

DATA RESOURCE PROFILE

Data Resource Profile: The World Health Organization Study on global AGEing and adult health (SAGE)

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Population ageing is rapidly becoming a global issue and will have a major impact on health policies and programmes. The World Health Organization's Study on global AGEing and adult health (SAGE) aims to address the gap in reliable data and scientific knowledge on ageing and health in low- and middle-income countries. SAGE is a longitudinal study with nationally representative samples of persons aged 50+ years in China, Ghana, India, Mexico, Russia and South Africa, with a smaller sample of adults aged 18–49 years in each country for comparisons. Instruments are compatible with other large high-income country longitudinal ageing studies. Wave 1 was conducted during 2007–2010 and included a total of 34 124 respondents aged 50+ and 8340 aged 18–49. In four countries, a subsample consisting of 8160 respondents participated in Wave 1 and the 2002/04 World Health Survey (referred to as SAGE Wave 0). Wave 2 data collection will start in 2012/13, following up all Wave 1 respondents. Wave 3 is planned for 2014/15. SAGE is committed to the public release of study instruments, protocols and meta- and micro-data: access is provided upon completion of a Users Agreement available through WHO's SAGE website (www.who.int/healthinfo/systems/sage) and WHO's archive using the National Data Archive application (<http://apps.who.int/healthinfo/systems/surveydata>).

Data resource basics

Few low- and middle-income countries have data on levels and distribution of health and disability among the older population, much less on which morbidity trajectory their respective ageing populations are following: expansion of morbidity, where people are living longer with more disease and disability;^{1,2} compression of morbidity, where longevity increases but with delays in the age at onset and progression of disease;^{3,4} or a dynamic equilibrium, where longevity and disability rates both increase, but the severity of disability is not as severe.^{5,6} Large-scale longitudinal research in multiple settings is required to provide comparable information on health and well-being, as well as to track the impact of health interventions and policies within and across countries. The World Health Organization (WHO) Study on global AGEing and adult health (SAGE) aims to address this gap with a global perspective. Its core consists of national longitudinal studies of older people in six lower- and upper-middle-income countries, complemented by research collaborations with existing local population-based research studies, comparisons with other domestic ageing studies, and also comparisons to studies outside these six countries.

SAGE is a longitudinal study with nationally representative samples of persons aged 50+ years in China, Ghana, India, Mexico, the Russian Federation and

South Africa (see Figure 1), with comparison samples of younger adults aged 18–49 years in each country. The main aim is to generate valid, reliable and comparable information on a range of health and well-being outcomes of public health importance, in adult and older adult populations. The core SAGE countries provide a broad representation from different geographic regions of the world, different levels of economic development and different stages in the demographic and health transition, and include the two most populous countries of the world. SAGE is also designed to provide results that are comparable to ageing studies in high-income countries, such as the US Health and Retirement Study (<http://hrsonline.isr.umich.edu/>), the English Longitudinal Study on Ageing (www.ifs.org.uk/elsa/) and the Collaborative Research on Ageing in Europe (COURAGE in Europe) Project (www.courageproject.eu/) in three countries.

Data resource area and population coverage

Face-to-face interviews conducted in China (2008–10), Ghana (2008–09), India (2007–08), Mexico (2009–10), the Russian Federation (2007–10) and South Africa (2007–08). Half the interviews in China were completed using a computer-assisted

