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Sociodemographic and behavioral characteristics associated with self-reported diagnosed diabetes mellitus in adults aged 50+ years in Ghana and South Africa: results from the WHO-SAGE wave 1

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ABSTRACT

Objective The objective is to identify and describe the sociodemographic and behavioral characteristics of adults, aged 50 years and over, who self-reported having been diagnosed and treated for diabetes mellitus (DM) in Ghana and South Africa.

Research design and methods This is a cross-sectional study based on the WHO Study on global AGEing and adult health (SAGE) wave 1. Information on sociodemographic factors, health states, risk factors and chronic conditions is captured from questionnaires administered in face-to-face interviews. Self-reported diagnosed and treated DM is confirmed through a 'yes' response to questions regarding[1] having previously been diagnosed with DM, and[2] having taken insulin or other blood sugar lowering medicines. Crude and adjusted logistic regressions test associations between candidate variables and DM status. Analyses include survey sampling weights. The variance inflation factor statistic tested for multicollinearity.

Results In this nationally representative sample of adults aged 50 years and over in Ghana, after adjusting for the effects of sex, residence, work status, body mass index, waist-hip and waist-height ratios, smoking, alcohol, fruit and vegetable intake and household wealth, WHO-SAGE survey respondents who were older, married, had higher education, very high-risk waist circumference measurements and did not undertake high physical activity, were significantly more likely to report diagnosed and treated DM. In South Africa, respondents who were older, lived in urban areas and had high-risk waist circumference measurements were significantly more likely to report diagnosed and treated DM.

Conclusions Countries in sub-Saharan Africa are challenged by unprecedented ageing populations and transition from communicable to non-communicable diseases such as DM. Information on those who are already diagnosed and treated needs to be combined with estimates of those who are prediabetic or, as yet, undiagnosed. Multisectoral approaches that include socioculturally appropriate strategies are needed to address diverse populations in SSA countries.

Significance of the study

What is already known about this subject?

- In low-income countries undergoing economic development and social change, non-communicable diseases are diagnosed and treated more often in higher socioeconomic groups.

What are the new findings?

- We extend the literature in an important way by including only adults aged 50 years and over in two sub-Saharan African countries who answered standardised questions regarding their diagnosis and treatment for diabetes mellitus.

How might these results change the focus of research or clinical practice?

- Future research should focus on investigating social inequalities in diabetes mellitus and other non-communicable diseases in sub-Saharan African countries.

BACKGROUND

The world is witnessing an unprecedented rise in non-communicable diseases (NCDs) driven by urbanization, the globalization of markets, and increasing longevity. Four major NCDs—cardiovascular disease, cancer, chronic respiratory disease and diabetes mellitus (DM)—are responsible for over 80% of NCD deaths of which more than 40% are premature, that is, occurring in people under 70 years of age.[1] NCDs impact disproportionately on developing countries where the health burden is shifting from communicable infectious conditions to NCDs. Almost three quarters of all NCD deaths (28 million) and over 80% of premature deaths occur in low-income and middle-income countries

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(LMICs).[1–3] As part of the Agenda for Sustainable Development, United Nations Member States set targets specifying a one-third reduction in NCD premature mortality by 2030.[4] Globally DM represents one of the major health and development challenges of the twenty-first century.[5]

People with DM have high blood glucose levels, either because they are not producing enough insulin or because their bodies do not respond properly to natural insulin production. This condition is the major endocrine driver of the global burden of disease.[6] People with DM have increased risk of serious morbidity and premature death associated with a range of medical complications such as heart disease, stroke, visual impairment and kidney disease. There are three main clinical manifestations of DM—type 1, type 2 and gestational DM. Type 1 (insulin dependent) occurs in all age groups while type 2 is mostly seen in mid and older aged adults. Gestational DM occurs in pregnancy and can lead to serious health risks for mothers and babies. Over 90% of known DM cases are type 2.[5 7–9]

Type 2 DM can remain undiagnosed for many years; over 80% of undiagnosed cases are people living in LMICs.[10–13] There are a number of known modifiable and preventable risk factors for type 2 DM. They include excess body fat, poor diet, lack of physical activity, tobacco smoking and excess alcohol consumption.[4 14] Mortality, morbidity and disability resulting from DM could be reduced by limiting the consumption of saturated fats, transfatty acids, alcohol, salt and sugars, increasing the consumption of fruit and vegetables, and promoting physical activity.[15]

In high-income countries, association between social factors and health is well established. Social and economic factors, known as the 'social determinants', impact on health and lead to unfair differences, or inequities, between individuals and groups.[16] The term 'social inequalities in health' is used here, and in the wider public health literature, to mean health differences that are unfair, unjust and amenable to change by social policies and actions.[17] Exposure to risk factors for type 2 DM and many other NCDs is inversely related to social position.[11] However, in low-income countries undergoing economic development and social change, NCD risk factors are more prevalent in higher socioeconomic groups as they increasingly adopt 'western' lifestyles that predispose inadequate physical activity and overconsumption of high energy foods.[11 18–20]

The International Diabetes Federation (IDF) stimulates global public health interest by publishing best estimates (including CIs) of the total numbers of people in the world who are either undiagnosed (eg, prediabetic) or diagnosed with DM.[12 21] Although the data on DM prevalence in developing countries are not reliable, the IDF estimates draw attention to the global burden of DM and the health, social and economic consequences of this chronic condition. In the next decade the largest increases in DM prevalence are expected to be in the sub-Saharan African (SSA) region.[10 22] Here NCDs are a relatively new public health problem because resources and policy priorities have traditionally targeted HIV and child and maternal health.[4] Health systems need to respond to these epidemiological changes by providing and enabling access to services for diagnosis and treatment.[19]

The objective of this observational study is to identify and describe the sociodemographic and behavioral characteristics of adults, aged 50 years and over, who self-reported having been diagnosed and treated for DM in Ghana and South Africa. The purpose is to provide a basis for further investigation of social inequalities in DM and other NCDs in SSA countries.

