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

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Background: Declining rates of fertility and mortality are driving demographic transition in all regions of the world, leading to global population ageing and consequently changing patterns of global morbidity and mortality. Understanding sex-related health differences, recognising groups at risk of poor health and identifying determinants of poor health are therefore very important for both improving health trajectories and planning for the health needs of ageing populations.

Objectives: To determine the extent to which demographic and socio-economic factors impact upon measures of health in older populations in Africa and Asia; to examine sex differences in health and further explain how these differences can be attributed to demographic and socio-economic determinants.

Methods: A total of 46,269 individuals aged 50 years and over in eight Health and Demographic Surveillance System (HDSS) sites within the INDEPTH Network were studied during 2006–2007 using an abbreviated version of the WHO Study on global AGEing and adult health (SAGE) Wave I instrument.

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The survey data were then linked to longitudinal HDSS background information. A health score was calculated based on self-reported health derived from eight health domains. Multivariable regression and post-regression decomposition provide ways of measuring and explaining the health score gap between men and women.

Results: Older men have better self-reported health than older women. Differences in household socio-economic levels, age, education levels, marital status and living arrangements explained from about 82% and 71% of the gaps in health score observed between men and women in South Africa and Kenya, respectively, to almost nothing in Bangladesh. Different health domains contributed differently to the overall health scores for men and women in each country.

Conclusion: This study confirmed the existence of sex differences in self-reported health in low- and middle-income countries even after adjustments for differences in demographic and socio-economic factors. A decomposition analysis suggested that sex differences in health differed across the HDSS sites, with the greatest level of inequality found in Bangladesh. The analysis showed considerable variation in how differences in socio-demographic and economic characteristics explained the gaps in self-reported health observed between older men and women in African and Asian settings. The overall health score was a robust indicator of health, with two domains, pain and sleep/energy, contributing consistently across the HDSS sites. Further studies are warranted to understand other significant individual and contextual determinants to which these sex differences in health can be attributed. This will lay a foundation for a more evidence-based approach to resource allocation, and to developing health promotion programmes for older men and women in these settings.

Keywords: *ageing*; *survey methods*; *public health*; *burden of disease*; *demographic transition*; *disability*; *well-being*; *health status*; *INDEPTH WHO-SAGE*

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

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Declining rates of fertility and mortality are driving demographic transitions in all regions of the world, leading to global population ageing. This includes substantial growth in the numbers and proportions of older adults in low- and middle-income countries, estimated at an annual growth rate of 2.6%. In 2010, about 9.9% of the total Asian and 5.4% of the total African populations are aged 60 years and over. By 2050, these population proportions of older people are projected to increase to 23.6% and 10.7%, respectively. Along with population ageing, the burden of morbidity and mortality in the population will also undergo change from burden profiles dominated by infectious diseases to those affected by chronic non-communicable diseases (NCD) (1). The chronic NCD burden is predicted to increase over the next 20 years from 60% to 79% in Asia and from 28% to 51% in Africa (2). The impact of HIV/AIDS in eastern and southern Africa has been extreme, leading to major reversals in mortality and different patterns of demographic transition. The dominant scenario in many sub-Saharan African countries will be co-existing chronic infectious and non-communicable disease (3). The consequences for population ageing are considerable and impact the roles played by older people, especially women. Widespread availability of antiretrovirals is improving the quality and length of life lived with HIV, but the overall effects on mortality patterns, life expectancy, population structure and social roles will be considerable for years to come. All this furthers the idea that multiple transitions are underway in contrasting settings.

Estimates of life expectancies at birth and at 60 years of age provide an objective way of measuring and comparing the health status of populations over time. In most countries, the life expectancies of women exceed those of men and these differences are expected to widen in low-income countries over the next 30–40 years. Despite living longer, there are indications that, compared with men, women in low-income countries report poorer health (4–6). Understanding sex-related health differences along with gendered aspects of health, recognising groups at risk of poor health and identifying determinants of poor health are all critical for planning the health needs of ageing populations and improving health trajectories.

This article discusses this pattern in eight Health and Demographic Surveillance System (HDSS) sites within the INDEPTH Network (International Network for the Demographic Evaluation of Populations and Their

Health, http://www.indepth-network.org) across Africa and Asia. The study used data collected using a modified, summary version of the WHO Study on global AGEing and adult health (SAGE) which was linked with longitudinal HDSS background variables. This collaboration between WHO-SAGE and the INDEPTH–HDSS sites links the SAGE survey tools with longitudinal HDSS data collection platform in order to improve understanding of the determinants of adult health and ageing in low- and middle-income countries in Africa and Asia.

The work underscores the importance of using international survey data on self-reported health and functionality of older adults to complement statistics on life expectancy and burden of illness. Our goal is to determine the extent to which various factors impact upon measures of health, and how this occurs differentially for men and women. We measure differences in self-reported health by sex, and explain how these differences can be attributed to demographic and socio-economic determinants measured in this study. These analyses inform an understanding of the distribution and the socio-demographic and economic determinants of self-reported health, which can contribute to the development of health-promotion programmes and more general support and development initiatives for older men and women.

