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Prevalence of angina and co-morbid conditions among older adults in six low- and middle-income countries: Evidence from SAGE Wave 1

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ABSTRACT

Background: Global commitments to reduce cardiovascular disease (CVD) burden by 2025 will require data on CVDs from lower income countries. This study aimed to estimate the prevalence of angina, and its association with hypertension, diabetes, and depression, in six low- and middle-income countries (LMICs).
Methods: Data from the World Health Organization (WHO) Study on global AGEing and adult health (SAGE) Wave 1 from China, Ghana, India, Mexico, Russia and South Africa were utilized. Multivariable logistic regression methods were used to examine the factors associated with angina.
Results: A total of 31,443 respondents aged 50 years and over were included in these analyses. The prevalence of angina was highest in Russia (39%), lowest in China (8%), and consistently higher in women than men. Angina was comorbid with chronic conditions and depression but patterns varied across countries. Depression was negatively associated with angina among older adults in Ghana but was positively associated with angina in all other countries. Hypertension was associated with increased odds of angina among older adults in China (OR 1.9; 95% CI 1.59–2.25), India (OR 1.4; 95% CI 1.14–1.78) and Russia (OR 3.7; 95% CI 2.33–6.00). Diabetes was associated with higher odds of angina in China (OR 1.6; 95% CI 1.15–2.15), Russia (OR 2.5; 95% CI 1.57–3.87), and South Africa (OR 4.1; 95% CI 2.49–6.88).
Conclusions: CVD is a significant contributor to disease burden in LMICs. Angina was often co-morbid with other conditions, therefore compelling health systems to develop longer-term integrated care systems to address co- and multi-morbidity.

1. Introduction

Cardiovascular disease (CVD), especially ischaemic heart disease, is the top contributor to disease burden globally, and increasing in low- and middle-income countries (LMICs) as populations grow and age [1,2]. Angina, a hallmark symptom of cardiovascular disease, has become an important public health issue in LMICs especially as it is often co-morbid with other chronic non-communicable diseases and mental health conditions such as hypertension, diabetes, and depression [3–6]. These chronic conditions present growing economic and institutional challenges for LMICs where health care systems are not adequately developed for diagnosis and chronic treatment regimens [7,8].

Valid and reliable assessment of angina is important in epidemiological studies, particularly those that compare populations. The 7-item Rose angina questionnaire is a structured set of questions to identify and differentiate the characteristics of chest pain [9]. It has been widely used to estimate the prevalence of angina in the general population [10,11], and among older adults [12]. Nevertheless, determining the prevalence of angina across populations is complicated by cultural differences where symptoms like chest pain may signify mental health conditions, such as depression, or other conditions manifested as physical symptoms [11].

Population based studies among high and lower income countries show that depression is associated with cardiovascular disease [13–15]. Among older adults, studies within developed countries studies indicate that depression is an independent risk factor for the incidence of, and mortality due to, cardiovascular disease [16–18]. In LMICs, the importance of depression to cardiovascular disease outcomes among older adults is underexplored. Noting that health literacy and health system responses to chronic disease prevention and management are

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underdeveloped in many LMICs [8,19,20], symptoms of angina may be undetected and untreated resulting in poor health outcomes. Therefore, it is increasingly important to understand the role of cardiovascular disease and concurrent comorbid conditions to health outcomes among older adults in LMICs.

This study aims to estimate the prevalence of angina, and its relationship with other risk factors and related chronic conditions for cardiovascular disease, among older adults in six countries using data from the World Health Organization Study on global AGEing and adult health.