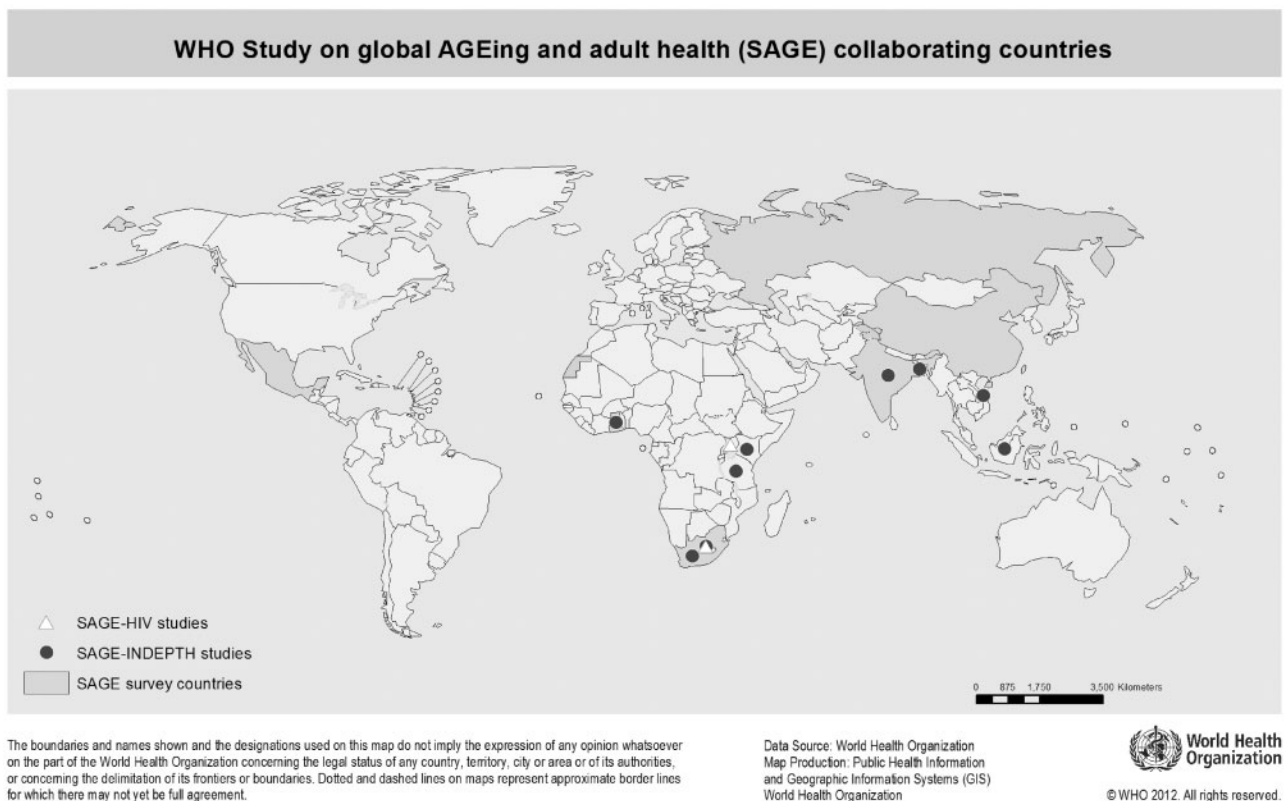


Figure 1 World map showing SAGE and SAGE sub-studies, by collaborating country

personal interview (CAPI) and the other half using paper and pencil. SAGE Mexico used CAPI throughout and the other four countries used paper and pencil format for all interviews.

Multistage cluster sampling strategies were used in all countries where, except for Mexico, households were classified into one of two mutually exclusive categories: (1) all persons aged 50 years and older were selected from households classified as '50+ households'; and (2) one person aged 18–49 years was selected from a household classified as an '18–49 household'. The arrangement in Mexico was similar, but included supplementary and replacement samples to account for losses to follow up in selected sampling units since Wave 0 (more sampling details provided when accessing the data through <http://apps.who.int/healthinfo/systems/surveydata/index.php/catalog>). The sample in India is also representative at the sub-national and sub-state

levels for the selected states. Household enumerations were carried out for the final sampling units. One household questionnaire was completed per household—where a household informant and individual respondent need not be the same individual. One individual was selected from 18–49 households, whereas for 50+ households all individuals aged 50+ were invited to complete the individual interview. Proxy respondents were identified for selected individuals who were unable to complete the interview. Household-level analysis weights and person-level analysis weights were calculated for each country, which included sample selection and a post-stratification factor. Post-stratification correction techniques used the most recent population estimates provided by the national statistical offices. The pooled Wave 1 six-country totals for individual respondents included 34 124 respondents aged 50+ and 8340 aged 18–49 (Table 1).

Table 1 Sample sizes and response rates for SAGE Waves 0 and 1, by country and age groups

Country	Age group	Number selected for Wave 0	Individual response rate Wave 0	Number selected for Wave 1	Individual response rate Wave 1 ^a	Household follow-up rate, Wave 0 to 1
China	18–49	2584		1636	100	
	50–59	618		5701	92	
	60+	791		7474	93	
	Total	3993	100	14 811	93	N/A
Ghana	18–49	2797		803	95	
	50–59	492		1689	76	
	60+	648		2616	80	
	Total	3937	95	5108	81	98
India ^b	18–49 male	3559		1045	83	
	18–49 female	3871		3625	47	
	50–59	1212		2939	90	
	60+	1347		3621	85	
	Total	9989	94	11 230	68	99
Mexico	18–49	27 736		429	58	
	50–59	4628		434	42	
	60+	6381		1879	55	
	Total	38 745	100	2742	53	87
Russian Federation	18–49	2114		417	92	
	50–59	701		1473	80	
	60+	1607		2465	84	
	Total	4422	99	4355	83	74
South Africa	18–49	1893		385	56	
	50–59	239		1695	76	
	60+	219		2142	80	
	Total	2351	89	4223	75	N/A

^aThe China team and WHO decided to use a new sampling frame for Wave 1. The South Africa team chose not to follow up Wave 0 respondents for Wave 1. Both samples are new, and do not include any Wave 0 follow-up respondents.

