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Ageing and adult health status in eight lower-income countries: the INDEPTH WHO-SAGE collaboration

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Background: Globally, ageing impacts all countries, with a majority of older persons residing in lower- and middle-income countries now and into the future. An understanding of the health and well-being of these ageing populations is important for policy and planning; however, research on ageing and adult health that informs policy predominantly comes from higher-income countries. A collaboration between the WHO Study on global AGEing and adult health (SAGE) and International Network for the Demographic Evaluation of Populations and Their Health in developing countries (INDEPTH), with support from the US National Institute on Aging (NIA) and the Swedish Council for Working Life and Social Research (FAS), has resulted in valuable health, disability and well-being information through a first wave of data collection in 2006–2007 from field sites in South Africa, Tanzania, Kenya, Ghana, Viet Nam, Bangladesh, Indonesia and India.

Objective: To provide an overview of the demographic and health characteristics of participating countries, describe the research collaboration and introduce the first dataset and outputs.

Methods: Data from two SAGE survey modules implemented in eight Health and Demographic Surveillance Systems (HDSS) were merged with core HDSS data to produce a summary dataset for the site-specific and cross-site analyses described in this supplement. Each participating HDSS site used standardised training materials and survey instruments. Face-to-face interviews were conducted. Ethical clearance was obtained from WHO and the local ethical authority for each participating HDSS site.

Results: People aged 50 years and over in the eight participating countries represent over 15% of the current global older population, and is projected to reach 23% by 2030. The Asian HDSS sites have a larger

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proportion of burden of disease from non-communicable diseases and injuries relative to their African counterparts. A pooled sample of over 46,000 persons aged 50 and over from these eight HDSS sites was produced. The SAGE modules resulted in self-reported health, health status, functioning (from the WHO Disability Assessment Scale (WHODAS-II)) and well-being (from the WHO Quality of Life instrument (WHOQoL) variables). The HDSS databases contributed age, sex, marital status, education, socio-economic status and household size variables.

Conclusion: The INDEPTH WHO–SAGE collaboration demonstrates the value and future possibilities for this type of research in informing policy and planning for a number of countries. This INDEPTH WHO–SAGE dataset will be placed in the public domain together with this open-access supplement and will be available through the GHA website (www.globalhealthaction.net) and other repositories. An improved dataset is being developed containing supplementary HDSS variables and vignette-adjusted health variables. This living collaboration is now preparing for a next wave of data collection.

Access the supplementary material to this article: INDEPTH WHO-SAGE questionnaire (including variants of vignettes), a data dictionary and a password-protected dataset (see **Supplementary files** under **Reading Tools** online). To obtain a password for the dataset, please send a request with 'SAGE data' as its subject, detailing how you propose to use the data, to global.health@epiph.umu.se

The ageing of populations is often considered as a global public health success, but results in many ensuing challenges, particularly in lower- and middle-income countries where societies did not grow wealth before growing old, as in higher-income countries. Societal ageing will affect economic and health systems in all nations, including the ability of states and societies to both maintain contributions from and also provide resources for older population groups.

But will population ageing affect lower- and higher–income countries in similar ways? The projected macroeconomic and health impacts from longer life expectancies have only recently become clearer for higher-income nations (1–5); but few non-Organization for Economic Cooperation and Development (OECD) countries have the data to determine if extended longevity coincides with healthier lives until older ages (that is, a compression of morbidity). Unlike wealthier countries, the existing formal social protection systems in most lower-income countries cover only a small proportion of the older population (6); however, if we believe in demographic dividends, lower-income countries will have a long lead period to collect data which can be used to inform economic and health systems (7). Burden of disease shifts from maternal/child health and acute communicable diseases to chronic infectious and non-communicable diseases in lower-income countries will challenge health systems without the data necessary to inform policy and planning (8–11).

Interest in the measurement and comparability of adult health, the ageing process and well-being at older ages across countries has been increasing in recent years. The potential benefits of cross-national studies of ageing that enable us to understand the nature of demographic and epidemiological transitions have been widely recognised (12, 13). The US Health and Retirement Study (HRS) and other notable surveys, such as the English Longitudinal Study on Ageing (ELSA), have provided the necessary evidence base to begin to address the needs and contributions of older persons in higher-income countries. However, the majority of older persons now and into the future will reside in lower-income countries where the evidence base is very limited.

The HRS and ELSA studies, and more recently the World Health Organization's (WHO) multi-country Study on global AGEing and adult health (SAGE), have also been used as the basis for harmonisation with other national studies and many cross-national comparisons. Longitudinal ageing studies are critical to develop the evidence base to better understand ageing processes and adult health dynamics, especially in countries with limited mortality data due to poorly functioning or low coverage of vital registration systems. They have particular advantages in their ability to examine multiple exposures, determinants and outcomes, and to measure relationships over time: all essential aspects for understanding ageing across different contexts. However, while critical to research, policy and planning, longitudinal studies are resource and time intensive.

The extent to which lower-income countries have begun to generate and use critical evidence for an

effective health response has been slow and suboptimal in many countries (14). This lack of evidence is particularly prominent in low- and middle-income countries, partly because the demographic transitions have been relatively recent and also because political will and financial support have not been sufficient. Combining standardised survey modules with existing surveillance infrastructures, especially systems collecting vital registration details, offers a unique opportunity to reduce research costs and efficiently collect needed data in low- and middle-income countries.

If populations in any country are to age well, an improved understanding of ageing processes, of resilience factors for well-being, and of the determinants of health status (HS) across countries are needed. This knowledge will in turn inform health care and social protection policies and planning. Results from a collaboration between the WHO-SAGE survey platform and the International Network for the Demographic Evaluation of Populations and Their Health in developing countries (INDEPTH), involving Health and Demographic Surveillance Sites (HDSS) in eight countries (four African and four Asian) will provide HS, disability and well-being results for ageing and adult health in South Africa, Tanzania, Kenya, Ghana, Viet Nam, Bangladesh, Indonesia and India. Data collection included methods to improve cross-country comparability, thereby providing a basis for comparisons with data from higher-income countries, such as the US Health and Retirement Study and the ELSA. This article describes the background to the INDEPTH WHO-SAGE collaboration and introduces the methods used to generate the first wave of results – which includes site-specific analyses and cross-site comparisons.