2. Methods

2.1. Data and respondents

Data are drawn from the World Health Organization's Study of global AGEing and adult health (WHO SAGE) Wave 1 (2007–2010). SAGE is a cross-national study of adults aged 50 years and older (50+), with a smaller sample of younger adults aged 18–49 years, in six LMICs, China, Ghana, India, Mexico, the Russian Federation (hereafter abbreviated to Russia), and South Africa [21,22]. The countries represent different geographic regions of the world, levels of economic development, stages in demographic and health transitions, and include the two most populous countries. Households in each country were selected using stratified, multistage, cluster random sampling, as either 18–49 or 50+ age group households. Face-to-face interviews were conducted with all individuals aged 50+ in the 50+ households, using standardized survey instruments, training, and methods. Individual respondents aged 50+ years were included in this analysis. The survey instruments were based on tested or standard measures with demonstrated validity and reliability, including the Rose Questionnaire [10]. Primary data management, checking and quality assurance was undertaken by country survey teams and coordinated centrally through WHO Geneva. Individual response rates were 53% for Mexico, 68% for India, 75% for South Africa, 81% in Ghana, 83% for Russia and 93% in China. The response rates in Mexico reflect practical challenges at the time of survey implementation - analysis of the non-respondents in Mexico showed minimal differences in available covariates compared to the final cohort.

2.2. Outcome measure

Angina was derived from an algorithm using a set of symptomatic questions based on the Rose questionnaire [9]. Respondents were asked about their experience of any chest pain or discomfort, management, relief and location of pain or discomfort, and whether they were on any medication for angina. Responses were then coded into a dichotomous variable, indicating the presence or absence of angina.

2.3. Covariates

Socio-demographic characteristics include age, sex, marital status, location of residence, highest level of education (no formal education, less than primary school, primary school only, secondary school, or higher education), and wealth quintile. Wealth quintiles were derived within countries from a series of 21 questions on household ownership of durable goods, dwelling characteristics and access to services such as improved water, sanitation and cooking fuel [23].

Lifestyle risk factors for cardiovascular disease included tobacco and alcohol consumption, fruit and vegetable intake, body mass index (BMI), and physical activity [24–27]. Tobacco use was dichotomized as daily smoker versus not current daily smoker (including never, ex- and occasional smokers, based on self-reported ever and current tobacco use). Alcohol consumption was derived from respondents' reports of ever drinking alcohol, and the quantity and frequency of use within the previous 12 months and seven days. Respondents were classified as having ever (combining occasional, non-heavy, infrequent heavy, and frequent heavy drinkers) or never consumed alcohol. Responses for the number of servings of fruit and vegetables eaten in a typical day were added together, and intake was classified as adequate if respondents reported five or more servings of fruit and vegetables and inadequate if respondents reported less than five servings on a typical day [28]. Weight and height were measured without shoes and wearing light clothing using mechanical (bathroom) scales and a stadiometer, respectively. BMI was calculated as weight in kilograms divided by height (in metres) squared. Respondents were classified as overweight or obese if they have a BMI ≥ 25 kg/m^2 for Russia, Mexico, Ghana, and South Africa [29] and ≥23 kg/m^2 for China and India, since the relationships among BMI, body fat percentage, and health risk are different in Asian populations [30]; otherwise they were classified as normal/underweight. Physical activity was based on self-reported vigorous or moderate intensity activity for leisure and work during the week prior to data collection [31]. Respondents recorded the number of days per week, and the time spent per day, in vigorous or moderate activities. High to moderate physical activity was defined as a minimum of 600 metabolic equivalent minutes per week for moderate activity or 1500 metabolic equivalents per week for vigorous activity. Those not meeting these criteria were classified as having low physical activity.

One high burden risk factor (hypertension) and two chronic conditions (diabetes and depression) were included. While respondents were seated, blood pressure was measured three times with one-minute intervals between measures. The mean of the second and third readings were used. Respondents also reported whether they had been diagnosed with high blood pressure, and, if so, whether they had been taking medication for hypertension during the last 2 weeks and/or 12 months. Respondents were considered hypertensive if the mean of their two systolic or diastolic blood pressure measurements exceeded 140 or 90 mm Hg, respectively, or they reported taking antihypertension medication in the last 12 months. Respondents were considered diabetic if they reported that they had been diagnosed with diabetes (not associated with pregnancy), or that they had been taking insulin or other blood sugar lowering medications in the last 12 months.