^bThe India sample for Wave 1 includes a large number of women aged 18–49 as part of a nested study, subsidized by the SAGE India team.

SAGE also includes two longitudinal sub-studies to develop further hypotheses, assess the effects of interventions and study specific populations, based on collaborations with existing demographic and health surveillance systems fieldsites and local community studies. The SAGE collaboration with the International Network for the Demographic Evaluation of Populations and Their Health in developing countries (INDEPTH; www.indepth-network.org) involves collaboration with eight fieldsites in eight countries.⁷⁻⁹ One round of data collection took place in 2007, with a second round planned to start in 2013 (see Box 1). In addition, SAGE includes collaboration with Medical Research Centre Uganda, Uganda, and the Africa Centre for Population and Health, South Africa, building upon existing studies, to prospectively examine the direct and indirect effects of HIV/AIDS on the health and well-being of

older people.^{10,11} Wave 1 was completed in 2009/10, with a second wave planned in late 2012/13 (see Box 2). Further sub-studies include the validation of self-reported physical activity against accelerometry measures in older adults (paa2012.princeton.edu/papers/122841), the assessment of happiness through different versions of the Day Reconstruction Method,^{12,13} and the validation of self-reported chronic conditions through confirmatory medical tests.

Survey frequency

During 2002–04, WHO coordinated the World Health Survey (WHS), a health interview survey in 70 countries of adults aged 18+ years, including the six SAGE countries. The WHS samples were drawn from a current national sampling frame using a stratified, multi-stage cluster design so as to allow each

Box 1 SAGE collaboration with demographic and health surveillance systems field sites (SAGE-INDEPTH)

INDEPTH is a network of local longitudinal demographic surveillance studies in 19 countries in Africa, Asia, Central America and Oceania based on health and socio-demographic surveillance within defined areas. Four African and four Asian Health and Demographic Surveillance System (HDSS) field sites were included in a study of persons aged 50+ as part of a research collaboration with WHO SAGE.⁸ The data represent the total population aged 50+ in six HDSS sites: Agincourt (South Africa), Ifakara (Tanzania), Nairobi (Kenya), FilaBavi (Viet Nam), Purworejo (Indonesia) and Vadu (India); and a random sample of people aged 50+ in the two remaining HDSS sites, Navrongo (Ghana) and Matlab (Bangladesh). SAGE-INDEPTH Wave 1 data were collected in 2007, from which a pooled sample of 43 935 respondents aged 50+ (24 434 women and 19 501 men) was produced.⁹ The overall response rate was 75%. The eight fieldsites implemented an adapted version of the standard SAGE modules. Socio-economic and demographic information was taken from the HDSS site datasets. SAGE-INDEPTH Wave 2 is planned for late 2013. A special volume of publications was published in 2010 (www.globalhealthaction.net/index.php/gha/issue/view/408).

The full SAGE questionnaire was also implemented in sub-samples of persons aged 50 years and over in Agincourt ($N=425$), Navrongo ($N=594$) and Vadu ($N=375$). Data from these fieldsites can also be compared with SAGE national samples in overlapping countries (South Africa, Ghana and India) to assess plausibility of findings and generalizability, as well as to generate new hypotheses that can be more intensively studied at the INDEPTH fieldsites before incorporating these components into future rounds of SAGE in national samples.

Box 2 SAGE collaboration with existing local longitudinal studies (SAGE-HIV)

The SAGE sub-study on the effects of HIV on older people's health and well-being, with special attention to the effects of antiretroviral therapy, includes two collaborations and was implemented in 2009/10. The samples consist of HIV-positive people aged 50+ years, and HIV-negative older people indirectly affected by the HIV/AIDS epidemic because their children are living with or died of HIV. The sub-studies are led by the Medical Research Council/Uganda Virus Research Institute (510 people aged 50+ years, including 198 who are living with HIV)¹⁰ and the Africa Centre for Population and Health Studies (Africa Centre), situated in the Mpukonyoni tribal area, Hlabisa sub-district, northern KwaZulu-Natal, South Africa (422 participants aged 50+ years, 203 people living with HIV).¹¹ The SAGE modules for health and functioning, chronic conditions, risk factors, health care utilization and caregiving were used during interviews. Respondent characteristics, living conditions, household assets and income, transfers and social networks were included. Anthropometric measures and blood samples were collected.

household and individual respondents to be assigned a known non-zero probability of selection.¹⁴ Pooling the data from the six SAGE countries resulted in 18 883 respondents aged 50 and over and 44 554 aged 18–49 years; this sample is referred to as SAGE Wave 0.