Background

The WHO's Multi-Country Studies unit, with the support of the US National Institute on Aging's Behavioral and Social Research Program (NIA BSR), has implemented multi-country ageing and adult health studies to fill data gaps in lower-income countries and has worked to improve cross-national comparability with available data. WHO's SAGE conducts nationally representative household health surveys in six countries, with direct links to an additional 14 countries through various collaborations. SAGE is guided by an international expert Advisory Committee and coordinated from WHO's Multi-Country Studies unit. In addition, comparisons with ageing research in higher-income countries, such as the US HRS, English ELSA and the pan-European Survey of Health, Ageing and Retirement in Europe (SHARE) are ongoing.

WHO's collaboration with INDEPTH has generated data from HDSS sites in eight countries (Africa: Agincourt, South Africa; Ifakara, Tanzania; Nairobi, Kenya;

Navrongo, Ghana; Asia: Filabavi, Viet Nam; Matlab, Bangladesh; Purworejo, Indonesia and Vadu, India) and provides another valuable data collection platform for cross-national comparisons of ageing. The NIA BSR was instrumental in bringing the two groups together from the outset and has provided technical guidance throughout in combining survey and surveillance data collection efforts to fill needed data gaps on ageing and adult health. WHO SAGE, the INDEPTH Adult Health and Ageing Working Group, the NIA and the eight participating INDEPTH HDSS sites have developed a collaboration built on these survey and surveillance data collection platforms. This included health and well-being survey data collected within or parallel to HDSS household (HH) census update rounds and linked socio-demographic household data. While this initial dataset is cross-sectional, there are plans to include longitudinal HDSS data and further waves of data collection using an adapted summary version of the SAGE instrument in the HDSS sites. This will significantly enhance the value of the collaboration and resulting datasets by tracking changes over time in the same population samples and relating them to health determinants, predictors and outcomes, such as mortality in older adults. An introduction to the countries, HDSS sites and research methods follows.

Setting the stage

Country characteristics

The ongoing demographic shift provides concrete evidence that most countries will be faced with an increasingly old or ageing population – the challenge is for national and international health communities to use available data to best prepare for these changes. At present, 62% of older persons reside in less developed countries and this is projected to increase to almost 80% by 2050 (15).

Table 1 includes the estimated and projected total populations and proportions of older adults for the world and participating INDEPTH countries in 2009 and 2030. The World Bank income category is also included for each country, with a mix of five low- and three middle-income countries (16). In 2009, over 281 million people aged 50 years and over resided in the eight nations included in this collaboration, which constitutes 20% of the global population in that age group (15). Similarly, 18% of the global population aged 60 and over lives in these eight countries. These proportions will increase to 23% and 21%, respectively, by 2030. Over the same time period, the percentage of the population aged 0–14 years in these countries will drop from 29.9 to 28.5% and five of the eight countries will have a larger proportion of persons aged 60 and over than under 15 years by 2050 (the four Asian countries and South Africa). Overall, the

Table 1. Population totals and proportions of older adults for the world and by INDEPTH country, in 2009 and projected to 2030

Country	Country income category[a]	2009			2030		
		Total, N[b]	50+, N (%)	60+, N (%)	Total, N	50+, N (%)	60+, N (%)
World		*6,829*	*1,379 (20.2)*	*737 (10.8)*	*8,309*	*2,283 (27.5)*	*1,370 (16.5)*
Sub-Saharan Africa		*843*	*110 (10.9)*	*54 (5.3)*	*1,308*	*157 (12.0)*	*78 (5.9)*
South Africa	UMI	50	8 (15.0)	4 (7.1)	55	10 (19.1)	6 (11.1)
Tanzania	Low	44	4 (9.5)	2 (4.8)	75	8 (10.6)	4 (5.3)
Kenya	Low	40	3 (8.8)	2 (4.1)	63	7 (11.5)	3 (5.5)
Ghana	Low	24	2 (11.2)	1 (5.7)	35	5 (15.3)	3 (7.7)
Asia		*4,121*	*785 (19.1)*	*400 (9.7)*	*4,917*	*1,398 (28.4)*	*821 (16.7)*
Viet Nam	Low	88	15 (17.2)	6 (8.6)	105	32 (30.6)	19 (18.2)
Bangladesh	Low	162	20 (12.9)	10 (6.0)	203	46 (22.9)	23 (11.3)
Indonesia	LMI	230	40 (17.4)	20 (8.8)	271	79 (28.9)	43 (16.0)
India	LMI	1,198	187 (15.6)	89 (7.4)	1,485	343 (23.1)	185 (12.4)
Pooled INDEPTH country (8) totals		1,836	281 (15.3)	135 (7.3)	2,293	531 (23.2)	286 (12.5)

[a]World Bank country income category: Low, low income; LMI, lower-middle income; UMI, upper-middle income.
[b]N in millions (,000,000).
Sources: UN Population Division (15) and World Bank (16).

percentage increase in population aged 60+ will grow more in the African than Asian countries.

With ageing populations and increasing life expectancies, countries will inevitably see changing population disease burdens. Burdens of disease, risk factors and patterns of injury are changing through a complex combination of evolving social, demographic, health, political and economic processes. Diseases thought to be the domain of higher-income countries are now significant causes of morbidity and mortality in a number of lower- and middle-income countries (17–19).