METHODS

Data collection

The data source is the WHO Study on global AGEing and adult health (SAGE) wave 1 which is a longitudinal study conducted in six LMICs—China, Ghana, India, Mexico, Russia and South Africa. WHO-SAGE cohorts comprise nationally representative samples of adults aged 50 years and over and smaller comparative samples of people aged 18–49 years. Information on sociodemographic factors, health states, risk factors and chronic conditions is captured from questionnaires administered in face-to-face interviews by trained interviewers. This study is a secondary analysis of WHO-SAGE data collected from adults aged 50 years and over in Ghana and South Africa in 2007–2008.

WHO-SAGE employs a stratified random sampling strategy with households as the final sampling units. Post-stratification weights were generated to adjust for the age and sex population distributions of the respective countries at the time of survey. Country-specific household-level and person-level analysis weights are made available by WHO.[23] Further details of WHO-SAGE are published elsewhere.[24]

Study variables

The binary dependent variable is DM status. This indicates self-reported diagnosed and treated DM which is confirmed through a 'yes' response to two questions in the WHO-SAGE individual questionnaire. The first question was: 'Have you ever been diagnosed with diabetes (high blood sugar) – not including diabetes associated with a pregnancy?' People who answered 'no' are classified as not having been diagnosed with DM. People who answered 'yes' were asked: 'Have you been taking insulin or other blood sugar lowering medications in the past 12 months?' A 'yes' answer to both questions in this study denotes DM status. The questions do not differentiate between DM types 1 and 2.

Sociodemographic variables are: sex; age; residence; marital status; educational status and work status. Age is classified as: 50–59 years; 60–69 years, and 70+years. Residence is urban or rural. Marital status is a dichotomy, single (unmarried, widowed or separated)

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versus married or cohabiting. Educational status is classified as: no formal schooling; <6 years of schooling; completed primary; completed secondary; completed high school, and completed college or university. Work status is defined as not currently working or currently working.[25]

Body mass index (BMI) is categorised as: underweight BMI <18.50; normal weight BMI 18.50–24.99; preobese BMI 25.00–29.99, and obese BMI>=30.00.[26] Men are classified as normal when waist circumference <94 centimetres (cm), and high risk for metabolic disorders when waist circumference 94–102 cm. For women the cut-offs are: normal <80 cm, and high risk 80–88 cm. Above 102 cm in men and above 88 cm in women is indicative of high risk for metabolic disorders. Men with waist-hip ratios <0.9 and women with waist-hip ratios <0.85 are considered normal, and higher scores are considered high risk.[27] The waist-height ratio variable is dichotomized into two groups whereby <0.5 is considered low risk and ≥0.5 high risk.[28,29]

WHO-SAGE individual questionnaires include questions on behaviors consistent with the WHO NCD STEPwise approach.[30] A smoking variable is categorised as non-smokers, former smokers, occasional smokers or daily smokers. Alcohol use is assessed by asking questions about alcohol intake during the previous 30 days. Fruit and vegetable intake (in a typical 24 hours period) is categorised as inadequate (less than five servings daily) versus adequate (less than five servings daily).[15,31] Physical activity (high, moderate or low) is categorised according to self-reported answers to questions from the Global Physical Activity Questionnaire (GPAQ) that relate to the workplace, as well as sport, leisure and fitness activities.[15,32]

Socioeconomic status is measured through wealth or assets. Information reported on dwelling characteristics (type of floors, walls, and cooking stove), ownership of durable goods *(chairs, tables, cars, television, fixed and mobile telephone, bucket or washing machine, or access to electricity), and access to services such as improved water, sanitation, and cooking fuel is used. H*ousehold*s* are arranged on an asset ladder, from the poorest to the wealthiest. Ordinal scores are transformed into wealth quintiles, with quintile 1 representing individuals in households with the lowest wealth and quintile 5 the highest.[33,34]

Data preparation and study sample

The available study populations from WHO-SAGE wave 1 were 5573 in Ghana and 4227 in South Africa. The survey response rates were 96% and 76% in Ghana and South Africa, respectively.[35,36]Only respondents aged 50 years and above who completed WHO-SAGE questionnaires were included (Ghana n=4732; South Africa n=3842). Eligibility required non-missing responses on all study variables. The final samples comprised 4289 respondents in Ghana and 3660 in South Africa.

Statistical analysis

Country samples are described by sociodemographic, physical and behavioral characteristics. χ^2 tests of statistical significance show association between characteristics and DM status in each country. Variables were tested for correlation before proceeding to regression analyses. Weighted crude and adjusted logistic regressions test associations between candidate variables and DM status in Ghana and South Africa. ORs, 95% CIs and P values are given. The variance inflation factor (VIF) statistic tests multicollinearity. All analyses were performed using STATA V.13.0 (StataCorp, College Station, Texas, USA).

RESULTS

In Ghana, almost 3% (n=122) self-reported DM diagnosis and treatment compared with nearly 8% (n=308) in South Africa. Non-DM status (Ghana n=4167; South Africa n=3352) includes those who reported DM but not treatment (Ghana n=45; South Africa n=52).

There were more men (52%) in Ghana and more women in South Africa (56%). About 40% were aged between 50 years and 59 years in Ghana, compared with almost 50% in South Africa. Most (59%) were from rural areas in Ghana compared with just 35% in South Africa. Almost 54% in Ghana reported no education compared with 24% in South Africa. Almost 70% reported currently working in Ghana compared with 30% in South Africa.

About 33% of respondents in Ghana were classified as overweight or obese compared with 75% in South Africa. In Ghana 75% reported never smoking compared with 67% in South Africa. About 62% of respondents in Ghana reported high physical activity compared with only 28% in South Africa. About 18% of respondents were in the poorest wealth quintile in Ghana compared with 20% in South Africa.