SAGE Wave 0 samples were revisited in SAGE Wave 1 in four countries, resulting in a longitudinal data set of 8160 respondents in total. In India, all people aged 50 years and older were revisited in Wave 1. In Ghana, Mexico and the European region of the Russian Federation, a randomly selected sub-set was followed up. All added random samples of new respondents to the Wave 0 samples. China and South Africa interviewed only newly selected respondents—with China using an entirely new sampling frame based on the national non-communicable disease (NCD) surveillance system and South Africa updating the Wave 0 sampling frame and then selecting all new respondents. The Russian Federation added new respondents from its Asian region and the South Federal Districts of the European part of country. The data from Waves 0 and 1 were linked based on unique household and individual identifiers, and location, age and sex. Age and sex variables were verified case by case. Every household in the study has location coordinates available through the use of a Global Positioning System (GPS) device as part of the interview process at both points in time.

Response rates were generally high in Wave 1 (see Table 1). In Mexico, response rates were lowest, partly because of the short time available for the field work which did not allow sufficient time for multiple revisits if the respondent was not at home at the initial visit. The revised sampling targets and long interval between data collection efforts (on average 6 years) contributed to high attrition between SAGE Wave 0 and Wave 1 (Table 1). Mexico had the highest loss to follow-up between Waves 0 and 1: 45% out of 3188 sampled Wave 0 respondents were interviewed in Wave 1. Only 676 refused or did not complete the interview, whereas the remaining 1082 could not be located (31.0%), had died (2.3%) or were otherwise not enrolled in Wave 1. In future Waves, follow-up rates are expected to be considerably higher because of the shorter time interval and the design measures employed in Wave 1.

Wave 2 will be implemented in 2012/13 and Wave 3 in 2014/15.

Measures

A standardized survey instrument, set of methods, interviewer training and translation protocols are used in all SAGE countries. The SAGE household questionnaire consists of (1) a household roster and modules about the dwelling, income, transfers in and out of the household, assets and expenditures; (2) an individual questionnaire with modules on

health and its determinants, disability, work history, risk factors, chronic conditions, caregiving, subjective well-being, health care utilization and health systems responsiveness; (3) a proxy questionnaire about health, functioning, chronic conditions and health care utilization; (4) a verbal autopsy module questionnaire to ascertain the probable cause of death for deaths in the household in the 24 months prior to interview or between interview waves; and (5) appendices including showcards to assist with the interviews. In addition, SAGE Wave 1 included anthropometric measurements (height, weight, waist and hip circumferences), blood pressure measures and a blood sample via finger prick, and performance tests including near and distant vision, a timed 4-m walk, grip strength, lung function and cognition. International standards were used to harmonize education levels¹⁵ and occupations.¹⁶ Table 2 presents a summary of the main measurements included in SAGE Waves 0 and 1.

Data resource use

Some illustrative results are presented about health status and various predictors, cross-sectionally by country and age, and also the change in overall health over time. The analyses presented here focus on the assessment of health state: a multidimensional construct consisting of eight health domains including affect, cognition, interpersonal relationships, mobility, pain, self-care, sleep/energy and vision. A single composite health score was constructed from responses to self-reported difficulties in the eight domains. Data were scored using item response theory, and a partial credit model was used to calculate the composite health score, ranging from 0 (poor health) to 100 (good health).¹⁷

Figure 2 presents the overall health status by age and income group for SAGE Wave 0. Across all countries there is a consistent decline in health across the age spectrum, with respondents in China in better health and respondents from India in worse health as compared with the other countries. The sharpest decline with age in Wave 0 is seen in Russia. The differences by country are smallest between the ages of about 50 and 75 years. This same inter-country pattern was seen when using a single self-reported overall general health question (of the type, 'In general, how would you rate your health today?').

The declines in health status in respondents who were assessed at both Wave 0 and Wave 1 were compared and predictors for decline between the two waves generated using a generalized estimating equation regression model.¹⁸ Figure 3 shows the mean health score results for respondents aged 50+ years from four SAGE countries pooled across Waves 0 and 1. Age gradients in health status are seen in both waves of the survey (with women being in consistently worse health than men across all age