The most recent Global Burden of Disease (GBD) 2004 update includes distributions of mortality and morbidity by three major groupings: (Group I) communicable diseases, maternal health and nutrition; (Group II) non-communicable diseases; and (Group III) violence and injuries. The 2004 update incorporates revisions and new data working from the initial 1990 GBD (20). The 1990 GBD results estimated 44% of total burden was Group I, 41% for Group II and 15% for Group III worldwide (21). These data show that even in 1990, NCDs were a significant contributor to mortality rates. Fig. 1 shows the distributions of fatal disease burden by geographic grouping and country for 2004. Preliminary results indicate a substantial increase in the proportion of deaths due to non-communicable diseases from 59% in 2002 to 69% in 2030 (19). All the participating Asian HDSS sites had higher NCD rates than the 1990 estimates – and Indonesia had a much higher Group III burden. Countries that are at an earlier phase of the demographic transition typically have a higher mortality burden from Group I conditions, and this is more clearly the case for the African countries participating in the INDEPTH WHO–SAGE

collaboration (Fig. 1). South Africa's burden profile is exceptional here because as an upper-middle income country, a lower communicable disease burden is expected; however, the massive HIV/AIDS burden clearly shifts the burden distribution. Similarly, despite being a lower-income country, Viet Nam has a comparatively lower communicable disease burden.

Shifting to morbidity, the top three contributors to morbidity burdens in middle-income countries in 2004 were unipolar depressive disorders, ischaemic heart disease and cerebrovascular disease (20). The top three for lower-income countries were lower respiratory infections, diarrhoeal diseases and HIV/AIDS. Fig. 2 illustrates the burden of non-fatal health outcomes by major grouping
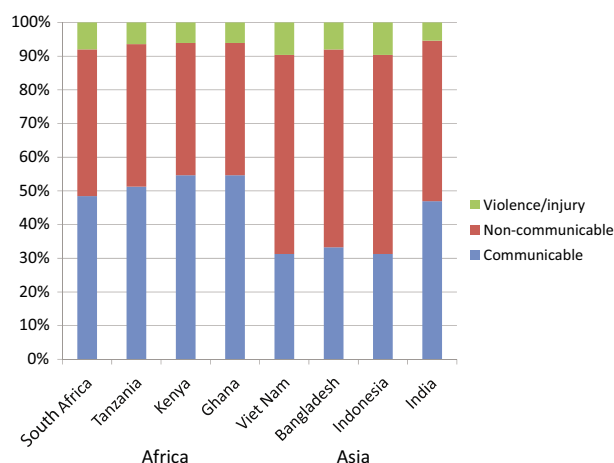

Fig. 1. Mortality profiles (age-standardised death rates) by major Burden of Disease grouping and country, 2004 (WHO 2008).

and INDEPTH HDSS site country for 2004, indicating those conditions which lead to longer years of life lived in a state of less than full health (non-fatal health outcomes or disability). The figure illustrates the mixture of disease burden in the participating low- and middle-income countries, with Group I burden featuring more prominently in African countries and Group II in Asian countries. Still, a majority of the main chronic conditions predominate in older age groups in both regions (19). From currently available data, the overall contribution of disability from non-communicable diseases is projected to grow substantially and ageing will be one of the major drivers of the burden (22).

HDSS characteristics

INDEPTH (http://www.indepth-network.org) is a network of 37 sites in 19 countries in Africa, Asia, Central America and Oceania based on health and socio-demographic surveillance within defined areas. The network brings together virtually all of the world's HDSSs located in low- and middle-income settings, and currently covers over 2 million individuals. Regular household census updates at each HDSS site allow for continuous, household-level monitoring of all vital events (births, deaths and migrations) in the defined population. INDEPTH provides an exceptional resource with which to characterise the health, demographic and social dynamics of some of the world's most vulnerable populations. The INDEPTH Adult Health and Ageing Working Group has established INDEPTH's capability to contribute critical insights into the adult health, ageing and disease transitions evolving in Africa and Asia, and to use this understanding to inform policy and evaluate interventions of potentially high impact.
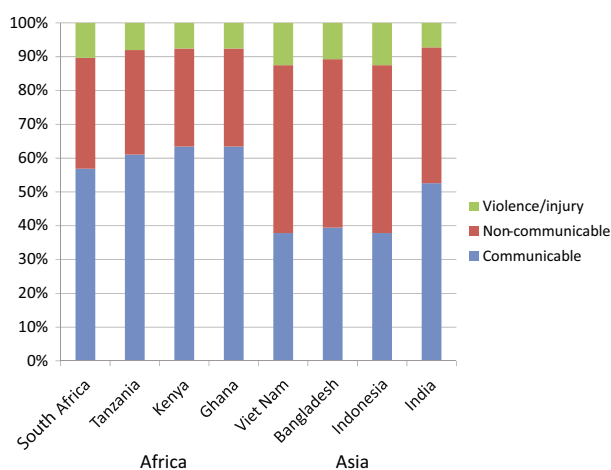

Fig. 2. Morbidity profiles (age-standardised DALYs) by major Burden of Disease grouping and country, 2004 (WHO 2008).

SAGE characteristics

The SAGE project (http://www.who.int/healthinfo/systems/sage) has become a leading multi-country study on ageing and adult health in lower- and middle-income countries. Launched in 2003 as part of the WHO's World Health Survey (WHS), SAGE has implemented nationally representative population surveys in six core countries: China, Ghana, India, Mexico, the Russian Federation and South Africa. The specific aims of SAGE are to:

- Obtain reliable, valid and comparable data on levels of health on a range of key domains for older adult populations.
- Examine patterns and dynamics of age-related changes in health using longitudinal follow-up of survey respondents as they age, and to investigate socio-economic consequences of these health changes.
- Supplement and cross-validate self-reported measures of health and the anchoring vignette approach to improve comparability of self-reported measures, through measured performance tests for selected health domains.
- Collect data on health examinations and biomarkers to improve reliability of data on morbidity, risk factors and monitor effect of interventions.

