development of a dementia diagnostic algorithm, providing dementia risk estimates for the overall HAALSI cohort. Last, although we collected 99 MRI scans, we concluded early due to COVID-19. We plan to expand the MRI to the larger HAALSI Dementia study cohort in our second wave, to capture quantitative structural markers relevant to aging and Alzheimer's disease in a larger and more representative sample.

Can I get hold of the data? Where can I find out more?

HAALSI Dementia data including respondent battery, informant interview and neurological examinations are publicly available on the Harvard DataVerse website [https://doi.org/10.7910/DVN/YDGSBW]. Data published on previous work relating to HCAP battery is found here: [https://doi.org/10.7910/DVN/AS5YNB]. Data on the main HAALSI study (baseline and wave 2) are publicly available through the Inter-university Consortium for Political and Social Research (ICPSR) at the University of Michigan [www.icpsr.umich.edu] and the INDEPTH Data Repository [http://www.indepth-ishare.org/index.php/catalog/113]. Contact Dr Darina Bassil [dbassil@hsph.harvard.edu] for HAALSI Dementia study and David Kapaon [dkapaon@hsph.harvard.edu] for HAALSI main data.

Supplementary data

Supplementary data are available at *IJE* online.

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Author Contributions

D.B. and M.T.F. had primary responsibility for writing the manuscript. All authors contributed to the final manuscript, revising it critically for intellectual content. All authors made substantial contributions to the study concept, design, data collection, analysis and interpretation of results. All authors reviewed the results and approved the final version of the manuscript.

Conflict of Interest

None declared.

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