Table 2 Summary of measures included in SAGE Waves 0 and 1 questionnaires

Source	Domain	Wave 0 measures	Wave 1 measures
Household data	Household identification, contact and sampling details	Identification and contact details; structure of household; house construction; availability of water, sanitation and cooking facilities	Identification and contact details; structure of household; dwelling characteristics; improved water, sanitation and cooking facilities
	Transfers and support networks	None	Family, community and government assistance into and out of the household; informal personal care provision/receipt
	Assets, income and expenditure	List of household assets; household expenditures on food, goods and health	List of household assets; sources and amount of household income; improved household expenditure on food, goods and services, health care
	Malaria prevention	Use of bed-nets	No
	Household care and health insurance	Persons in household needing care; mandatory and voluntary health insurance coverage	Persons in household needing care; mandatory and voluntary health insurance coverage
	Maternal and child health	Health care; immunizations	No
Individual data	Sociodemographic characteristics	Sex; age; marital status; education; ethnicity/background	Sex; age; marital status; education; ethnicity/background; religion; language spoken; area of residence; employment and education of parents; childhood residence, migration
	Work history and benefits	Occupation for current job	Length of time worked; reasons for not working; type of employment; mode of payment; hours worked; retirement
	Health states and descriptions	Overall self-rated health; eight self-rated health domains (affect, mobility, sleep and energy, cognition, interpersonal activities, vision, self-care, pain and breathing); vignettes on health state descriptions to allow for anchoring of subjective responses and adjustment for cross-country differences in interpretation and perceptions	Overall self-rated health; eight self-rated health domains [affect, mobility, sleep/energy, cognition, interpersonal activities, vision, self-care and pain (plus breathing in ZAF)]; 12-item WHO Disability Assessment Schedule, Version 2 (WHODAS-II); activities of daily living (ADLs); instrumental activities of daily living (IADLs); vignettes on health state descriptions
	Anthropometrics, performance tests and biomarkers	No	Measured blood pressure; self-report and measured height and weight; measured waist and hip circumference; timed walk; near- and distant-vision tests; grip strength, executive functioning (verbal recall, digit span forwards and backwards, verbal fluency); spirometry; non-fasting fingerprick blood sample (stored at -20°C) as dried blood spots
	Risk factors and preventive health behaviours	Tobacco and alcohol consumption; fruit and vegetable intake; physical activity (IPAQ)	Tobacco and alcohol consumption; fruit and vegetable intake; physical activity (GPAQ)
	Chronic conditions and health services coverage	Self-reported and symptomatic reporting of arthritis; stroke; angina (Rose Questionnaire) and asthma; self-report of diabetes; depression; schizophrenia, tuberculosis; cataracts; oral health (edentulism); injuries; cervical and breast cancer screening; maternal and child health; reproductive health (women)	Self-reported and symptomatic reporting of arthritis; stroke; angina (Rose Questionnaire); asthma; and depression (ICD-10, DSM-IV). Self-reporting of diabetes; chronic lung disease; hypertension; cataracts; oral health (edentulism); injuries; cervical and breast cancer screening

(continued)

Table 2 Continued

Source	Domain	Wave 0 measures	Wave 1 measures
	Health care utilization	Past need for health care; reasons for health care or for not receiving health care; inpatient and outpatient health care: number of admissions/visits within the past 5 years (inpatient) or 1 year (outpatient); reasons for admission/visit; details of hospital or provider; costs of hospitalization or health care visit; health system responsiveness; vignettes for responsiveness to allow for anchoring of subjective responses and adjustment for cross-country differences in interpretation and perceptions	Past need for health care; reasons for health care or for not receiving health care; inpatient and outpatient health care: number of admissions/visits within the past 3 years (inpatient) or 1 year (outpatient); reasons for admission/visit; details of hospital or provider; costs of hospitalization or health care visit; satisfaction with treatment; health system responsiveness; vignettes for responsiveness of health services
	Social cohesion	Perceptions of other people and institutions; safety in local area; stress; interest in politics and perceptions of government	Community involvement and social networks; perceptions of other people and institutions; safety in local area; stress; interest in politics and perceptions of government
	Subjective well-being and quality of life	No	Perceptions about quality of life and well-being; 8-item WHO Quality of Life measure (WHOQoL); Day Reconstruction Method (DRM)
	Impact of caregiving	No	Household members needing care; type of care required; length of time spent on care; costs of care; impact of providing care on career well-being
Proxy data	IQ Code ²⁴ (cognition screen)	No	IQ Code;
	Health state descriptions	–	All measures described above for individual data
	Chronic conditions	–	All measures described above for individual data
	Health care utilization	–	All measures described above for individual data
Mortality data	Deaths and cause of death	Sibling survivorship history	Verbal Autopsy for all deaths within past 24 months in households

groups—results not shown). Health scores remain somewhat level for the decade between the ages of 50 and 60 years, after which an increase in decline with age is evident.

Table 3 includes the results from a longitudinal analysis of 8160 respondents from Ghana, India, Mexico and Russia to identify the main predictors for decline in health over time. Age is clearly the strongest predictor of decline in health status, with older adults having a much more significant decline in health over time than their younger counterparts. Women's health state declines significantly more rapidly than men's health state between Wave 0 and Wave 1. Those with chronic illnesses and comorbidity show a much more rapid decline in health than those with no chronic conditions. Smokers also have a significantly higher decline in health, but not heavy alcohol drinkers. Those with higher levels of

education and from higher wealth quintiles have a significantly slower decline in health. The decline in health was largest in the Indian respondents, and smaller among respondents from Mexico—which is also borne out in the differences in life expectancy at age 60 in the four countries.