Table 1 shows statistically significant differences in DM status in Ghana: for residence, educational and wealth status, BMI, waist circumference, waist-height ratio, physical activity (P<0.001); for age and work status (P<0.01), and for waist-hip ratio and smoking (P<0.05). In South Africa statistically significant differences in DM status were reported for: age and waist circumference (P<0.001); for sex, residence, BMI and alcohol (P<0.01), and for work and wealth status, smoking, and physical activity (P<0.05).

Table 2 presents crude and adjusted logistic regressions of association between sociodemographic, behavioral and other characteristics and DM status in Ghana and South Africa. Tests for correlation showed adequate independence between individual pairs of variables. The largest VIF statistics among all independent variables were 1.48 for Ghana and 1.57 for South Africa. We considered VIF <5 as indication of reasonable independence among predictor variables.

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Table 1 Sociodemographic, physical and behavioral characteristics by DM status, adults 50+years, Ghana and South Africa: WHO-SAGE wave 1, 2007–2008

	Ghana (n=4289)			South Africa (n=3.660)		
	DM status: no n (%)	DM status: yes n (%)	Totals n (%)	DM status: no n (%)	DM status: yes n (%)	Totals n (%)
Overall	4167 (97.1)	122 (2.8)	4289 (100)	3352 (92.3)	308 (7.6)	3660 (100)
Sex				**		
Male	2181 (97.5)	56 (2.5)	2237 (52.3)	1443 (94.3)	110 (5.7)	1553 (43.9)
Female	1986 (96.7)	66 (3.3)	2052 (47.7)	1909 (90.8)	198 (9.2)	2107 (56.1)
Age, years	**			***		
50–59	1649 (98.1)	35 (1.9)	1684 (39.8)	1510 (94.6)	100 (5.4)	1610 (49.7)
60–69	1151 (95.4)	49 (4.6)	1200 (27.5)	1065 (91)	112 (9)	1177 (30.8)
70+	1367 (97.4)	38 (2.6)	1405 (32.6)	777 (88.9)	96 (11.1)	873 (19.4)
Residence	***			**		
Urban	1671 (95.3)	83 (4.7)	1754 (41)	2198 (90.8)	254 (9.2)	2452 (65.3)
Rural	2496 (98.5)	39 (1.5)	2535 (59)	1152 (95.3)	53 (4.7)	1205 (34.7)
Marital status						
Single	1794 (97.4)	50 (2.6)	1844 (40.8)	1534 (91.3)	150 (8.7)	1684 (43.9)
Married/cohabiting	2350 (97)	72 (3)	2422 (59.2)	1755 (93.1)	155 (6.9)	1910 (56.1)
Educational status	***					
No formal schooling	2309 (98.3)	38 (1.7)	2347 (53.9)	783 (94.9)	41 (5.1)	824 (24.5)
<6 years schooling	419 (97)	12 (3)	431 (10.4)	707 (92.6)	66 (7.4)	773 (24.6)
Completed primary	446 (97.4)	15 (2.6)	461 (10.9)	665 (90.4)	76 (9.6)	741 (22.3)
Completed secondary	164 (94)	9 (6)	173 (4)	380 (88.8)	50 (11.2)	430 (14.3)
Completed high school	672 (95.8)	31 (4.2)	703 (17.1)	189 (93.5)	14 (6.5)	203 (8.5)
Completed college/university	133 (89)	17 (11)	150 (3.6)	142 (94)	16 (6)	158 (5.8)
Work status	**			*		
Not currently working	1253 (96)	57 (4)	1310 (30.9)	2403 (91.1)	262 (8.9)	2665 (69.9)
Currently working	2898 (97.7)	65 (2.3)	2963 (69.1)	920 (95.2)	43 (4.8)	963 (30.1)
Wealth status	***			*		
Quintile 1 poorest	845 (99)	9 (1)	854 (18.3)	655 (95.2)	23 (4.8)	678 (20.2)
Quintile 2	835 (98.5)	12 (1.5)	847 (19.1)	687 (94.8)	34 (5.2)	721 (19.9)
Quintile 3	836 (98.1)	19 (2)	855 (20.6)	652 (92.5)	67 (7.5)	719 (18.6)
Quintile 4	839 (96.3)	28 (3.7)	867 (20.6)	671 (90.2)	91 (9.8)	762 (20)
Quintile 5 richest	807 (94.2)	54 (5.8)	861 (21.4)	671 (89.2)	91 (10.8)	762 (21.3)
BMI	***			**		
Underweight	631 (99.2)	6 (0.8)	637 (15.2)	137 (99.4)	2 (0.6)	139 (3.3)