The baseline data collection for SAGE (Wave 0) was conducted as part of the 2002/2003 WHS with SAGE Wave 1 data collected between 2007 and 2010. Biennial longitudinal follow-up is planned with Wave 2 in 2011 and Wave 3 in 2013.

SAGE provides data on the levels and differences in health and well-being across low- and middle-income countries, and methodologies that improve health measurement and cross-national comparability. SAGE covers a broad range of topics, with a focus on health, disability, risk factors, stress, happiness, social networks, economic well-being, care-giving, health care utilisation and health systems responsiveness. Furthermore, a host of biomarker data was collected, including anthropometrics, physical performance tests and dried blood spots.

Another objective for SAGE is to develop working relationships and linkages to other data collection platforms, including surveys and surveillance sites, to better understand changing health over the life course, compression of morbidity and perceptions of health, quality of life and economic well-being within and across countries. SAGE has a history of collaborating with other ageing research, like the US HRS; ELSA; SHARE; China Health, Ageing, Retirement Longitudinal Study; Longitudinal Ageing Study in India; and, now with INDEPTH HDSS sites. The collaboration with IN-DEPTH extends the possibilities of longitudinal household-based research through the combination of survey

and surveillance methods and provides opportunities to apply new methodological techniques to cross-country ageing research.

The collaboration

The collaboration between WHO-SAGE and INDEPTH has pursued four main goals: (1) to develop and implement a survey instrument that can be incorporated into a regular census update round placing minimal additional demands on existing research infrastructure; (2) to implement the full SAGE survey in parallel to a summary short survey round, but with separate infrastructure and resources; (3) to determine key areas where INDEPTH HDSS sites could be used as methodological laboratories to pilot new methods and test hypotheses – so as to exploit the complementary strengths of both survey and surveillance data; and (4) to derive more integrated analytical plans to assess ageing and adult health at national and sub-national levels.

For this article, we address goals 1 and 4 above using a summary version of the full SAGE instrument which was implemented in eight INDEPTH HDSS sites. This part of the collaboration had two primary aims. The first was to use survey and surveillance data to describe the situation of ageing and adult health within and across participating HDSS sites. This included the adaptation and implementation of standardised SAGE survey modules on health and wellbeing in INDEPTH HDSS sites. The HDSS sites identified overlapping content in their respective surveillance data and the SAGE survey instruments. HDSS sites then worked to enhance the comparability of the socio-demographic data collected at each site to be included in a cross-site dataset (for example, comparing socio-economic status indicators and mapping education levels to an international standard). The second aim was to determine the feasibility of collecting longitudinal data through combining the two types of data collection efforts as a means to establish ageing and adult health trends in a range of countries. A first step was to develop a survey instrument adapted from the full SAGE questionnaire that could be inserted into a regular census round without significant disruption to the infrastructure and process. The belief was that the potential increase in efficiency from adding modules to the regular data collection rounds, coupled with new analytical techniques, could provide data on changing health and well-being at a reduced cost whilst retaining the strengths of both surveillance and survey data. These data would then be used to inform the design of interventions addressing vital aspects of older adult health and functioning and, importantly, have the potential to be monitored more frequently within the HDSS sites than with the national-level surveys.

Methods

The initial step was to develop a health and well-being module that could be nested within a typical census update round in an INDEPTH HDSS site. This meant that the interview needed to be approximately 15–20 min in duration with minimal impact on interviewers and respondents. A meeting between WHO and INDEPTH at the University of the Witwatersrand, South Africa in 2006 was used to examine psychometric properties of the health and quality of life sections of the SAGE survey instrument based on results from the 2005 SAGE pilot study ($n = 1,500$) conducted in Ghana, India and Tanzania, to determine priorities, to outline the scope of the working relationship and to invite interested HDSS sites to participate. During the meeting, the survey instruments and results from the SAGE pilot were reviewed with commentary from each INDEPTH HDSS site. The group then worked together to create a shortened summary version of the full SAGE questionnaire (the INDEPTH WHO–SAGE instrument, available as a supplementary file to this article, including variants of vignettes) which consisted of questions on HS and vignettes, functioning and subjective well-being. This summary questionnaire was subsequently piloted in each HDSS site in 2006/2007 before implementing the full data collection. Pilot results and interview debriefings were used to refine and finalise the standardised questionnaire to be used across all HDSS sites. This version was then translated and back-translated in local languages using translation protocols from both the WHS and INDEPTH HDSS sites.

Standard interview protocols, training curricula (including a DVD with video clips of example interviews) and quality assurance procedures were used across all HDSS sites. Training sessions with experienced interviewers were conducted for survey teams at each HDSS site. These training sessions lasted an average of 4.5 days. The interview teams had the added advantage of long-standing relationships within the surveillance sites.

Face-to-face interviews with participants aged 50 and over were conducted in the course of the regularly scheduled census in three HDSS sites. Separate survey activities were used in five HDSS sites, where in one site it was part of a broader ageing survey (Nairobi). Feedback from the survey teams indicated that it took about three weeks to become maximally efficient at interviews and data collection. Across all the sites, the mean interview time, excluding vignettes, was 20 minutes towards the end of the survey process. This was about 14 minutes less than the average time at the beginning of the interview process. The vignettes took an average of 13 minutes of interview time, again, the time decreasing from an average of 19 minutes at the beginning of the process.

Vignette methodology

Cross-national comparative data analysis enhances understanding of HS differences, ageing dynamics and cultural differences, but also facilitates the evaluation of the performance of health, social and economic systems, and policies to address ageing and health. Typically, the measurement of HS relies on self-reported responses in surveys and the self-response data take the form of ordered categorical (ordinal) responses. Eight domains of health were used, which account for up to 80% of the variance in HS (23). As part of the WHO cross-country health survey approach, anchoring vignettes have been used to position self-reported responses onto a common scale comparable across individuals. An anchoring vignette is a description of a concrete level on a given health domain that respondents are asked to evaluate with the same questions and response scales applied to self-assessments on that domain.