Methods

Study population

This multi-centre INDEPTH WHO-SAGE study was conducted during 2006–2007 in eight HDSS sites in Africa and Asia: Agincourt (South Africa), Ifakara (Tanzania), Nairobi (Kenya), Navrongo (Ghana), Filabavi (Viet Nam), Matlab (Bangladesh), Purworejo (Indonesia) and Vadu (India) (7). The HDSS sites were selected to include different geographic and socio-economic contexts. A total of 93,347 individuals aged 50 years and over were identified from the surveillance databases across all eight field sites. In six sites, all adults 50 years and over were targeted for face-to-face interview; in the other two sites (Navrongo and Matlab) a random sample of households with at least one member aged 50 years and over was selected. Respondents within these households were selected using Kish tables (8). In both cases, older individuals had a known non-zero probability of selection. A total of 58,004 respondents aged 50 years and over were invited to participate, and the response rate was 80%, resulting in a final total sample of 46,269, ranging from 2,072 in Nairobi to 12,395 in Purworejo. A total of 2,334 respondents (5.0%) were later excluded from the analysis because of incomplete socio-demographic information [item non-response: age ($n = 11$); education ($n = 450$); socio-economic status ($n = 1,627$); marital status ($n = 121$); living arrangements ($n = 125$)], giving a total sample of 43,935.

Study instruments and variables

This study used a modified and shortened INDEPTH WHO-SAGE instrument consisting of health status description, subjective well-being and quality of life modules (see information at the end of the abstract). The study questionnaire was developed through a consultative process between INDEPTH and WHO-SAGE with the goal of integrating a feasible number of useful SAGE modules into routine surveillance update activities with minimum impact on existing HDSS procedures and maximum return on measuring health and well-being. The survey instrument consisted of questions in eight health domains (affect, cognition, interpersonal relationships, mobility, pain, self-care, sleep/energy and vision) with related anchoring vignettes. In each domain, two questions were asked to assess how much difficulty the respondent had in performing activities during the last 30 days. The summary instrument also assessed functional status using Activities of Daily Living (ADL) or Instrumental Activities of Daily Living (IADL) type of questions, and covered subjective well-being and quality of life issues. This instrument was translated and back-translated in eight local languages. Standardised training, interview protocols and quality assurance procedures were used across all participating sites. Centralised training was provided to principal investigators from each site, who in turn trained their respective survey teams: site-based training averaged 4.5 days in duration across the sites. Mean interview time was 20 min. Three sites integrated the INDEPTH WHO-SAGE module into their routine HDSS surveillance, while the remaining five sites conducted the INDEPTH WHO-SAGE study as a separate data collection activity. Detailed descriptions of instruments, survey protocols and quality control measures are described in a companion article in this volume (9).

The INDEPTH WHO-SAGE questionnaire also collected information on overall self-reported health using the question 'In general, how would you rate your health today?', using a 5-point response scale. However, the main outcome of interest in this article is the health score. In brief, the composite health score was calculated based on self-reported health derived from the eight health domain items. Each item response was based on a 5-point ordered categorical scale. Due to its multidimensionality, the health score provided a more robust assessment of individual health levels than a single overall self-rated general health question and was subsequently used as the health outcome variable in the planned analyses (10, 11). The composite health scores were calculated using item response theory with a partial credit model (12). Each item was calibrated using chi-squared fit statistics to assess its contribution to the composite health score. The raw scores were transformed through Rasch modelling into a continuous cardinal scale, with 0 representing worst health and a maximum score of 100 representing

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best health (9). The psychometric properties of the health score have been assessed and reported elsewhere (13).

Background information for each respondent was obtained by linking the SAGE results to selected, standardised variables from the HDSS site databases, which contain extensive data on individual demographic characteristics as well as household-level information. The variables were harmonised across sites to ensure comparability. The socio-economic index for households in each site was based on a locally derived wealth index; all households in a site were allocated to wealth quintiles which were developed using principal component factor analysis (14) on a range of asset variables including dwelling characteristics and household possessions (such as livestock and durable goods). The wealth index was derived by each HDSS independently. Since these are relative measures, it was not possible to make direct comparisons of quintiles across sites, but it is possible to compare health outcomes across wealth quintiles within each site/country, and time-trends in outcomes by wealth quintile across all sites.

Data analyses

Descriptive results are presented for demographic and socio-economic variables at each site. Means and 95% confidence intervals (CI) for the health scores are presented to describe variations in different population subgroups across the eight HDSS sites.

The health score was used as the dependent variable in regression analyses. A mean score for each domain was obtained by taking the average of responses in the two domain-specific questions. The contribution of each health domain (affect, cognition, interpersonal relationships, mobility, pain, self-care, sleep/energy and vision) to the health score was determined using its regression coefficient, and the analyses were adjusted by household wealth quintiles and living arrangements, and respondents' age, education levels and marital status. Differences in health score by sex were then analysed to ascertain how much demographic and socio-economic factors contributed to the observed differences.

Multivariable linear regression was used to assess statistical associations between socio-economic and demographic characteristics as independent variables, and the health score as the dependent variable, for all respondents, separately by sex and HDSS sites. A post-regression decomposition based on Blinder-Oaxaca methods (15, 16) was performed in order to show the extent to which sex-based differences in outcomes were attributable to differences in sex distributions of socio-economic and demographic characteristics, and how much to other factors. Together, multivariable regression and decomposition provided a way of measuring and explaining an outcome gap, which in this case was the mean difference in health score between men and women.