Strengths and weaknesses

This is the first longitudinal study on health and ageing in multiple low- and middle-income countries. The six surveys have nationally representative samples, and will yield results that will be comparable to those of similar ageing surveys in high-income countries. Initial response rates were fairly good. GPS coordinates have been taken from all households in order to reduce problems of finding households for

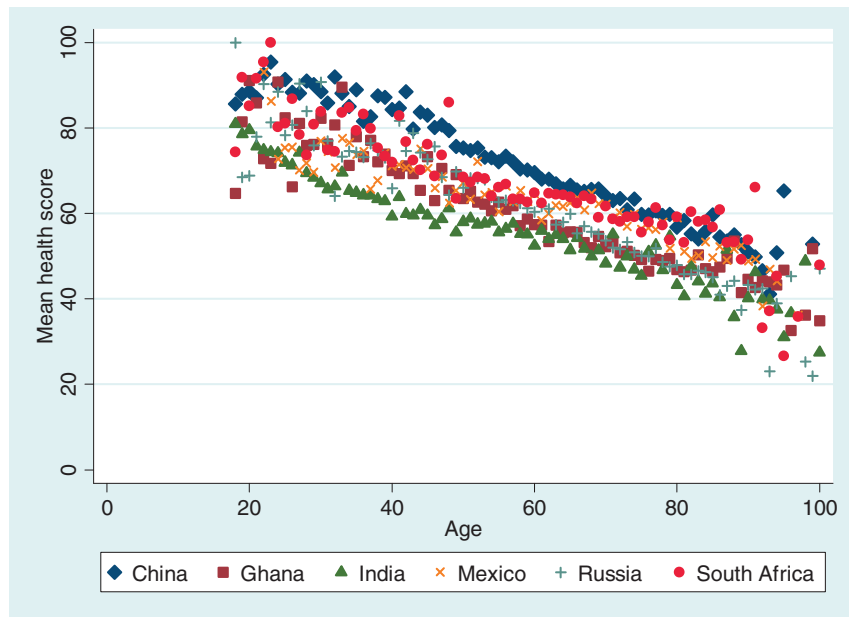


Figure 2 SAGE Wave 0 mean health scores, by age and country

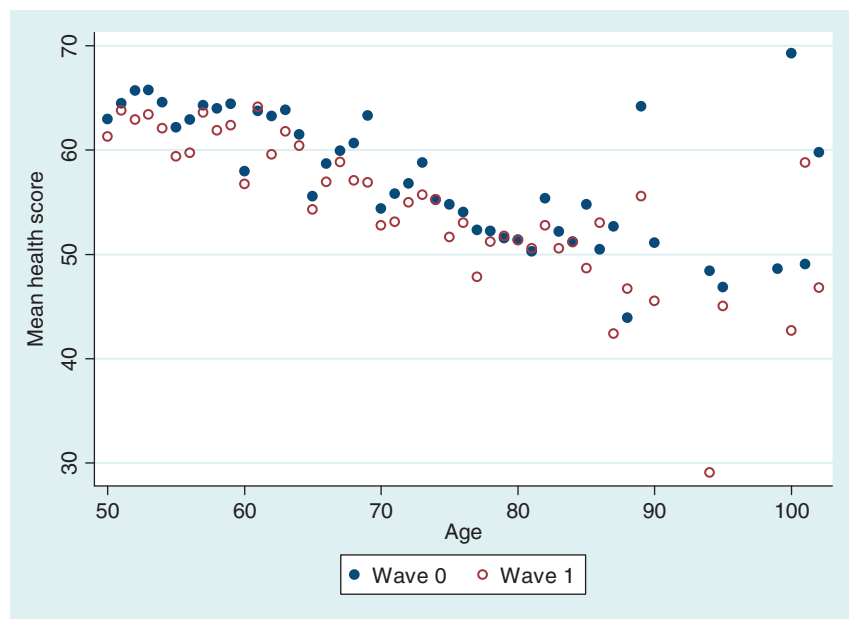


Figure 3 SAGE Waves 0 and 1 mean health scores for older adults, by age, pooled data for four countries (Ghana, India, Mexico and Russia)

Wave 2 in 2012/13 and Wave 3 in 2014/15. Funding has been secured for Waves 2 and 3 of data collection, with possible opportunities to expand the number of participating countries.

The study is coordinated by WHO in close collaboration with leading research institutions in the respective countries, with variable levels of involvement of the national health authorities. The latter is particularly critical to the overall success and strategic use of the results. The collection of a range of biological and

clinical markers in addition to a very comprehensive interview is an asset.