A concrete example of the HS questions and vignettes for one health domain, mobility, follows:

Female respondent X is asked two questions about her own level of mobility,

| Q1 | Overall in the last 30 days, how much difficulty did you have with moving around? | 'Was it none, mild, moderate, severe, extreme or cannot do this?' |
| Q2 | In the last 30 days, how much difficulty did you have in vigorous activities? | 'Was it none, mild, moderate, severe, extreme or cannot do this?' |

Next the respondent is asked to respond to questions about the vignettes. Vignettes are brief stories that describe a certain fixed level of health, with five vignettes covering a range of mobility levels. The respondent is instructed to put herself in the shoes of the person described in the vignettes and answer the same question as if she were that person:

[Someshni] has a lot of swelling in her legs due to her health condition. She has to make an effort to walk around her home as her legs feel heavy.

| Q3 | How much difficulty did [Someshni] have with moving around? | 'Was it none, mild, moderate, severe or extreme or cannot do this?' |
| Q4 | How much difficulty did [Someshni] have in vigorous activities? | 'Was it none, mild, moderate, severe or extreme or cannot do this?' |

By mapping responses to various questions on the same health domain to a common comparable scale, anchoring vignettes may provide a bridge between data collected across cultures or population sub-groups [further detailed information about anchoring vignettes and statistical models is available elsewhere (24–27)].

Ethical clearance was obtained from research review boards local to each participating HDSS site (several of which are linked to universities), plus from the WHO Ethical Review Committee as part of SAGE. Informed consent was obtained from each respondent prior to interview.

Sample: Six HDSS sites collected data from the entire population aged 50+ in their HDSS. Sampling in the two remaining HDSS sites (Navrongo, Ghana and Matlab, Bangladesh) was based on random selection of persons aged 50 and over within the HDSS site. For comparison purposes, a smaller sample of younger adults (aged 18–49, $n=5,794$) was interviewed in five HDSS sites using similar methods.

Questionnaire: The abbreviated survey instrument consisted of two modules adapted from the full SAGE questionnaire: the HS and associated vignette questions plus Activities of Daily Living (ADL)-type questions (following the WHO Disability Assessment Scale version II (WHODAS-II) model), and questions on subjective well-being as measured by the 8-item version of the WHO Quality of Life (WHOQoL) instrument (28). Some HDSS sites chose to add additional modules and/or questions, but the primary goal was a standardised questionnaire that could be applied in all HDSS sites embedded within existing HDSS census rounds.

Additional data targeted for inclusion into the final dataset, and deriving directly from the HDSS, included socio-demographic characteristics, such as age, sex, education, marital status, socio-economic status and household information, such as the number of household members.

Dataset

Following site-level data entry and cleaning, and after a data-sharing agreement was reached between the participating INDEPTH HDSS sites and with WHO, data were forwarded to a central location (Umeå, Sweden) for cleaning and imputation of missing data. Regular correspondence between HDSS sites improved the efficiency of the data checking and cleaning process. A working meeting held in 2008 at Umeå University, Sweden, was used to harmonise data across the sites, finalise the dataset and agree on initial outputs. A first dataset was generated and included:

- Comprehensive HH information including roster of all members (by age, sex, marital status, education, location (urban or rural), HH head) and socio-economic status.
- For each respondent: age and date of birth, sex, marital status and education.
- From the adapted SAGE modules: overall general self-rated health, HS from eight domains plus related vignette information, functioning assessment from the

12-item WHODAS and subjective quality of life results from the 8-item WHOQoL.

- Plans to archive the data at WHO, INDEPTH and the University of Michigan's National Archive of Computerized Data on Aging (NACDA) to maximise opportunities to share data and provide multiple access portals.

The four main outcome variables derived from this data and reported in the site-specific and cross-site articles in this issue are self-rated general health (SRH), overall HS, disability levels (WHODAS) and subjective quality of life (WHOQoL).

Overall general self-reported health (SRH)

Two overall general health questions were asked, each with 5-point Likert-type response scales. The first is a question asked very often in surveys: 'In general, how would you rate your health today? Would you say, very good (1), good (2), moderate (3), bad (4) or very bad (5)?'; and the other was a question related to general difficulties in day-to-day tasks: 'Overall in the last 30 days, how much difficulty did you have with work or household activities? Was it, none (1), mild (2), moderate (3), severe (4) or extreme/cannot do (5)?' These types of global measures of self-rated health are commonly used in health surveys and as measures of population health. At the individual level, the global self-rated health question is a good predictor of many health and health-related outcomes (29, 30). However, the true meaning of responses to a single question for a multi-dimensional construct and the reliability of this measure over time has been questioned (31, 32).

Health status (HS)

Health scores were calculated based on self-reported health in eight health domains covering affect, cognition, interpersonal activities and relationships, mobility, pain, self-care, sleep/energy, and vision. Each domain included at least two questions. Asking more than one question about difficulties in a given domain provides more robust assessments of individual health levels and reduces measurement error for any single self-reported item. Item response theory (IRT) was used to score the responses to the self-reported health questions using a partial credit model which served to generate a composite HS score (33, 34). An item calibration was obtained for each item. In order to determine how well each item contributed to common global health measurement, chi-square fit statistics were calculated. The calibration for each of the health items was taken into account and the raw scores were transformed through Rasch modelling into a continuous cardinal scale where a score of 0 represents worst health and a maximum score of 100 represents best health.

Functional status (WHODAS)

Self-reported functioning was assessed through the standardised 12-item WHO Disability Assessment Scale, Version 2 (WHODAS) (35). It is a well-tested instrument, with published psychometric properties and a good predictor of global disability (36–38). The WHODAS is compatible with the International Classification of Functioning, Disability and Health (ICF) and contains many of the most commonly asked ADL and Instrumental Activities of Daily Living (IADL) questions. The WHODAS instrument also provides an assessment of severity of disability (39). Results from the 12-items were summed to get an overall WHODAS score, which was then transformed to a 0–100 scale, with 0 as best functioning (no disability) and 100 maximum disability.