All the analyses were weighted by the 2007 population age and sex distribution at each HDSS site. The descriptive results were standardised to the WHO world standard population distribution to account for the different population distributions across HDSS sites (17). All statistical analyses were conducted in STATA Version 10.0 (18).

Ethical considerations

The research was approved by the Ethical Committee or Board in each HDSS site and/or their host institutions, and the Ethics Review Committee at WHO, Geneva. Informed consent was obtained from each individual prior to the study.

Results

A total of 43,935 respondents aged 50 years and over (24,434 women and 19,501 men) were included in the analyses. Table 1 provides demographic and socio-economic characteristics of the respondents. The smaller number of women in Nairobi and men in Agincourt reflects the dynamics of labour and social migration occurring in these two settings. Overall, more women participated than men (55.6% and 44.4%, respectively) with substantial variation across the sites. In Agincourt, women constituted three-quarters of respondents, compared to only 35% in Nairobi. The majority of respondents were aged between 50 and 59 years (42%), along with a substantial proportion of the oldest old (6.8% aged 80 years and over). Nairobi had 72% of respondents aged 50–59 years and only 2.3% aged 80 years and over. In contrast, Filabavi had 7.4% men and 14.3% women respondents aged 80 years and over. In general, women respondents and those from African sites had lower education levels than men and those from Asian sites. Almost two-thirds of male respondents in Filabavi reported more than six years of education, in contrast to only 6% in Ifakara and 13% in Navrongo. The corresponding figures for women ranged from 2.3% in Ifakara to 33% in Filabavi. Over 88% of male respondents in Asian sites were in current partnerships; while in the African settings, the corresponding proportion ranged from 76% in Agincourt to 87% in Nairobi. There were more older women in African sites who were not currently in a relationship compared to women in Asian sites. Notably, 74% of women respondents in Nairobi were either widowed, divorced or never married. Overall, more than 90% of respondents lived with other family members, except in Nairobi where up to 29% of men and 21% of women lived alone.

Tables 2 and 3 show the distributions of the health score for men and women by different demographic and socio-economic characteristics across the HDSS sites. In all sites, both men and women aged 80 years and over consistently had lower health scores compared to respon-

Table 1. Distribution of study populations in eight Health and Demographic Surveillance System (HDSS) sites in Africa and Asia, 2006–2007

	Agincourt, South Africa		Ifakara, Tanzania		Nairobi, Kenya		Navrongo, Ghana		Filabavi, Viet Nam		Matlab, Bangladesh		Purworejo, Indonesia		Vadu, India	
Characteristics	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Total subjects	949	2,890	2,388	2,636	1,298	693	1,634	2,660	3,462	5,054	1,999	2,005	5,420	6,333	2,351	2,163
Age group (years)																
50–59	40.6	39.2	45.5	45.7	72.2	58.0	41.9	44.7	41.7	35.4	44.0	43.1	38.0	35.9	46.0	45.3
60–69	33.0	27.8	33.9	29.6	19.9	25.2	33.5	37.8	29.5	24.4	32.1	35.7	31.5	34.8	35.5	37.2
70–79	19.4	24.4	16.5	18.1	5.7	10.1	18.8	14.3	21.5	25.8	18.9	17.7	22.8	22.5	14.7	13.3
80 and over	7.1	8.6	4.1	6.5	2.3	6.7	5.7	3.2	7.4	14.3	4.9	3.5	7.7	6.7	3.8	4.1
Education levels																
No formal	49.9	63.8	20.9	56.1	25.5	52.7	NA	NA	2.0	10.6	41.3	72.2	14.2	36.7	4.6	7.2
At most 6 years	23.7	20.4	72.9	41.6	59.5	42.6	87.3	95.0	34.2	55.7	33.2	23.5	62.5	51.4	56.8	84.5
More than 6 years	26.4	15.8	6.2	2.3	15.0	4.6	12.7	5.0	63.8	33.7	25.6	4.3	23.3	11.9	38.6	8.3
Marital status																
In partnership	76.4	41.1	84.5	50.1	86.8	26.5	81.9	35.4	92.8	60.5	96.4	53.4	88.0	60.4	91.3	66.8
Single	23.6	58.9	15.5	49.9	13.2	73.5	18.1	64.6	7.2	39.5	3.6	46.6	12.0	39.6	8.7	33.2
Living arrangements																
Living together in household	89.0	96.4	97.5	98.2	70.7	79.4	96.4	94.7	98.7	91.1	99.6	95.0	96.3	90.2	99.0	96.5
Living alone	11.0	3.6	2.5	1.8	29.3	20.6	3.6	5.3	1.3	8.9	0.4	5.0	3.7	9.8	1.0	3.5
Household socio-economic status																
First quintile (lowest)	16.5	15.4	21.6	16.8	27.6	15.9	30.8	26.2	8.1	16.2	13.8	16.5	18.5	20.5	10.2	12.6
Second quintile	17.8	19.1	23.2	16.5	13.1	22.0	26.7	23.7	17.0	18.8	16.7	16.4	19.0	19.8	15.5	14.7
Third quintile	17.8	19.7	21.9	20.1	18.8	23.9	21.7	22.5	22.1	20.7	17.9	16.8	20.3	20.0	21.3	22.8
Fourth quintile	19.5	21.1	33.4	46.6	20.5	24.6	16.2	20.5	26.5	22.4	22.3	24.5	21.5	19.9	22.8	20.2
Fifth quintile (highest)	28.4	24.6	NA	NA	20.0	13.7	4.6	7.1	26.3	21.8	29.2	25.9	20.8	19.8	30.2	29.6