Depression was assessed using the World Mental Health Survey adaptation of the Composite International Diagnostic Interview and was derived from a diagnostic algorithm based on respondents' reports of depression in the past 12 months [32,33]. Individuals were considered depressed if they experienced a minimum of two basic symptoms (feelings of sadness, loss of interest in life, or low energy) in the past year, four detailed symptoms (low self-esteem, anxiety, loss of appetite, suicidal ideations, difficulties concentrating, and trouble sleeping) lasting most of the day or almost every day for 2 weeks, or had been diagnosed with depression and had been taking medication or other treatment for depression during the past 12 months.

2.4. Statistical analysis

SAGE respondents were included in this study if they had non-missing values for sex, age, and angina variables. Descriptive characteristics are presented for the eligible sample. Sex-specific age standardized prevalence of angina, with 95% Confidence Intervals (CIs), was obtained for each country, standardized to the WHO world standard population [34].

Chi-square tests examined the relationship between angina and each of the individual covariates/risk factors: sex, age group, location of residence, marital status, education level, wealth quintile, smoking status, alcohol consumption, overweight/obesity, physical activity, adequate fruit or vegetable intake, hypertension, diabetes and depression. Multiple logistic regression was undertaken with angina as the outcome, and including all risk factors/covariates specified above. Adjusted odds ratios with 95% CIs and p-values from adjusted Wald tests for the overall variable, are presented. Analyses were weighted using post-stratified individual probability weights, normalized to the eligible sample size for each country. All analyses were conducted using STATA SE statistical software version 11.2.

3. Results

Analyses were based on a total of 31,443 respondents aged 50+ years. Table 1 provides a description of the sample by country of residence. Generally, 50% or more of adults were 60 years, and women outnumbered men in Mexico, Russia, and South Africa. In three countries, China, Ghana, and India, older adults predominantly lived in rural areas. While <1% of respondents in Russia had no formal education, this increased to >50% in Ghana and India.

Country heterogeneity was further observed among the lifestyle risk factors for chronic diseases. Ghana and India showed the lowest proportion of overweight or obese adults, 29% and 22%, respectively, while Mexico had the highest prevalence (78%), followed closely by Russia (75%) and South Africa (73%). Respondents were, however, generally physically active except in South Africa where almost two-thirds (62%) reported low physical activity. The majority of adults were not current daily smokers, with India reporting the highest prevalence of current daily smoking of 46%. Russia (73%) had the highest percentage of respondents who reported ever having consumed alcohol followed by Ghana (58%) and Mexico (55%). Adequate fruit and vegetable consumption ranged from 9% in India to 65% in China. China showed the lowest prevalence of depression (2%) while India had the highest (19%). More than half of respondents were classified as hypertensive in all countries except for India, where the prevalence was 35%. The prevalence of diabetes ranged from 6% in China to 18% in Mexico.

The overall prevalence of angina was highest in Russia (39%), double the next highest prevalence of India (19%). China and South Africa had the lowest prevalence of angina, 8% and 9%, respectively. Fig. 1 provides the sex-specific age-standardized prevalence of angina for each country, showing the prevalence was higher for women than men for all six countries.

Table 2 shows the results of the bivariate associations between variables of interest and angina. While no variables were consistently associated with angina across all six countries, the prevalence of angina generally increased with increasing age and was higher for women than men in most countries. Unmarried respondents in China, Ghana, and Russia were more likely than married respondents to experience angina

Table 1
Sociodemographic characteristics, lifestyle risk factors and chronic conditions[a] of older adults by country of residence, WHO SAGE Wave 1, 2007–2010.