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Table 1 Continued

	Ghana (n=4289)			South Africa (n=3.660)		
	DM status: no n (%)	DM status: yes n (%)	Totals n (%)	DM status: no n (%)	DM status: yes n (%)	Totals n (%)
Normal weight	2191 (98.2)	41 (1.8)	2232 (52.1)	769 (96)	33 (4)	802 (21.4)
Overweight	804 (95.7)	37 (4.3)	841 (21.2)	903 (92.9)	86 (7.1)	989 (27.3)
Obese	416 (92.7)	33 (7.3)	449 (11.5)	1349 (90.1)	167 (9.9)	1516 (48.0)
Waist circumference	***			***		
Normal	2464 (98.6)	39 (1.4)	2503 (59)	908 (96.6)	41 (3.4)	949 (30.0)
High risk	673 (97.3)	22 (2.7)	695 (17.4)	611 (96.3)	45 (3.7)	656 (18.6)
Very high risk	907 (93.6)	57 (6.4)	964 (23.6)	1456 (89.7)	178 (10.3)	1634 (51.4)
Waist-hip ratio	*					
Normal	969 (98.3)	20 (1.7)	989 (23)	994 (94.6)	62 (5.4)	1056 (34.4)
High risk	3074 (96.8)	98 (3.2)	3172 (77)	1938 (92)	197 (8)	2135 (65.6)
Waist-height ratio	***					
Low risk	1718 (99.1)	16 (0.9)	1734 (40.4)	454 (95.4)	21 (4.6)	475 (15.6)
High risk	2311 (96)	101 (4)	2412 (59.6)	2487 (92.7)	239 (7.3)	2726 (84.4)
Smoking	*			*		
Non-smoker	3072 (96.9)	100 (3.1)	3172 (75.1)	2114 (91)	241 (9)	2355 (66.8)
Former smoker	555 (97)	17 (3)	572 (14.2)	308 (94.4)	19 (5.6)	327 (9.4)
Occasional smoker	113 (98)	3 (2)	116 (2.6)	137 (96.1)	8 (3.9)	145 (3.3)
Daily smoker	415 (99.6)	2 (0.4)	417 (8.1)	768 (95.1)	38 (4.9)	806 (20.5)
Alcohol				**		
No	1731 (97.5)	41 (2.5)	1772 (42)	2386 (91.2)	266 (8.8)	2652 (74.7)
Yes	2436 (97)	81 (3)	2517 (58)	960 (96)	41 (4)	1001 (25.3)
Fruit and vegetable intake						
Inadequate	2810 (97.4)	70 (2.6)	2880 (67.9)	2406 (92.9)	201 (7.1)	2607 (66.8)
Adequate	1229 (96.6)	48 (3.4)	1277 (32.1)	893 (91)	106 (9)	999 (33.2)
Physical activity	***			*		
High	2651 (98.3)	49 (1.7)	2700 (61.8)	837 (95.7)	51 (4.3)	888 (28.3)
Moderate	513 (95.6)	21 (4.4)	534 (12.5)	441 (92.2)	35 (7.8)	476 (12.3)
Low	1003 (95.1)	52 (4.9)	1055 (25.7)	2074 (90.8)	222 (9.2)	2296 (59.4)

Pearson's χ^2 tests undertaken for country comparisons. Survey sampling weights used to give percentage estimates. Percentages may not sum due to rounding
*P-value<0.05; **P-value<0.01; ***P-value<0.001.
BMI, body mass index; DM, diabetes mellitus; WHO-SAGE, WHO Study on global AGEing and adult health.

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Table 2 Logistic regressions showing association between sociodemographic, physical and behavioral characteristics and DM status, adults 50+years, Ghana and South Africa: WHO-SAGE wave 1, 2007–2008

	Ghana (n=4289)				South Africa (n=3.660)			
	Crude OR	**95% CI**	**Adjusted OR**	**95% CI**	**Crude OR**	**95% CI**	**Adjusted OR**	**95% CI**
Sex								
Male	1		1		1		1	
Female	1.36	0.92 to 2.0	1.36	0.79 to 2.36	1.68**	1.15 to 2.47	1.08	0.62 to 1.86
Age, years								
50–59	1		1		1		1	
60–69	2.46**	1.39 to 4.37	2.94**	1.58 to 5.45	1.73*	1.09 to 2.76	1.11	0.62 to 2.00
70+	1.36	0.76 to 2.43	1.84	0.94 to 3.62	2.19**	1.34 to 3.56	2.02*	1.07 to 3.81
Residence								
Rural	1		1		1		1	
Urban	3.17***	1.94 to 5.17	1.26	0.68 to 2.32	2.02**	1.21 to 3.39	1.77*	1.02 to 3.08
Marital status								
Single	1		1		1		1	
Married/cohabiting	1.17	0.79 to 1.75	1.83*	1.06 to 3.16	0.76	0.52 to 1.12	0.75	0.47 to 1.21
Educational status								
No formal schooling	1		1		1		1	
<6 years schooling	1.79	0.82 to 3.93	1.95	0.84 to 4.51	1.47	0.73 to 2.96	1.79	0.81 to 3.96
Completed primary	1.57	0.83 to 2.97	1.41	0.69 to 2.85	1.98*	1.08 to 3.6	1.82	0.95 to 3.51
Completed secondary	3.7**	1.71 to 7.98	2.48	0.90 to 6.76	2.35*	1.1 to 5.0	2.22*	1.08 to 4.54
Completed high school	2.57**	1.42 to 4.63	2.41*	1.17 to 4.98	1.28	0.49 to 3.36	1.42	0.45 to 4.50
Completed college/university	7.27***	3.5 to 15.0	4.31**	1.67 to 11.13	1.17	0.49 to 2.81	1.18	0.41 to 3.35
Work status								
Not currently working	1		1		1		1	
Currently working	0.55**	0.37 to 0.81	0.75	0.47 to 1.21	0.51*	0.30 to 0.86	0.80	0.37 to 1.74
Wealth status								
Quintile 1 poorest	1		1		1		1	
Quintile 2	1.52	0.59 to 3.87	1.36	0.47 to 3.88	1.1	0.47 to 2.55	0.60	0.23 to 1.60
Quintile 3	1.94	0.81 to 4.62	1.54	0.60 to 3.90	1.63	0.82 to 3.22	1.07	0.42 to 2.73
Quintile 4	3.79**	1.65 to 8.69	1.85	0.69 to 4.94	2.17*	1.04 to 4.49	0.83	0.34 to 2.04
Quintile 5 richest	6.21***	2.9 to 13.28	1.85	0.68 to 5.05	2.43*	1.21 to 4.89	1.44	0.61 to 3.38
BMI								
Normal weight	1		1		1		1	