Table 2. Distribution of health score across subgroups of men in eight Health and Demographic Surveillance System (HDSS) sites in Africa and Asia, 2006–2007

Characteristics	Mean health score and 95% confidence interval							
	Agincourt, South Africa	Ifakara, Tanzania	Nairobi, Kenya	Navrongo, Ghana	Filabavi, Viet Nam	Matlab, Bangladesh	Purworejo, Indonesia	Vadu, India
Age group (years)								
50–59	67.8 (66.5–69.1)	74.6 (73.8–75.4)	74.4 (73.5–75.3)	68.4 (67.7–69.1)	72.5 (71.9–73.1)	65.7 (65.1–66.3)	77.3 (76.8–77.7)	70.1 (69.3–70.9)
60–69	66.6 (65.3–67.9)	71.5 (70.7–72.4)	70.5 (68.9–72.0)	65.9 (65.2–66.6)	68.8 (68.2–69.4)	62.2 (61.6–62.8)	73.2 (72.7–73.7)	67.9 (67.2–68.6)
70–79	65.5 (64.3–66.7)	67.0 (65.9–68.1)	69.1 (66.1–72.1)	62.1 (61.2–63.1)	65.3 (64.6–65.9)	59.3 (58.4–60.2)	68.4 (67.9–69.0)	65.6 (64.8–66.5)
80 and over	62.6 (60.8–64.3)	61.4 (59.9–63.0)	60.1 (56.4–63.9)	61.0 (59.1–62.9)	59.7 (58.7–60.8)	54.9 (53.4–56.5)	64.0 (63.0–65.0)	65.8 (64.0–67.6)
Education levels								
No formal	65.9 (64.8–66.9)	71.5 (70.1–72.9)	69.8 (68.0–71.6)	NA	65.8 (63.7–68.0)	62.5 (61.9–63.0)	72.7 (71.7–73.8)	66.0 (64.3–67.6)
At most 6 years	66.4 (64.9–67.9)	71.5 (71.0–72.1)	71.6 (70.1–73.1)	65.8 (65.4–66.3)	68.2 (67.5–68.9)	62.7 (62.0–63.3)	73.5 (73.1–73.8)	67.8 (67.1–68.4)
More than 6 years	68.8 (67.3–70.2)	71.8 (69.9–73.7)	75.0 (72.5–77.5)	67.3 (64.3–70.4)	70.2 (69.7–70.6)	63.8 (63.1–64.5)	74.4 (73.8–75.0)	69.7 (68.8–70.5)
Marital status								
In partnership	67.1 (66.2–68.0)	71.6 (71.1–72.2)	71.4 (70.5–72.3)	66.4 (65.9–66.9)	69.3 (68.9–69.6)	62.8 (62.4–63.2)	73.8 (73.5–74.1)	68.5 (68.0–69.0)
Single	65.5 (64.0–67.0)	70.3 (68.9–71.6)	69.1 (66.6–71.6)	64.4 (63.3–65.5)	66.9 (65.1–68.7)	62.5 (60.2–64.8)	72.2 (71.2–73.2)	66.3 (64.3–68.3)
Living arrangements								
Living together in household	66.5 (65.7–67.3)	71.4 (70.9–71.9)	71.2 (70.1–72.2)	66.0 (65.6–66.5)	69.3 (68.9–69.6)	62.8 (62.4–63.2)	73.6 (73.3–73.9)	68.3 (67.9–68.8)
Living alone	68.0 (65.7–70.3)	74.2 (71.4–77.1)	72.0 (70.4–73.5)	66.3 (64.0–68.6)	67.2 (64.7–69.8)	64.5 (60.4–68.5)	72.4 (70.2–74.6)	69.2 (61.2–77.2)
Household socio-economic status								
First quintile (lowest)	65.6 (64.0–67.3)	70.7 (69.7–71.6)	71.1 (69.6–72.6)	66.1 (65.4–66.9)	66.7 (65.4–68.0)	62.6 (61.6–63.5)	73.0 (72.3–73.8)	67.1 (65.9–68.4)
Second quintile	66.3 (64.5–68.0)	72.5 (71.5–73.5)	71.8 (69.5–74.1)	66.1 (65.2–67.0)	68.2 (67.3–69.0)	61.8 (60.9–62.8)	72.7 (72.1–73.4)	67.2 (66.0–68.4)
Third quintile	66.6 (64.9–68.4)	71.5 (70.4–72.6)	73.9 (71.7–76.2)	65.4 (64.5–66.3)	69.2 (68.5–69.9)	62.6 (61.6–63.6)	74.1 (73.4–74.8)	67.4 (66.5–68.3)
Fourth quintile	65.6 (64.5–66.8)	71.2 (70.3–72.1)	69.6 (68.2–71.1)	66.2 (65.1–67.3)	69.5 (68.8–70.2)	62.6 (61.8–63.3)	73.9 (73.4–74.5)	69.3 (68.3–70.4)
Fifth quintile (highest)	68.0 (66.5–69.6)	NA	71.8 (69.3–74.3)	67.8 (65.1–70.5)	70.6 (69.9–71.3)	63.7 (63.1–64.4)	74.2 (73.6–74.8)	69.3 (68.5–70.2)