Characteristics	China, n = 12,277	Ghana, n = 4102	India, n = 5697	Mexico, n = 2204	Russia, n = 3615	South Africa, n = 3548
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Age						
50–59	6238 (50.8)	1626 (39.6)	2503 (43.9)	1082 (49.1)	1650 (45.7)	1777 (50.0)
60–69	3364 (27.4)	1120 (27.3)	1688 (29.6)	568 (25.8)	889 (24.6)	1088 (30.7)
70 and over	2675 (21.8)	1356 (33.1)	1506 (26.4)	554 (25.2)	1076 (29.8)	684 (19.3)
Male	6140 (50.0)	2151 (52.4)	2903 (51.0)	1028 (46.6)	1439 (39.8)	1556 (43.9)
Unmarried	1718 (14.0)	1665 (40.8)	1458 (25.6)	595 (27.0)	1482 (41.0)	1524 (43.7)
Urban	5438 (44.3)	1674 (40.8)	1825 (32.0)	1729 (78.5)	2668 (73.8)	2314 (65.2)
Education						
No formal education	2795 (22.8)	2193 (53.7)	2907 (51.0)	380 (17.2)	24 (0.7)	717 (20.4)
Less than primary	2364 (19.3)	423 (10.4)	594 (10.4)	845 (38.4)	48 (1.3)	922 (26.2)
Primary	2567 (20.9)	455 (11.1)	825 (14.5)	529 (24.0)	209 (5.8)	794 (22.5)
Secondary	4020 (32.8)	866 (21.2)	1058 (18.6)	271 (12.3)	2661 (73.7)	880 (25.0)
Tertiary	531 (4.3)	146 (3.6)	314 (5.5)	179 (8.1)	670 (18.6)	208 (5.9)
Wealth quintile						
I (poorest)	2035 (16.7)	742 (18.1)	1008 (17.7)	335 (15.2)	611 (16.9)	715 (20.3)
II	2252 (18.4)	784 (19.1)	1089 (19.2)	550 (25.0)	703 (19.5)	709 (20.1)
III	2420 (19.8)	852 (20.8)	1073 (18.9)	364 (16.5)	680 (18.8)	653 (18.5)
IV	2839 (23.3)	845 (20.6)	1157 (20.4)	367 (16.7)	739 (20.4)	699 (19.8)
V (wealthiest)	2667 (21.8)	874 (21.3)	1357 (23.9)	586 (26.6)	881 (24.4)	754 (21.4)
Overweight to obese	6689 (58.1)	1168 (29.5)	1185 (21.9)	1621 (78.3)	2391 (74.6)	2415 (73.0)
Low physical activity	3645 (29.8)	1089 (26.6)	1589 (27.9)	872 (40.1)	981 (27.2)	2194 (62.1)
Daily smoker	3330 (27.2)	323 (7.9)	2644 (46.4)	294 (13.3)	731 (20.3)	724 (20.5)
Ever consumed alcohol	4151 (33.9)	2351 (57.6)	866 (15.2)	1216 (55.2)	2628 (72.8)	858 (24.4)
Adequate fruit & vegetable intake	7988 (65.1)	1283 (31.3)	535 (9.4)	423 (19.2)	791 (21.9)	1154 (32.5)
Depression	245 (2.0)	370 (9.0)	1099 (19.3)	317 (14.4)	237 (6.6)	177 (5.0)
Hypertension	6900 (58.8)	2331 (57.5)	1923 (34.6)	1208 (57.8)	2497 (72.0)	2738 (78.0)
Diabetes	731 (6.0)	155 (3.8)	397 (7.0)	388 (17.6)	258 (7.1)	315 (8.9)
Angina	975 (8.0)	518 (12.6)	1070 (18.8)	297 (13.5)	1407 (38.9)	312 (8.8)

[a] Weighted distributions; Percentages may not all add to 100 due to rounding; numbers may not add to total sample size due to missing values.