Subjective well-being and quality of life (WHOQoL)

An 8-item version of the World Health Organization Quality of Life instrument (WHOQoL) was used to assess perceived well-being (28). This is a cross-culturally valid instrument for comprehensively assessing overall subjective well-being, yet is also very brief. Knowing that health and quality of life are strongly associated yet distinct concepts, WHOQoL will help describe the relationship in older persons across countries and over time. Results from the 8-items were summed to get an overall WHOQoL score which was then transformed to a 0–100 scale, similar to the health score.

Implementation results

Eight INDEPTH HDSS sites collected data using the summary questionnaire (see Table 2). Sample sizes ranged from almost 2,100 to over 12,000, with a total combined sample of over 46,000 persons aged 50 and over. Additionally, a random sample of persons aged 18–49 was included in five HDSS sites – as a comparison population – but these were not included in the initial dataset or analyses.

The survey took an average of 4.7 months to complete with a range of 3–8 months. Five sites implemented the survey as a stand-alone effort, with the three remaining HDSS sites (Navrongo, Ifakara and Agincourt) implementing the survey as part of a scheduled census update. Two of these three HDSS sites finished on schedule, with the one site requiring additional time and staff to complete the census and survey.

Discussion

Platform for research on adult health and ageing

In light of the projected demographic and epidemiologic transitions associated with an ageing world, a WHO and INDEPTH collaboration has demonstrated the capacity to generate data across African and Asian settings to better understand health outcomes and their determi-

Table 2. Selected features of participating HDSS sites: INDEPTH WHO-SAGE study, 2006–2007

HDSS site	Country	Year started	Periodicity of census updates	Total population	Total 50 years and over	Anticipated study population, all ages	Final study population 50 years and over
Africa							
Agincourt[a]	South Africa	1992	Annually	70,000	8,400	6,500	4,085
Ifakara[a]	Tanzania	1996	Every 4 months	84,000	9,400	5,000	5,131
Nairobi[a]	Kenya	2000	Every 4 months	69,000	2,700	2,700	2,072
Navrongo[a]	Ghana	1993	Every 4 months	144,000	22,900	5,000	4,584
Asia							
Filabavi[b]	Viet Nam	1999	Every 3 months	50,000	8,500	8,500	8,535
Matlab[a]	Bangladesh	1966	Every 2 months	212,000	33,800	5,000	4,037
Purworejo[b]	Indonesia	1990	Annually	53,000	14,200	14,200	12,395
Vadu[a]	India	2003	Every 6 months	68,000	8,000	8,000	5,430
			Totals	750,000	107,900	54,900	46,269

Note: The header has two spanning groups: "Approximate HDSS site populations" (Total population, Total 50 years and over) and "Study population" (Anticipated study population, all ages; Final study population 50 years and over).

[a]Support from the US National Institute on Aging.
[b]Support from Swedish Council for Working Life and Social Research.

nants in older adult populations. The initial results from the collaboration between WHO-SAGE and INDEPTH HDSS sites are a milestone for longitudinal research on ageing and adult health and provide an exceptional platform for multi-site and multi-country, longitudinal research on ageing and adult health in lower-income countries in Africa and Asia.

The data collection platform has the potential to substantially enhance the applications of findings from both survey (SAGE) and surveillance-based (INDEPTH) data collection. The very nature of the HDSS sites, with geographic boundaries defining their populations, along with established infrastructure and human resources, present a number of opportunities for methodological development and hypothesis testing prior to scaling to a national-level survey. A number of topics could be explored, such as the relationships between morbidity, well-being, social networks and mortality, because of the documentation levels and frequency of contact. Similarly, surveillance sites benefit from enhanced generalisability of results, expansion of objectives and comparability to other survey data, to name a few. Additionally, the methodological and practical strengths of each are accentuated, resulting in improved financial efficiencies for conducting longitudinal ageing research.

The collaboration will also support data harmonisation, data management and analytic capacity development, cross-validation and calibration of measures, contextualisation of the detailed information from HDSS within broader national patterns and trends, joint efforts to disseminate results and consideration of their policy implications.

The analysis of levels, trends and differentials in leading health problems globally is needed to identify persistent and emerging health challenges for older populations, and to monitor and evaluate health and social programmes to determine what works, assess how specific programmes are performing and inform decisions regarding programme design and implementation.

Limitations and difficulties
As with any longitudinal study, problems were experienced with locating respondents to be included – especially men, many of whom may be migrant labourers. Interviewers found difficulty in questioning the oldest old, even after training and increased awareness about the potential issues with interviewing this population segment. In addition, difficulties were experienced with explaining the vignettes, some of which included scenarios possibly foreign to rural settings. As part of the analysis of results, response patterns to the vignette questions would clearly indicate if, in the end, a respondent did not understand the vignettes.

Feasibility of longitudinal monitoring of adult health and ageing
Although we aimed to assess the feasibility of incorporating the INDEPTH WHO-SAGE short questionnaire into routine HDSS activities, only three of the eight sites attempted this, with the other five sites conducting the survey as a separate field activity. Of the three HDSS sites integrating the survey, one found need for additional time and staff. Interviewers needed time to gain experience interviewing older respondents and to develop strategies for high-quality interviews: the average duration of interviews, excluding vignettes, decreased on average by 14 minutes from about 34 minutes at the beginning of

the interviews to 20 minutes towards the end. The average length ended up at about 28 minutes.

In general, sites found value in targeting the age group of 50 and over, focusing on health rather than routine HDSS questions, linking INDEPTH WHO-SAGE data with existing HDSS variables and subsequent health outcomes. Any further data collection efforts will seek to shorten the questionnaire further; incorporate the survey modules into the routine census round; provide more training to implement the vignettes; and interview the entire population under surveillance rather than using a sample, where possible.