Table 3. Distribution of health score across subgroups of women in eight Health and Demographic Surveillance System (HDSS) sites in Africa and Asia, 2006–2007

	Mean health score and 95% confidence interval							
Characteristics	Agincourt, South Africa	Ifakara, Tanzania	Nairobi, Kenya	Navrongo, Ghana	Filabavi, Viet Nam	Matlab, Bangladesh	Purworejo, Indonesia	Vadu, India
Age group (years)								
50–59	66.2 (65.6–66.8)	72.1 (71.5–72.8)	69.6 (68.4–70.8)	65.2 (64.7–65.6)	68.8 (68.4–69.2)	57.8 (57.3–58.2)	74.7 (74.3–75.1)	67.1 (66.4–67.7)
60–69	65.7 (65.0–66.3)	68.3 (67.6–69.0)	64.1 (62.5–65.7)	62.1 (61.6–62.5)	64.9 (64.4–65.3)	55.4 (54.9–56.0)	70.0 (69.6–70.4)	66.0 (65.4–66.6)
70–79	62.7 (62.1–63.4)	64.4 (63.4–65.4)	60.7 (57.9–63.5)	59.1 (58.4–59.7)	61.9 (61.4–62.3)	51.4 (50.5–52.3)	66.0 (65.5–66.5)	63.9 (63.1–64.7)
80 and over	60.3 (59.2–61.4)	58.6 (57.0–60.2)	56.4 (53.8–59.0)	55.7 (53.9–57.4)	57.7 (57.1–58.3)	51.1 (49.1–53.0)	62.7 (61.7–63.7)	62.5 (60.9–64.0)
Education levels								
No formal	65.0 (64.5–65.4)	69.2 (68.6–69.9)	64.4 (63.1–65.6)	NA	63.3 (61.9–64.7)	55.1 (54.7–55.5)	70.5 (69.9–71.1)	65.3 (63.8–66.8)
At most six years	65.0 (64.2–65.7)	67.9 (67.2–68.5)	67.0 (65.7–68.2)	62.5 (62.2–62.8)	65.2 (64.9–65.6)	56.3 (55.5–57.0)	71.1 (70.7–71.4)	65.7 (65.3–66.1)
More than six years	66.7 (65.5–67.9)	71.0 (68.1–74.0)	64.5 (61.7–67.4)	62.7 (61.2–64.2)	67.4 (66.7–68.1)	58.0 (56.6–59.3)	72.9 (72.1–73.7)	67.5 (66.0–69.0)
Marital status								
In partnership	65.8 (65.2–66.3)	69.5 (68.9–70.2)	69.0 (66.4–71.6)	64.1 (63.6–64.6)	66.2 (65.9–66.5)	56.0 (55.5–56.5)	71.6 (71.2–71.9)	65.8 (65.3–66.3)
Single	64.6 (64.1–65.1)	68.1 (67.4–68.7)	65.0 (63.9–66.0)	61.9 (61.5–62.2)	64.7 (64.2–65.2)	55.3 (54.8–55.9)	70.2 (69.7–70.6)	65.8 (65.0–66.6)
Living arrangements								
Living together in household	65.1 (64.7–65.5)	68.7 (68.3–69.1)	65.7 (64.6–66.8)	62.5 (62.2–62.8)	65.7 (65.4–66.0)	55.4 (55.1–55.8)	71.0 (70.7–71.3)	65.8 (65.4–66.2)
Living alone	63.7 (62.0–65.4)	67.8 (64.8–70.7)	65.1 (63.5–66.6)	62.8 (61.2–64.3)	64.6 (63.4–65.8)	57.7 (56.0–59.3)	70.0 (69.0–71.0)	66.9 (65.0–68.8)
Household socio-economic status								
First quintile (lowest)	65.6 (64.6–66.5)	67.3 (66.3–68.3)	66.8 (64.5–69.2)	62.9 (62.3–63.4)	64.0 (63.3–64.7)	54.9 (54.1–55.7)	70.2 (69.7–70.8)	65.5 (64.4–66.6)
Second quintile	64.2 (63.4–65.0)	69.4 (68.3–70.4)	64.8 (63.1–66.4)	62.5 (61.9–63.0)	65.1 (64.6–65.7)	54.8 (53.9–55.7)	71.1 (70.6–71.7)	65.0 (64.0–66.1)
Third quintile	65.3 (64.5–66.2)	69.4 (68.5–70.4)	64.7 (62.9–66.4)	62.3 (61.7–62.9)	65.8 (65.3–66.4)	55.0 (54.2–55.8)	71.2 (70.6–71.8)	65.4 (64.6–66.2)
Fourth quintile	64.3 (63.6–65.1)	68.6 (68.0–69.3)	66.0 (64.0–67.9)	62.5 (61.8–63.1)	65.8 (65.2–66.3)	56.0 (55.4–56.7)	70.8 (70.2–71.3)	66.5 (65.6–67.4)
Fifth quintile (highest)	65.8 (65.0–66.5)	NA	66.7 (64.8–68.7)	62.1 (60.7–63.4)	66.8 (66.3–67.4)	56.2 (55.6–56.9)	71.4 (70.8–71.9)	66.3 (65.6–67.0)