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Table 2 Continued

	Ghana (n=4289)				South Africa (n=3.660)			
	Crude OR	95% CI	Adjusted OR	95% CI	Crude OR	95% CI	Adjusted OR	95% CI
Underweight	0.41	0.14 to 1.17	0.63	0.22 to 1.82	0.16*	0.02 to 0.93	0.14	0.01 to 1.17
Overweight	2.43***	1.52 to 3.88	1.17	0.61 to 2.25	1.88	0.76 to 4.63	1.50	0.55 to 4.04
Obese	4.24***	2.4 to 7.48	1.57	0.71 to 3.50	2.7*	1.21 to 6.03	1.27	0.48 to 3.33
Waist circumference								
Normal	1		1		1		1	
High risk	1.95*	1.06 to 3.58	1.44	0.66 to 3.15	1.08	0.52 to 2.24	1.11	0.50 to 2.44
Very high risk	4.78***	2.88 to 7.93	2.27*	1.03 to 5.01	3.24***	1.69 to 6.18	2.62*	1.09 to 6.31
Waist-hip ratio								
Normal	1		1		1		1	
High risk	1.85	0.99 to 3.43	1.32	0.72 to 2.45	1.49	0.94 to 2.36	1.24	0.74 to 2.10
Waist-height ratio								
Low risk	1		1		1		1	
High risk	4.45***	2.27 to 8.69	1.37	0.60 to 3.08	1.63	0.67 to 3.93	0.49	0.19 to 1.27
Smoking								
Non-smoker	1		1		1		1	
Former smoker	0.97	0.54 to 1.72	1.22	0.65 to 2.25	0.59	0.28 to 1.24	1.17	0.47 to 2.91
Occasional smoker	0.61	0.18 to 2.04	0.27	0.03 to 2.17	0.41	0.13 to 1.25	1.02	0.26 to 4.03
Daily smoker	0.13**	0.03 to 0.56	0.43	0.09 to 1.99	0.51*	0.28 to 0.94	0.77	0.31 to 1.88
Alcohol								
No	1		1		1		1	
Yes	1.23	0.81 to 1.86	1.35	0.87 to 2.09	0.43**	0.23 to 0.8	0.53	0.25 to 1.11
Fruit and vegetable intake								
Inadequate	1		1		1		1	
Adequate	1.31	0.86 to 1.98	1.06	0.67 to 1.66	1.30	0.87 to 1.95	1.14	0.70 to 1.86
Physical activity								
High	1		1		1		1	
Moderate	2.65***	1.55 to 4.53	1.88*	1.03 to 3.42	1.89	0.9 to 3.95	1.66	0.78 to 3.52
Low	3.01***	2.0 to 4.51	1.58	0.95 to 2.63	2.27**	1.26 to 4.0	1.35	0.66 to 2.73

Survey sampling weights applied. VIF Ghana 1.48. VIF South Africa 1.57.
*P value < 0.05; **P value < 0.01; ***P value < 0.001.
BMI, body mass index; DM, diabetes mellitus; VIF, variance inflation factor; WHO-SAGE, WHO Study on global AGEing and adult health.

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Ghana

In the crude regression, respondents aged 60–69 years had almost two and a half times the odds of reporting a DM diagnosis (OR 2.46; 95% CI 1.39 to 4.37) compared with those aged 50–59 years. Respondents living in urban areas were more than three times as likely to report diagnosed and treated DM (OR 3.17; 95% CI 1.94 to 5.17) as respondents living in rural areas. Those who had completed college or university were over seven times more likely to report diagnosed and treated DM (OR 7.27; 95% CI 3.5 to 15.0) compared with those who reported no formal schooling. Respondents who were currently working were 45% less likely to report DM diagnosis and treatment, compared with those not working (OR 0.55; 95% CI 0.37 to 0.81). Respondents in the richest wealth quintile had more than six times the odds of reporting DM diagnosis and treatment compared with those in the poorest wealth quintile (OR 6.21; 95% CI 2.9 to 13.28).

BMI measurement showed that compared with those of normal weight, people who were overweight were almost two and a half times more likely to report DM diagnosis and treatment (OR 2.43; 95% CI 1.52 to 3.88); people who were obese were over four times more likely to report DM diagnosis and treatment (OR 4.24; 95% CI 2.4 to 7.48). Respondents with very high-risk waist circumference measurements were almost five times more likely to report DM diagnosis and treatment (OR 4.78; 95% CI 2.88 to 7.93) compared with people with normal waist circumference. Those with high-risk waist-height ratios had almost four and a half times the odds of reporting diagnosed and treated DM compared with people with low-risk waist-height ratios (OR 4.45; 95% CI 2.27 to 8.69).

Compared with non-smokers, daily smokers had significantly lower odds of reporting DM diagnosis and treatment (OR 0.13; 95% CI 0.03 to 0.56). Compared with those who undertook high physical activity, respondents who undertook low physical activity were three times more likely to report diagnosed and treated DM (OR 3.01; 95% CI 2.0 to 4.51).

In the adjusted regression, residence, work status, BMI, waist-height ratio, smoking and wealth status attenuated to non-significance. There was positive attenuation for age. Holding all other variables constant, compared with those who were aged 50–59 years, respondents aged 60–69 years were almost three times more likely to report diagnosed and treated DM (OR 2.94; 95% CI 1.58 to 5.45). Marital status was not statistically significant in the crude regression but in the presence of all other variables, those who were married or cohabiting were 80% more likely to report DM diagnosis and treatment compared with those who were single (OR 1.78; 95% CI 1.03 to 3.07). There was negative attenuation for educational status comparing those who had completed college or university with those with no formal schooling (OR 4.21; 95% CI 1.62 to 10,80), and waist circumference, comparing very high risk with normal (OR 2.21; 95% CI 1.002 to 4.90). After adjusting for all other variables, the odds of reporting DM diagnosis and treatment among those who reported moderate, compared with high, physical activity, were almost 90% higher (OR 1.87; 95% CI 1.03 to 3.41).

In Ghana, after adjusting for the effects of sex, residence, work status, BMI, waist-hip and waist-height ratios, smoking, alcohol, fruit and vegetable intake, and household wealth, WHO-SAGE survey respondents who were older, married, had higher education, very high risk waist circumference measurements and did not undertake high physical activity, were significantly more likely to report diagnosed and treated DM.