Future plans and possibilities

The next steps in the INDEPTH WHO-SAGE collaboration include further work on improving the existing dataset, incorporating additional existing HDSS variables and future rounds of data collection. Work will be undertaken to further harmonise HDSS variables, across INDEPTH HDSS sites, for example, re-examining the education data and wealth quintiles from each site. This will help to improve comparability across HDSS sites and countries, and with the nationally representative full SAGE studies implemented in three of the countries (South Africa, Ghana and India).

Additional HDSS variables have already been identified and will be added to the current summary dataset to produce an enhanced dataset. Planned additions include longitudinal HDSS data such as in- and out-migration, births, deaths, additional respondent characteristics (mother tongue, ethnicity, religious denomination) or changes in respondent and household characteristics over time (education, marital status, walls, floors, water, sanitation, fuel use for cooking, food security), and relevant data about health (non-communicable disease risk factors for example) and household composition (members). We will also include historical HDSS data to cover at least SAGE baseline years (back through 2002).

Three HDSS sites (Agincourt, Navrongo and Vadu) collected data using both the summary and full versions of the SAGE questionnaire. Examination of data from respondents who completed both the short and full survey will be undertaken and then compared with the nationally representative SAGE survey in their respective countries. These steps will allow examination of sub-national variation in health levels, as well as variation in the relationships between physical and mental functioning and other socio-demographic factors. The performance of the SAGE health module and vignettes among older adults in the surveillance sites can also be compared to the performance in the community SAGE samples from these countries. It will provide opportunities to compare and correlate findings from African and Asian countries participating in SAGE with INDEPTH sites in the same – as well as contrasting – national settings.

Further exploration of results using small area analyses and optimising the combination of survey and surveillance data are needed.

Finally, another wave of data collection is planned, for which funding was recently secured. Further hypothesis testing can be undertaken to take advantage of the unique panel data that the ongoing surveillance systems provide. For example, differences in functioning at older ages given different socio-economic and health transition environments may be explored in cross-site comparisons. The contrast, for instance, between the leading health problems in Navrongo, Ghana, which remain dominated by many persistent 'pre-transition' challenges (infectious diseases, nutritional disorders, maternal and perinatal conditions) and the emerging epidemics of non-communicable diseases in Agincourt, South Africa, provide a detailed epidemiologic backdrop for analysis of variation in levels on core health domains (40). Other hypotheses that could be examined relate to functioning of older adults in the context of evolving childcare contributions (for example, due to AIDS mortality of household members), levels of family and household support, and associated economic activity. Health issues of mortality, the compression of morbidity and social networks will also be pursued. The ability to connect comparable data on different dimensions of functioning to rich databases on individual and household variables has the potential to support important analyses for a wide range of questions concerning shifting determinants of health in older adults in settings undergoing dramatic socio-demographic changes.

Archiving and sharing

Appropriate metadata and the summary SAGE dataset with selected HDSS variables included will be made publicly available to researchers in concert with the publication of this supplement (see Supplementary files under Reading Tools online). The dataset will also be archived in the University of Michigan's National Archive of Computerized Data on Aging (NACDA).

Conclusion

This collaboration provides both the practical tools and infrastructure for collecting critical evidence needed by researchers and policy-makers. Health, disability, living conditions and social support are concerns for ageing populations throughout the world. Considering the dearth of health and well-being data for older people in most lower- and middle-income countries (13, 41, 42), this collaboration directly addresses this data gap now and into the future. WHO and INDEPTH will work to improve availability and use of reliable, valid and comparable health information at the country and global levels, developing and improving tools and methods for collecting this information, and providing norms, stan-

dards and technical guidance for data collection, research, analysis and synthesis of knowledge. The articles that follow in this supplement illustrate the value and quality of the data collected as part of this collaboration.