dents in younger age groups. The discrepancies in health score between the lowest and the highest age groups were less in Agincourt and Vadu than in other HDSS sites. Both men and women with higher levels of education also consistently had higher health scores compared to respondents with lower levels of education, except for women in Nairobi and Navrongo where the patterns were not entirely clear. In all sites, both men and women who were not in current partnerships also had marginally lower health scores than those with partners. There were no statistically significant within-site differences in health scores observed between those who lived alone and those who lived together with other family members, nor across different household socio-economic quintiles. There was a clear gradient in health score across different levels of self-reported health categories. The average health scores ranged from 52.0 (95% CI: 50.4–53.6) in men who reported their health as 'very bad' to 76.7 (75.9–77.5) in men who reported their health as 'very good'. The corresponding figures were 48.0 (46.5–49.5) and 74.5 (73.5–75.5) for women (data not shown).

Each of the eight health domains contributed differently to the overall health score in each site. Table 4 shows the commonalities and differences in contributions from each domain across the sites. Matlab had the least dispersion across the domains, whereas Purworejo had the most. Four health domains were identified as contributing the most to the overall health score: pain/discomfort (in Ifakara and Purworejo men and women, and in Matlab and Filabavi women), vision (in Nairobi and Vadu), mobility (in Matlab and Filabavi men) and sleep/energy (in Navrongo and Agincourt). Interpersonal relations contributed relatively less to the overall health score than the other domains, except in Vadu. Self-care contributed the least with the regression coefficients ranging from -0.14 among women from Ifakara (compared to a pain domain coefficient of -3.01 in the same site) to 0.94 in men from Purworejo.

A decomposition of the health score by sex was conducted using a separate regression model adjusted for the effects of socio-economic and demographic characteristics. Table 5 shows that in all sites, men had higher health scores than women across all age-groups ($p < 0.001$). The gaps in the health score between men and women were significantly larger in Matlab and Nairobi compared to the other HDSS sites. There were large discrepancies in the proportion of the health score difference between men and women attributable to group differences in socio-economic and demographic characteristics; and similarly in the proportion of the gap that was attributed to other influences not adjusted for in the model, such as gender discrimination. Within the proportion of the inequality attributed to individual characteristics, sex differences in age contributed from -13.4% to 24.8% of the disparity observed in health score between men and women in Navrongo and Filabavi, respectively. Inclusion of additional determinants (level of education, marital status, living arrangements and household wealth quintiles) showed that up to 82% of the sex difference in the mean health score in Agincourt was attributable to the distribution of the determinants between the two groups, with a remaining 18% attributable to other factors not included in the model. In contrast, almost none of the health score disparity between men and women in Matlab was attributable to this set of determinants. The results of the fully adjusted model, therefore, provide a better understanding of the way in which known factors contributed to sex differences in health scores across the fieldsites.

Discussion

This article presents novel findings on how the differences in health between men and women can be partially explained by socio-demographic and social factors, by unexplained inequality, and by the differences in unexplained inequality between settings. The aim of the decomposition analysis was to move beyond a basic comparison of sex differences in self-reported health, and instead begin to unravel the determinants of the differences and variations across contrasting African and Asian settings. By statistically regressing available (and commonly used) independent variables, such as age, education, marital status, socio-economic status and living arrangements, the decomposition technique characterised the association of other factors – potentially gender-related issues – on health scores. Referring to Table 5, model 5, a possible interpretation is that gendered aspects of society in the Matlab area of rural Bangladesh contribute more to the differences in reported health between men and women than in the Agincourt area of rural South Africa. This suggests that the influence of gendered aspects of health warrants closer examination when investigating sex-based differences in health. However, caution should be taken with this hypothesis until the limitations outlined below are taken into account.

Three key results emerge from this cross-site study on health and ageing in eight low- and middle-income countries. Firstly, despite women having higher life expectancy than men, older men reported better health than older women in these settings. These results are in line with findings from Europe and North America showing that women reported poorer health than men (19, 20). The INDEPTH WHO-SAGE results also indicated significantly larger sex differences in health in Nairobi and Matlab than in the other HDSS sites. A previous study from Matlab also reported poorer self-reported health in women than in men, independent of age. However, the contribution of sex to self-reported health disappeared after controlling for objective physical

Table 4. Regression coefficients for each domain (ranked from highest to lowest) with health score as outcome in eight Health and Demographic Surveillance System (HDSS) sites in Africa and Asia, 2006–2007