The SAGE collaborations with local health and demographic surveillance studies or systems provide an opportunity to link non-fatal health outcomes data to information from demographic surveillance, such as risk factors, mortality and migration, and track these populations over time. Data from these sites and systems can be compared with SAGE national samples in China, Ghana, India and South Africa to

Table 3 Generalized estimation equation regression results for declines in the health score between Wave 0 and Wave 1, pooled data from four countries ($N = 8160$)

Characteristics		Coefficient	P-value	Confidence interval	
Sex	Men				
	Women	-4.93	<0.01	-5.67	-4.18
Age group	50-59				
	60-70	-3.86	<0.01	-4.60	-3.12
	70-80	-8.06	<0.01	-8.95	-7.17
	80+	-11.79	<0.01	-13.14	-10.45
Education	No formal education				
	Less than primary	0.41	0.55	-0.91	1.73
	Primary completed	-0.84	0.27	-2.33	0.64
	Secondary school	0.29	0.65	-0.98	1.57
	High school	1.48	<0.01	0.46	2.49
	College/university	2.47	<0.01	0.95	3.98
Income	Postgraduate	3.88	<0.01	2.09	5.66
	Q1 (lowest)				
	Q2	0.89	0.09	-0.15	1.93
	Q3	1.25	0.02	0.20	2.30
	Q4	2.11	<0.01	1.04	3.18
Chronic conditions ^a	Q5 (highest)	3.79	<0.01	2.60	4.98
	None				
	1	-5.81	<0.01	-6.59	-5.04
	2	-8.29	<0.01	-9.44	-7.13
	3+	-9.46	<0.01	-11.30	-7.63
Alcohol ^b	No				
	Yes	-0.10	0.79	-0.90	0.69
Tobacco ^c	No				
	Yes	-1.21	<0.01	-2.02	-0.40
Country	Mexico				
	Ghana	-4.20	<0.01	-5.55	-2.84
	India	-6.02	<0.01	-7.06	-4.98
	Russian Federation	-4.74	<0.01	-6.01	-3.47
Time	Wave 0				
	Wave 1	-0.39	0.17	-0.96	0.17
Constant		70.91	<0.01	69.28	72.53

Reference groups: Men, 50-59 year age group, no formal education, lowest income quintile, no chronic conditions, alcohol abstainer, non-smoker, Ghana, Wave 0.

^aAngina, arthritis, asthma, diabetes and depression.

^bHeavy alcohol use in the past week, 4+ standard drinks for women and 5+ standard drinks for men in any single episode.

^cCurrent daily smoking.

assess plausibility of findings, as well as to generate new hypotheses that can be more intensively studied using surveillance field sites before incorporating these components into future rounds of SAGE in national samples.

Weaknesses are related to the potential high attrition rates that often characterize national longitudinal

sample surveys. The duration of the interview is long (mean time for Wave 1 was 2.5 h), as multiple dimensions of health and well-being are measured, which may be particularly demanding for both respondents and interviewers. This may affect the data quality, although no systematic problems have been detected so far. In several countries, urban dwellers more often

refused to participate in the survey, as is the case in other population surveys internationally. All countries in future waves of SAGE will use CAPI, which will improve efficiency in terms of sample and data management. Information from earlier waves will be preloaded in the CAPI for respondents who are being followed up and consistency checks will be carried out in future rounds.

Data resource access

The SAGE website (www.who.int/healthinfo/systems/sage) and Wikipedia site (http://en.wikipedia.org/wiki/Study_on_Global_Ageing_and_Adult_Health) provide additional details and access to survey materials. A recent US Census Bureau report provides a cogent summary of some of the measures included in SAGE.¹⁹

SAGE is committed to the public release of study instruments, protocols and meta- and micro-data for Waves 0 and 1. Study documentation was based on standards created by the Data Documentation Initiative (www.ddialliance.org/) for data archiving. Prospective users will be asked to complete a Users Agreement before access is provided. Micro- and meta-data are available through:

- WHO's SAGE website by request (Wave 0: www.who.int/healthinfo/survey, Wave 1: www.who.int/healthinfo/systems/sage) (22 November 2012, date last accessed);
- WHO's archive using the National Data Archive application: <http://apps.who.int/healthinfo/systems/surveydata> (22 November 2012, date last accessed);
- National Archive of Computerized Data on Aging: www.icpsr.umich.edu/icpsrweb/NACDA/ at the University of Michigan; (22 November 2012, date last accessed)
- International Household Survey Network: www.surveynetwork.org/home/?q=activities/catalog/surveys (22 November 2012, date last accessed); and
- Meta-data are archived in the RAND Survey Meta Data Repository: <https://mmicdata.rand.org/megametadate/> (22 November 2012, date last accessed).