South Africa

In the crude regression, women were almost 70% more likely to report DM diagnosis and treatment (OR 1.68; 95% CI 1.15 to 2.47). Those aged 60–69 years had significantly higher odds of reporting diagnosed and treated DM (OR 1.73; 95% CI 1.09 to 2.76) compared with those aged 50–59 years. Respondents living in urban areas were twice as likely to report DM diagnosis and treatment (OR 2.02; 95% CI 1.21 to 3.39) as those living in rural areas. Compared with those who reported having no formal schooling, respondents who completed primary or secondary schooling were twice as likely to report diagnosed and treated DM (OR 1.98; 95% CI 1.08 to 3.6) and (OR 2.35; 95% CI 1.1 to 5.0) respectively. Respondents who were currently working were half as likely to report DM diagnosis and treatment, compared with those who were not working (OR 0.51; 95% CI 0.30 to 0.86).

Compared with those of normal weight, underweight respondents were significantly less likely to report DM diagnosis and treatment (OR 0.16; 95% CI 0.02 to 0.93) and obese respondents were over two and a half times more likely to report diagnosed and treated DM (OR 2.7; 95% CI 1.21 to 6.03). Having a very high-risk waist circumference was significant (OR 3.24; 95% CI 1.69 to 6.18).

Compared with non-smokers, daily smokers were less likely to report DM diagnosis and treatment (OR 0.51; 95% CI 0.28 to 0.94) and compared with non-drinkers, drinkers were less likely to report DM diagnosis and treatment (OR 0.43; 95% CI 0.23 to 0.8). Respondents who reported undertaking low physical activity were more than twice as likely to report DM diagnosis and treatment compared with those who reported high physical activity (OR 2.27; 95% CI 1.26 to 4.0). Respondents in the richest wealth quintile had more than twice the odds of reporting diagnosed and treated DM, compared with those in the poorest wealth quintile (OR 2.43; 95% CI 1.21 to 4.89).

In the adjusted regression, female sex, educational status, work status, BMI, smoking, alcohol, physical activity and wealth status attenuated to non-significance. Holding all other variables constant, respondents aged 70 years and over were twice as likely to report diagnosed and treated DM compared with respondents aged 50–59 years (OR 2.02; 95% CI 1.07 to 3.81); those living in urban areas had 80% higher odds of reporting DM diagnosis and treatment compared with rural dwellers

(OR 1.82; 95% CI 1.04 to 3.18), and respondents with very high-risk waist circumference measurements were more than two and a half times as likely to report diagnosed and treated DM, compared with respondents with normal waist circumference measurements (OR 2.71; 95% CI 1.12 to 6.56).

In South Africa, after adjusting for the effects of sex, marital status, educational status, work status, BMI, waist-hip and waist-height ratios, smoking, alcohol, fruit and vegetable intake, physical activity and household wealth, WHO-SAGE survey respondents who were older, lived in urban areas and had high-risk waist circumference measurements, were significantly more likely to report diagnosed and treated DM.

DISCUSSION

We investigated sociodemographic and behavioral characteristics of adults aged 50 years and over, who self-reported diagnosed and treated DM in Ghana and South Africa. This work is important for a number of reasons. First, we extend the public health literature by including only older adults. Second, both Ghana and South Africa are undergoing major demographic and epidemiological shifts and studies such as this can help inform policy-making. Third, our study specifically defined DM status according to self-reported diagnosis and treatment. Importantly the findings can add to prevalence information from other sources and contribute to a broader epidemiological evidence base.

Our research is timely given the recent *Lancet Diabetes & Endocrinology* Commission on diabetes (the Commission) in SSA.[22] Consistent with this foremost report we show that being older, inactive and overweight, were risk factors in Ghana and South Africa, and highlight the need for coordinated, context-specific responses giving consideration to available resources, needs and priorities within individual countries. The Commission identified data deficiencies as barriers for estimating the true prevalence and burden of DM and recommended the collection and analysis of high-quality population-representative data such as WHO-SAGE.[22]

In this study the prevalence of diagnosed DM was 3.8% in Ghana and 9.2% in South Africa, compared with 2.8% and 7.6%, respectively, for those who reported having been diagnosed and treated. The IDF estimates that 14.2 million people aged 20–79 years in SSA have DM, with only about a third aware of their condition. The SSA region has the highest proportion of undiagnosed cases of DM in the world.[12] Old age, urban residence, being married, having higher education, high waist circumference and low physical activity were the main predictors of diagnosed and treated DM although these associations differed between Ghana and South Africa.

We found that older age was associated with DM although in Ghana the prevalence dropped in the oldest groups (70 years and over) possibly due to survival bias. The association between older age and DM has been demonstrated in studies in African countries[37 38] and Europe.[39] Type 2 DM in older adults is recognised as an important public health challenge in older adults.[40] Physiological changes associated with advancing age can lessen the body's ability to dispose glucose.[40] The IDA predicts that, by 2030, the SSA region will have the highest prevalence of DM in the 60–79 years age group.[5]

Central obesity measures such as waist circumference are associated with increased visceral fat and subsequent development of multiple metabolic syndromes including DM.[41] The findings are consistent with those from other studies in SSA countries.[42]

There is substantial evidence that links the epidemiological transition from communicable disease to NCDs to the western lifestyle, characterised by decreased physical activity and increased consumption of calorie-dense nutrient-poor foods, as one of the consequences of urbanization.[19] Rapid urbanization in SSA has been attributed to an observed rising prevalence of diagnosed DM in urban areas.[43] Urban residence was significantly associated with DM in South Africa. Studies have found that rural residents in South Africa face geographical and other barriers to accessing healthcare.[44] Older rural dwellers in SSA countries face barriers in obtaining diagnosis and treatment due to the distance and out-of-pocket financial costs.[45]

Physical activity protects individuals from developing health-related problems including obesity and DM by preserving their body weight and further weight gain.[15] Physical activity was protective of DM in the multivariable analysis in Ghana, but the association was not significant in South Africa. Association between urbanization and DM has been observed in SSA countries.[46]

In Ghana people with relatively higher education were significantly more likely to report DM diagnosis and treatment. A multilevel analysis across 49 LMICs demonstrated significant positive associations between higher education and DM.[47] Higher education is facilitating upward movement in socioeconomic status in African countries and it is likely that educated people have greater opportunities to access the region's limited resources for the diagnosis and treatment of DM although the Commission noted that this is changing in some SSA countries.[22] South Africa may be one such example given that education was not significantly associated with self-reported DM in our study. Socioeconomic and behavioral determinants of health present major public health challenges.[16 43 48]