Agincourt, South Africa	Ifakara, Tanzania	Nairobi, Kenya	Navrongo, Ghana	Filabavi, Viet Nam	Matlab, Bangladesh	Purworejo, Indonesia	Vadu, India
Men							
−2.48 Sleep/energy	−3.51 Pain	−3.88 Vision	−2.66 Sleep/energy	−2.81 Mobility	−2.09 Mobility	−4.06 Pain	−3.17 Vision
−2.25 Cognition	−3.19 Mobility	−3.57 Sleep/energy	−2.20 Affect	−2.70 Sleep/energy	−1.85 Pain	−3.41 Cognition	−2.61 Mobility
−2.24 Affect	−2.60 Vision	−3.53 Pain	−2.15 Mobility	−2.38 Pain	−1.82 Affect	−3.18 Vision	−2.59 Pain
−2.23 Pain	−2.42 Sleep/energy	−3.38 Affect	−2.04 Pain	−2.14 Cognition	−1.66 Sleep/energy	−2.81 Sleep/energy	−2.52 Affect
−1.80 Vision	−2.30 Cognition	−2.56 Mobility	−2.00 Cognition	−1.88 Affect	−1.55 Cognition	−2.43 Affect	−2.43 Interpersonal
−1.70 Mobility	−1.89 Affect	−2.38 Cognition	−1.54 Interpersonal	−1.80 Vision	−1.48 Vision	−2.19 Mobility	−2.26 Cognition
−1.50 Interpersonal	−0.56 Interpersonal	−1.87 Interpersonal	−1.51 Vision	−1.10 Interpersonal	−0.96 Self-care	−0.94 Interpersonal	−1.39 Self-care
−0.50 Self-care	−0.46 Self-care	0.16 Self-care	−0.19 Self-care	0.20 Self-care	−0.94 Interpersonal	0.94 Self-care	−1.39 Sleep/energy
Women							
−2.29 Sleep/energy	−3.01 Pain	−2.53 Pain	−1.90 Sleep/energy	−2.10 Pain	−1.51 Pain	−3.40 Pain	−2.38 Vision
−2.22 Pain	−2.99 Mobility	−2.41 Mobility	−1.78 Mobility	−2.04 Sleep/energy	−1.51 Interpersonal	−3.04 Cognition	−2.35 Pain
−2.12 Cognition	−2.16 Vision	−2.30 Vision	−1.74 Pain	−2.03 Mobility	−1.49 Affect	−2.68 Vision	−2.19 Interpersonal
−2.01 Affect	−2.15 Cognition	−2.14 Cognition	−1.71 Affect	−1.88 Cognition	−1.46 Vision	−2.30 Mobility	−2.11 Mobility
−1.58 Mobility	−2.07 Sleep/energy	−2.02 Affect	−1.69 Cognition	−1.59 Affect	−1.46 Mobility	−2.30 Sleep/energy	−2.02 Affect
−1.53 Vision	−1.92 Affect	−1.94 Sleep/energy	−1.49 Interpersonal	−1.48 Vision	−1.39 Self-care	−2.16 Affect	−1.91 Cognition
−1.31 Interpersonal	−0.71 Interpersonal	−1.74 Interpersonal	−1.34 Vision	−1.21 Interpersonal	−1.37 Sleep/energy	−1.31 Interpersonal	−1.51 Self-care
−0.80 Self-care	−0.14 Self-care	−0.54 Self-care	−0.81 Self-care	−0.59 Self-care	−1.34 Cognition	0.68 Self-care	−1.50 Sleep/energy

Note: Numbers represent regression coefficients for each health domain derived from separate regression analyses for each site. Health score was used as the outcome variable, and the regression analyses were adjusted for age (as continuous variable), education level, marital status, living arrangements, and wealth quintiles.

Table 5. Decomposition analysis of predictors of inequality in health scores between men and women in eight INDEPTH HDSS sites, 2006–2007

Characteristics	Agincourt, South Africa	Ifakara, Tanzania	Nairobi, Kenya	Navrongo, Ghana	Filabavi, Viet Nam	Matlab, Bangladesh	Purworejo, Indonesia	Vadu, India
Mean health score								
Men	66.67	71.78	73.13	65.87	68.93	62.86	72.92	68.45
Women	64.62	68.74	66.65	62.81	64.39	55.56	70.28	66.00
Difference between men and women	2.05	3.04	6.48	3.07	4.55	7.30	2.64	2.45
Model 1: % explained by inclusion of age	5.1	6.2	21.1	−13.4	24.8	−1.9	−0.9	−1.0
Model 2: % explained by inclusion of age and education level	20.8	6.6	30.3	−9.6	46.1	1.9	8.0	24.8
Model 3: % explained by inclusion of age, education level, and marital status	48.2	21.3	67.5	21.8	44.6	1.6	24.6	36.2
Model 4: % explained by inclusion of age, education level, marital status, and living arrangements	79.7	28.7	70.5	23.5	45.7	0.8	24.8	35.1
Model 5: % explained by inclusion of age, education level, marital status, living arrangements, and household wealth quintiles	81.5	30.3	69.1	22.1	44.6	−0.4	22.5	35.6

performance, limitations in activities of daily living, and acute and chronic morbidity (21).