References

1. Cairncross F. Economics: age, health and wealth. Nature 2007; 448: 875–6.
2. Lee R, Mason A. Population aging, wealth, and economic growth: demographic dividends and public policy. Background Paper for the World Economic and Social Survey. New York: United Nations, Department of Economic and Social Affairs; 2007.
3. Deaton A. Policy implications of the gradient of health and wealth. Health Aff 2002; 21: 13–30.
4. England RS. The macroeconomic impact of global aging. A new era of economic frailty? Washington, DC: CSIS Press; 2002.
5. World Health Organization. Macroeconomics and health: investing in health for economic development. Report of the Commission on Macroeconomics and Health. Geneva: World Health Organization; 2001.
6. International Social Security Association. Social Security Programs throughout the World. Geneva: ISSA; 2009. Available from: http://www.issa.int/aiss/Resources/ISSA-Publications/Social-Security-Programs-Throughout-the-World6 [cited 10 May 2010].
7. Bloom DE, Canning D, Sevilla J. The demographic dividend. A new perspective on the economic consequences of population change. Santa Monica, CA: RAND; 2002.
8. Frenk J. The global health system: strengthening national health systems as the next step for global progress. PLoS Med 2010; 7: e1000089. Doi: 10.1371/journal.pmed.10000898.
9. Coovadia H, Jewkes R, Barron P, Sanders D, McIntyre D. The health and health system of South Africa: historical roots of current public health challenges. Lancet 2009. Doi: 10.1016/S0140-6736(09)60951-X.
10. Tollman SM, Kahn K, Sartorius B, Collinson MA, Clark SJ, Garenne ML. Implications of mortality transition for primary health care in rural South Africa: a population-based surveillance study. Lancet 2008; 372: 893–901. Doi: 10.1016/S0140-6736(08)61399-9.
11. Lafortune G, Balestat G. Trends in severe disability among elderly people: assessing the evidence in 12 OECD countries and the future implications. OECD Health Working Papers No. 26. 2007. DELSA/HEA/WD/HWP (2007)2.
12. Banks J, Marmot M, Oldfield Z, Smith JP. Disease and disadvantage in the United States and in England. JAMA 2006; 295: 2037–45.
13. National Research Council. Preparing for an aging world: the case for cross-national research. Panel on a research agenda and new data for an aging world. Washington, DC: National Academy Press; 2001.
14. Ferreira M. Research on ageing in Africa: what do we have, not have and should we have? Generations Rev 2005; 15: 32–5.
15. United Nations Department of Economic and Social Affairs, Population Division. World Population Prospects: the 2008 Revision. New York: United Nations; 2009.
16. World Bank. Country classification; 2009. Available from: http://data.worldbank.org/about/country-classifications [cited 10 May 2010].
17. Ebrahim S, Smeeth L. Non-communicable diseases in low and middle-income countries: a priority or a distraction? Int J Epidemiol 2005; 34: 961–6.
18. Salomon JA, Murray CJL. The epidemiologic transition revisited: compositional models for causes of death by age and sex. Popul Dev Rev 2002; 28: 205–28.
19. Mathers C, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med 2006; 3: 2011–30, e442. Doi: 10.1371/journal.pmed.0030442.
20. Mathers C, Fat DM, Boerma JT. The global burden of disease: 2004 update. Geneva: World Health Organization; 2008. Available from: http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf [cited 10 May 2010].
21. Murray CJL, Lopez AD. Global mortality, disability, and the contribution of risk factors: global Burden of Disease Study. Lancet 1997; 349: 1436–42.
22. Chatterji S, Kowal P, Mathers C, Naidoo N, Smith J, Suzman R. The health of aging populations in China and India. Health Aff 2008; 27: 1052–63.
23. Ustun TB, Chatterji S, Mechbal A, Murray CJL, WHS Collaborating Groups. The World Health Surveys. In: Murray CJL, Evans D, eds. Health systems performance assessment: debates, methods and empiricism. Geneva: World Health Organization; 2003.
24. King G, Murray CJL, Salomon JA, Tandon A. Enhancing the validity and cross-population comparability of measurement in survey research. Am Political Sci Rev 2004; 98: 567–83.
25. Murray CJL, Ozaltin E, Tandon A, Salomon JA, Sadana R, Chatterji S. Empirical evaluation of the anchoring vignette approach in health surveys. In: Murray CJL, Evans D, eds. Health systems performance assessment: debates, methods and empiricism. Geneva: World Health Organization; 2003.
26. Salomon JA, Tandon A, Murray CJL. Comparability of self rated health: cross-sectional multi-country survey study using anchoring vignettes. BMJ 2004; 328: 258–61.
27. Tandon A, Murray CJL, Salomon JA, King G. Statistical models for enhancing cross-population comparability In: Murray CJL, Evans D, eds. Health systems performance assessment: debates, methods and empiricism. Geneva: World Health Organization; 2003.
28. Schmidt S, Mühlan H, Power M. The EUROHIS-QOL 8-item index: psychometric results of a cross-cultural field study. Eur J Public Health 2006; 16: 420–8.

29. Bardage C, Saskia M, Pluijm F, Pedersen NL, Deeg DJH, Jylhä M, et al. Self-rated health among older adults: a cross-national comparison. Eur J Ageing 2005; 2: 149–58.

30. Frankenberg E, Jones NR. Self-rated health and mortality: does the relationship extend to a low income setting? J Health Soc Behav 2004; 45: 441–52.

31. Salomon JA, Nordhagen S, Oza S, Murray CJL. Are Americans feeling less healthy? The puzzle of trends in self-rated health. Am J Epidemiol 2009; 170: 343–51.

32. Sadana R, Mathers CD, Lopez AD, Murray CJL, Iburg KM. Comparative analysis of more than 50 household surveys of health status. In: Murray CJL, Salomon JA, Mathers CD, Lopez AD, eds. Summary measures of population health: concepts, ethics, measurement and applications. Geneva: World Health Organization; 2002.

33. Wilson M, Allen DD, Li JC. Improving measurement in health education and health behavior research using item response modelling: introducing item response modelling. Health Educ Res 2006; 21: i4–18.

34. Andrich D. Controversy and the Rasch model: a characteristic of incompatible paradigms? Med Care 2004; 42: 1–16.

35. World Health Organization. Measuring health and disability: a manual for the World Health Organization Disability Assessment Schedule (WHODAS 2.0). Geneva: World Health Organization; 2009.

36. Sousa RM, Dewey ME, Acosta D, Jotheeswaran AT, Castro-Costa E, Ferri CP, et al. Measuring disability across cultures – the psychometric properties of the WHODAS II in older people from seven low- and middle-income countries. The 10/66 Dementia Research Group population-based Surrey. Int J Methods Psych Res 2010; 19: 1–17.

37. Luciano JV, Ayuso-Mateos JE, Fernández A, Serrano-Blanco A, Roca M, Haro JM. Psychometric properties of the twelve item World Health Organization Disability Assessment Schedule II (WHO-DAS II) in Spanish primary care patients with a first major depressive episode. J Aff Disord 2010; 121: 52–8.

38. O'Donovan M-A, Doyle A. Measure of Activity and Participation (MAP), World Health Organization's Disability Assessment Schedule (WHODAS II); 2007. Available from: http://www.hrb.ie/uploads/tx_hrbpublications/mapbulletin.pdf [cited 3 August 2010].

39. World Health Organization. International classification of functioning, disability and health (ICF); 2001. Available from: http://www.who.int/classifications/icf/en/ [cited 10 May 2010].

40. WHO SAGE survey programme; 2010. Available from: http://www.who.int/healthinfo/systems/sage [cited 10 May 2010].

41. INDEPTH Network, iSHARE; 2010. Available from: http://www.indepth-network.org [cited 10 May 2010].

42. National Research Council. Aging in sub-Saharan Africa: recommendations for furthering research. Panel on policy research and data needs to meet the challenge of aging in Africa. In: Cohen B, Menken J, eds. Committee on population, division of behavioral and social sciences and education. Washington, DC: The National Academies Press; 2006.

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