Typical of other SSA countries, the Ghana health system is facing the double burden of infectious diseases and NCDs. The rising burden of NCDs will affect the achievement of universal health coverage. Lack of economic and other resources, limited access to diagnostic and treatment services in rural areas, and poor public sector collaboration present major challenges for the provision of healthcare across the country. A national health insurance scheme was implemented in Ghana in 2003 but in 2010 enrolment was just 34%.[49]

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Compared with being single, being married increased the odds of DM diagnosis and treatment in Ghana and decreased the odds of DM diagnosis and treatment in South Africa. However these results need to be interpreted with caution. Social and cultural factors come into play and it is difficult to generalize across settings. Other studies report the importance of marriage in preventing diseases.[49] This could be due to the long-lasting support that married people obtain from their partners in helping to maintain and sustain good physical and mental health. Yet other studies have shown that being married is associated with overweight and reduced physical activity which are both risk factors for type 2 DM.[50]

Strengths and limitations

A strength of this study is the use of valid, comparable national data. The stratified multistage sampling design ensured that samples were representative of national populations. In Ghana the sample was stratified by administrative region and type of locality (urban/rural) resulting in 18 strata. In South Africa there were 50 strata defined by provinces, locality (urban/rural) and race.

The focus on older adults who self-reported diagnoses and treatment provides one set of evidence. Combining these data with estimates of undiagnosed DM will help inform estimates of true prevalence.

The analyses were cross-sectional and causality cannot be assumed. Given the nature of the survey questions we were unable to differentiate between the different types of DM, however we expect that the majority had type 2.

CONCLUSIONS

There is an urgent need for governments in SSA to develop and implement national policies, programme and guidelines for the prevention, timely diagnosis and treatment of DM. Information on those who are already diagnosed and treated needs to be combined with estimates of undiagnosed cases. Multisectoral approaches that include socioculturally appropriate strategies are needed to address the diverse populations in SSA countries.

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Contributors FET made substantial contribution to the conception of the study, analysed the data and wrote the first draft. MP together with FET designed the study. MP provided methodological advice, helped in manuscript preparation and revised the manuscript critically. JS assisted in the interpretation of data and participated in drafting of the manuscript and revising it critically. JSW provided overall direction, advice and guidance throughout the manuscript development, reviewed and edited work in progress, and provided critical intellectual and scientific input at all stages. JSW led the response to reviewers and wrote the final draft which was approved by all the authors.

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Data sharing statement The anonymised data sets are in the public domain: http://apps.who.int/healthinfo/systems/surveydata/index.php/catalog/central. SAGE is committed to the public release of study instruments, protocols and meta data and micro data: access is provided upon completion of the Users Agreement available through WHO's SAGE website: www.who.int/healthinfo/systems/sage. The questionnaires and other materials can be found at: http://www.who.int/healthinfo/sage/cohorts/en/index2.html.

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REFERENCES

1. World Health Organization. *Global status report on noncommunicable diseases*. Geneva: World Health Organization, 2014.
2. Beard JR, Biggs S, Bloom DE, *et al*. *Global population ageing: Peril or promise?* Geneva: The World Economic Forum, 2012.
3. Bloom DE, Mahal A, Rosenberg L. Designand operation of health systems in developing countries. *Global population ageing: Peril or promise?* Geneva: World Economic Forum, 2012.
4. World Health Organization. *Global report on diabetes*. Geneva: World Health Organization, 2016.
5. International Diabetes Federation. *A call to action on diabetes*. Brussels, Belgium: International Diabetes Federation, 2010.
6. Murray CJ, Vos T, Lozano R, *et al*. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2197–223.
7. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract* 2010;87:4–14.
8. Wong E, Backholer K, Gearon E, *et al*. Diabetes and risk of physical disability in adults: a systematic review and meta-analysis. *Lancet Diabetes Endocrinol* 2013;1:106–14.
9. American Diabetes Association. (2) Classification and diagnosis of diabetes. *Diabetes Care* 2015;38(Suppl):S8–16.
10. Levitt NS. Diabetes in Africa: epidemiology, management and healthcare challenges. *Heart* 2008;94:1376–82.
11. Whiting D, Unwin D, Roglic G. Diabetes: equity and social determinants. In: Blas E, Sivasankara Kurup A, eds. *Equity, social determinants and public health programmes*. Geneva: World Health Organization, 2010:77–94.
12. International Diabetes Federation. *IDF diabetes*. 7th edn. Atlas: International Diabetes Federation, 2015.
13. World Health Organization. *Global health and ageing*. Geneva: World Health Organization, 2011.
14. Willi C, Bodenmann P, Ghali WA, *et al*. Active smoking and the risk of type 2 diabetes: a systematic review and meta-analysis. *JAMA* 2007;298:2654–64.
15. World Health Organization. *Global strategy on diet, physical activity and health*. Geneva: World Health Organization, 2004.
16 Blas E, Kurup AS. *Equity, social determinants and public health programmes*. Geneva: World Health Organization, 2010.
17. Whitehead M, Dahlgren G. *Concepts and principles for tackling social inequities in health: Levelling up Part 1*. Geneva: World Health Organization, 2007.