Secondly, individual and household socio-economic determinants contributed differently across settings in explaining the sex differences in reported health. Differences in household socio-economic levels and living arrangements, and respondent's age, education and marital status, provided virtually no explanation in Bangladesh while accounting for 71% and 82% of the sex difference in health score observed in Nairobi, Kenya and Agincourt, South Africa, respectively. Importantly, inequalities observed in the health score, and the sex differences between sites, may also be explained by individual and contextual factors not assessed in this study, such as occupational status, history of chronic morbidity, presence of physical disabilities and other environmental and socio-demographic risk factors at household and village levels.

Thirdly, different health domains contributed differently to the overall health score for men and women in each setting. Questions on self-care, which assess respondents' difficulties in washing/dressing or bathing and maintaining general appearance, have been used extensively in different health measurement tools (22, 23) but consistently contributed least to overall health scores, in both men and women and in almost all the study sites. This might be due to the help given by members of extended families in many of these field settings. This study provides deeper understanding on how various functional domains affect people's perception of their health. Despite its usefulness in predicting future morbidity and mortality in both developed and developing countries (24–26), a single question on self-rated health provides little indepth understanding of something as complex and multifaceted as health. This study, however, showed a consistent trend towards better health scores in people who rated their health as 'very good' compared to those who rated their health as 'very bad'. This domain-specific knowledge is vital in laying the foundation for rational resource allocation and for developing appropriate evidence-based health promotion programmes for older adults.

The study attempts to measure and compare the health of older adults in low- and middle-income countries, information largely lacking in resource-constrained settings. Increasing longevity will have substantial health, economic and social impacts in all countries, and will particularly affect under-resourced and under-performing health systems in low-income countries, which are generally poorly prepared to provide the chronic care needed to manage non-communicable conditions in older people (3, 27, 28). This study has highlighted prominent sex differences in the health of older adults and raises the need to further study the factors contributing to these disparities. This will be important for developing targeted interventions to address differences in health between men and women.

The study was designed as an add-on to established HDSS sites in Africa and Asia. Embedding this study within HDSS sites allowed for data linkages between this cross-sectional study and the rich demographic and socio-economic information available in HDSS databases. The infrastructure established for this research provides the unique opportunity to follow these populations longitudinally in a scientifically reliable manner. Linking the health and function indices with future morbidity and mortality data, collected routinely as part of regular HDSS update rounds, will allow deeper understanding of the dynamics of health transition and population ageing in low- and middle-income countries (29–31). The results of this study may also serve as a baseline for observing trends and changes in older people's health in the future, whether occurring naturally or following policy shifts.

There are some limitations to this study. Firstly, the study subjects may not have been representative of older people in their respective countries – although, in all cases, they reflect poorer, often rural, populations. In some HDSS sites, a random sample of the older adults under surveillance was recruited into the study, whereas others surveyed the entire surveillance population aged 50 years and over. Due to the differing population structure within each HDSS and differences in sampling strategies, all prevalence data were standardised to the WHO standard population (17). Secondly, the comparability of this cross-national study on self-reported health may be compromised by the dynamics of ageing and the cultural influences on health in the different settings. The instrument used to assess self-reported health in the different domains might not be able to fully capture people's experiences and expectations for their health. However, this method for measuring health has been used as part of the World Health Survey in some 70 countries with robust results (32). Future research should compare how these self-reported health items are correlated with more objective measures, such as blood pressure and other findings from medical examination. Thirdly, since the wealth quintiles, serving as a proxy for socio-economic status, were constructed by each HDSS, they are relative rather than absolute measures and were not harmonised across sites. The expected patterns of health by wealth were not clearly demonstrated within or across HDSS sites and did not contribute significantly to the decomposition results. This may need to be addressed in future analyses of the dataset using longitudinal approaches. Fourthly, the cross-sectional nature of the data limits the possibility of drawing causal associations on how health influences socio-economic status or vice-versa. The potential to use these cross-sectional data as a baseline for further longitudinal data analyses strengthens the benefit of embedding the INDEPTH WHO-SAGE study in the HDSS operation.

This comparative study may therefore benefit from analyses incorporating vignette-based adjustments (data for which have been collected) that map self-reported health to a common comparable scale in each domain (32, 33). These adjustments might improve the cross-site comparability of the results. Similarly, subsequent analyses correlating health outcomes by sex with observed mortality – a robust potential with HDSS longitudinal data collection – will probably be enlightening.

Despite these limitations, the study provides a robust data set, baseline and data collection platform that can be used to inform future interventions – and their evaluation – for older people's health across contrasting geographic and socio-cultural settings.

Conclusion

This INDEPTH WHO-SAGE study examined sex differences in health among older adults within low- and middle-income countries and found that men reported significantly better health than women. It also unveiled wide variation in how individual and household socio-economic characteristics explain the gaps in self-reported health observed between men and women in Africa and Asia. Further studies are needed to examine individual and contextual determinants to which the health gaps between older men and women can be attributed, including gender roles, thus addressing the health inequalities observed. We expect such analyses to inform our understanding of the distribution and determinants of health and well-being by sex and age, and to provide stronger evidence on which to base national and global policies on population health and ageing. While the gender paradox between health and life expectancy exists in all these settings, our results affirm that old age will bring particular problems for women in low-resource societies. There will be clear need for gender-sensitive health interventions to address the higher level of poor health reported in older women and the documented health differences between the sexes.

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