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India to increase the sample of women aged 15–49 as a nested study examining health in younger women, which used the Wave 0 questions about maternal and child health in the Wave 1 interview for these women. SAGE Waves 2 and 3 are funded through committed support from the NIA and WHO. All collaborating institutions provided substantial resources to conduct the studies.

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KEY MESSAGES

- SAGE provides health and well-being data on over 34 000 older adults in China, Ghana, India, Mexico, the Russian Federation and South Africa, suggesting significant differences in the rates of health decline between the countries.
- SAGE provides health, disability, chronic conditions, risk factors and health care utilization data needed to prepare for an ageing world in lower-income countries, with data comparable to studies in higher-income countries, such as the Health and Retirement Study family of studies.
- The SAGE-INDEPTH collaboration generates two waves of health, disability and well-being data in eight health and demographic surveillance system field sites in four African and four Asian countries.
- A SAGE-HIV sub-study on the impacts of HIV, anti-retroviral therapy and caregiving in older adults generates two waves of data in Uganda and South Africa.

References

- Gruenberg EM. The failures of success. *Milbank Mem Fund Q Health Soc* 1977;**55**:3–24.
- Schneider EL, Brody JA. Aging, natural death and the compression of morbidity: another view. *N Engl J Med* 1983;**309**:854–57.
- Fries JF. Aging, natural death, and the compression of morbidity. *N Engl J Med* 1980;**303**:130–35.
- Fries JF. Measuring and monitoring success in compressing morbidity. *Ann Intern Med* 2003;**139**:455–59.
- Manton KG. Changing concepts of morbidity and mortality in the elderly population. *Milbank Mem Fund Q Health Soc* 1982;**60**:183–244.
- Manton KG, Xiliang Gu, Lamb VL. Change in chronic disability from 1982 to 2004/2005 as measured by long term changes in function and health in the U.S. elderly population. *PNAS* 2006;**103**:18374–79.
- Suzman R. Guest Editorial: The INDEPTH WHO-SAGE multicentre study on ageing, health and well-being among people aged 50 years and over in eight countries in Africa and Asia. *Glob Health Action* 2010;**3**(Suppl 2):5–7.
- Kowal P, Kahn K, Ng N *et al.* Ageing and adult health status in eight lower-income countries: the INDEPTH WHO-SAGE collaboration. *Glob Health Action* 2010;**3**(Suppl 2):11–22.
- Ng N, Kowal P, Kahn K *et al.* Health inequalities among older men and women in Africa and Asia: evidence from eight Health and Demographic Surveillance System sites in the INDEPTH WHO-SAGE study. *Glob Health Action* 2010;**3**(Suppl 2):96–107.
- Scholten F, Mugisha J, Seeley J *et al.* Health and functional status among older people with HIV/AIDS in Uganda. *BMC Public Health* 2011;**11**:886.
- Nyirenda M, Chatterji S, Falkingham J *et al.* An investigation of factors associated with the health and well-being of HIV-infected or HIV-affected older people in rural South Africa. *BMC Public Health* 2012;**12**:259.
- Kahneman D, Krueger AB, Schkade DA, Schwarz N, Stone AA. A survey method for characterizing daily life experience: The Day Reconstruction Method. *Science* 2004;**306**:1776–80.
- Miret M, Caballero FF, Mathur A *et al.* Validation of a measure of subjective well-being: an abbreviated version of the Day Reconstruction Method. *PLoS One* 2012;**7**:e43887.
- Ustun TB, Chatterji S, Mechbal A, Murray CJL, WHS Collaborating Groups. The World Health Surveys. In: Murray CJL, Evans DB (eds). *Health Systems Performance Assessment: Debates, Methods and Empiricism*. Geneva: World Health Organization, 2003.
- United Nations Educational, Scientific and Cultural Organization. *International Standard Classification of Education 1997; (ISCED 97)*, 2006 (22 Nov 2012, date last accessed).
- International Labour Organization. *International Standard Classification of Occupations; (ISCO-88)*, 1988 (22 Nov 2012, date last accessed).
- Wilson M, Allen DD, Li JC. Improving measurement in health education and health behavior research using item response modeling: introducing item response modeling. *Health Educ Res* 2006;**21**(Suppl 1):i4–18.
- Hanley JA, Negassa A, Edwardes MD, Forrester JE. Statistical analysis of correlated data using generalized estimating equations: an orientation. *Am J Epidemiol* 2003;**157**:364–75.
- Wan H, Muenchrath MN, Kowal P. US Census Bureau. Shades of gray. *A Cross-country Study of Health and Well-Being of the Older Populations in SAGE Countries; 2007-10, 2012* (22 Nov 2012, date last accessed).
- Jorm AF. The Informant Questionnaire on cognitive decline in the elderly (IQCODE): a review. *Int Psychogeriatr* 2004;**16**:275–93.