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18. Hossain P, Kawar B, El Nahas M. Obesity and diabetes in the developing world--a growing challenge. *N Engl J Med* 2007;356:213–5.
19. Miranda JJ, Kinra S, Casas JP, *et al*. Non-communicable diseases in low- and middle-income countries: context, determinants and health policy. *Trop Med Int Health* 2008;13:1225–34.
20. Gwatidzo SD, Stewart Williams J. Diabetes mellitus medication use and catastrophic healthcare expenditure among adults aged 50+ years in China and India: results from the WHO study on global AGEing and adult health (SAGE). *BMC Geriatr* 2017;17:15.
21. International Diabetes Federation. *Global diabetes scorecard*. Brussels: International Diabetes Federation, 2014.
22. Atun R, Davies JI, Gale EAM, *et al*. Diabetes in sub-Saharan Africa: from clinical care to health policy. *Lancet Diabetes Endocrinol* 2017;5:622–67.
23. Naidoo N. *WHO Study on global AGEing and adult health (SAGE) Waves 0 and 1 - Sampling information for China, Ghana, India, Mexico, Russia and South Africa*. Geneva: World Health Organisation, 2012. SAGE Working Paper No. 5.
24. Kowal P, Chatterji S, Naidoo N, *et al*. Data resource profile: the World Health Organization Study on global AGEing and adult health (SAGE). *Int J Epidemiol* 2012;41:1639–49.
25. Schneider SL. The International Standard Classification of Education 2011. Birkelund GE, ed. *Class and stratification analysis (Comparative Social Research)*: Emerald Group Publishing Limited, 2013:365–79.
26. World Health Organization. *Obesity: preventing and managing the global epidemic*. Geneva: World Health Organization, 2000.
27. World Health Organization. *Waist circumference and waist-hip ratio: report of a WHO expert consultation*. 8. Geneva: World Health Organization, 2008.
28. Hsieh SD, Yoshinaga H, Muto T. Waist-to-height ratio, a simple and practical index for assessing central fat distribution and metabolic risk in Japanese men and women. *Int J Obes Relat Metab Disord* 2003;27:610–6.
29. Browning LM, Hsieh SD, Ashwell M. A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0·5 could be a suitable global boundary value. *Nutr Res Rev* 2010;23:247–69.
30. Riley L, Guthold R, Cowan M, *et al*. The World Health Organization STEPwise approach to noncommunicable disease risk-factor surveillance: methods, challenges, and opportunities. *Am J Public Health* 2016;106:74–8.
31. He W, Muenchrath M, Kowal P. *Shades of Gray: a cross-country study of health and well-being of the older populations in SAGE Countries, 2007–2010*. Washington DC: US Department of Health and Human Services, 2012.
32. World Health Organization. *Global Physical Activity Questionnaire (GPAQ). Analysis guide. Surveillance and population-based prevention*. Geneva, Switzerland: World Health Organization, 2006.
33. Ferguson B, Murray CL, Tandon A, *et al*. Estimating permanent income using asset and indicator variables. In: Murray CL, Evans DB, eds. *Health systems performance assessment debates, methods and empiricism*. Geneva: World Health Organization, 2003.
34. Howe LD, Galobardes B, Matijasevich A, *et al*. Measuring socio-economic position for epidemiological studies in low- and middle-income countries: a methods of measurement in epidemiology paper. *Int J Epidemiol* 2012;41:871–86.
35. Biritwum R, Mensah G, Yawson A, *et al*. *Study on global AGEing and adult health (SAGE) Wave 1 Ghana National report*. Geneva: World Health Organization, 2013.
36. Human Sciences Research Council. *Study on global AGEing and adult health (SAGE) Wave 1 South Africa National report*. South Africa: Human Sciences Research Council, 2012.
37. Levitt NS, Katzenellenbogen JM, Bradshaw D, *et al*. The prevalence and identification of risk factors for NIDDM in urban Africans in Cape Town, South Africa. *Diabetes Care* 1993;16:601–7.
38. Abebe SM, Berhane Y, Worku A, *et al*. Diabetes mellitus in North West Ethiopia: a community based study. *BMC Public Health* 2014;14:8.
39. DECODE Study Group. Age- and sex-specific prevalences of diabetes and impaired glucose regulation in 13 European cohorts. *Diabetes Care* 2003;26:61–9.
40. Kesavadev JD, Short KR, Nair KS. Diabetes in old age: an emerging epidemic. *J Assoc Physicians India* 2003;51:1083–94.
41. Tyrovolas S, Koyanagi A, Garin N, *et al*. Diabetes mellitus and its association with central obesity and disability among older adults: a global perspective. *Exp Gerontol* 2015;64:70–7.
42. Mbanya VN, Kengne AP, Mbanya JC, *et al*. Body mass index, waist circumference, hip circumference, waist–hip-ratio and waist–height-ratio: Which is the better discriminator of prevalent screen-detected diabetes in a Cameroonian population? *Diabetes Res Clin Pract* 2015;108:23–30.
43. Mbanya JC, Motala AA, Sobngwi E, *et al*. Diabetes in sub-Saharan Africa. *Lancet* 2010;375:2254–66.
44. van der Hoeven M, Kruger A, Greeff M. Differences in health care seeking behaviour between rural and urban communities in South Africa. *Int J Equity Health* 2012;11:31.
45. Aboderin IAG, Beard JR. Older people's health in sub-Saharan Africa. *Lancet* 2015;385:e9–e11.
46. ASPRAY T, Mugusi F, Rashid S, Whiting D, Edwards R, Alberti KG. Rural and urban differences in diabetes prevalence in Tanzania: the role of obesity, physical inactivity and urban living. *Trans R Soc Trop Med Hyg* 2000;94:637–44.
47. Wang A, Stronks K, Arah OA, Onyebuchi AA. Global educational disparities in the associations between body mass index and diabetes mellitus in 49 low-income and middle-income countries. *J Epidemiol Community Health* 2014;68:705–11.
48. Ziraba AK, Fotso JC, Ochako R. Overweight and obesity in urban Africa: a problem of the rich or the poor? *BMC Public Health* 2009;9:9.
49. de-Graft Aikins A, Kushitor M, Koram K, *et al*. Chronic non-communicable diseases and the challenge of universal health coverage: insights from community-based cardiovascular disease research in urban poor communities in Accra, Ghana. *BMC Public Health* 2014;14(Suppl 2):S3.
50. Cornelis MC, Chiuve SE, Glymour MM, *et al*. Bachelors, divorcees, and widowers: does marriage protect men from type 2 diabetes? *PLoS One* 2014;9:9.

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