($p < 0.001$). In China, a higher proportion of urban rather than rural dwellers experienced angina ($p = 0.047$) but in Ghana the opposite pattern was observed ($p < 0.001$). Higher wealth and education were significantly associated with lower prevalence of angina in Ghana and India. In Russia, however, higher education was associated with lower prevalence of angina ($p < 0.001$) while wealth was unrelated. In China, higher wealth was associated with a lower prevalence of angina while education showed a non-linear relationship. Being overweight or obese was marginally associated ($p = 0.05$), and low physical activity ($p < 0.001$) was associated with a higher prevalence of angina only in China. Lower prevalence of angina was observed among current smokers in China ($p < 0.001$) and Mexico ($p = 0.007$), those who had ever consumed alcohol in China and Ghana and those with sufficient fruit and vegetable intake in Ghana. In all countries except Ghana, a higher proportion of older adults who reported depressive symptoms, relative to those with no depressive symptoms, also experienced angina. Hypertension was unrelated to angina in Ghana, Mexico, and South Africa. Diabetes was not associated with angina among older adults in Ghana and Mexico.

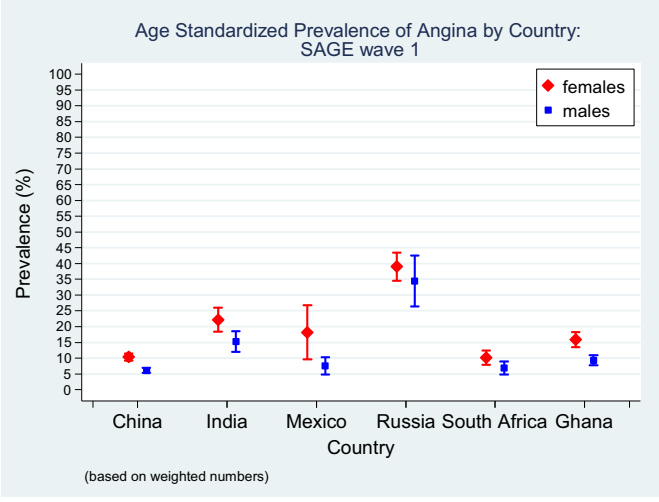

Fig. 1. Sex-specific age standardized prevalence of angina by country: SAGE Wave 1.

Overall, there was substantial variability in the relationships between risk factors and angina across countries in multivariable analyses (Table 3). The odds of angina increased significantly with increasing age in China, India and Russia (ORs of approximately 2–3, $p < 0.001$ for those aged 70 or over relative to those aged 50–59 years), and was lower for men than women in China, Ghana, India and South Africa, with ORs generally 0.6–0.7. Those who were not currently married had statistically significantly lower odds of angina, compared to married respondents, for China and Mexico, and marginally non-significantly lower odds for South Africa. The inverse association of higher odds of angina for unmarried respondents seen in Russia was only statistically significant at the 10% level. Area of residence was not associated with the odds of angina in any country. There were no consistent country patterns in the association between either educational attainment, or wealth quintile, and angina. There was some evidence of lower odds of angina with higher education in Ghana, India, Russia, and South Africa, and higher economic standing (wealth quintile) was associated with lower odds of angina in China, India and Mexico.

There were very few associations between lifestyle risk factors and angina. Neither overweight or obesity, nor being a current smoker was associated with angina in any country. There was an increased odds of angina among those with inadequate physical activity which was statistically significant for China (OR 1.3; 95% CI 1.0–1.5; $p = 0.023$), and marginally non-significant for Russia (OR 1.4, 95% CI 1.0–1.9 $p = 0.052$), while ever having consumed alcohol was associated with an approximate doubling of the odds of angina in Russia and South Africa. Sufficient daily fruit and vegetable intake was associated with an almost halving of the odds of angina in Ghana.

Table 2
Prevalence of Angina by sociodemographic characteristics, risk factors and chronic conditions of older adults by country of residence, WHO SAGE Wave 1, 2007–2010.

Characteristics	China, n = 975		Ghana, n = 518		India, n = 1070		Mexico, n = 297		Russia, n = 1407		South Africa, n = 312	
	n (%)	*p*-Value	n (%)	*p*-Value	n (%)	*p*-Value	n (%)	*p*-Value	n (%)	*p*-Value	n (%)	*p*-Value
Age		<0.001		0.042		<0.001		0.113		<0.001		0.341
50–59	315 (5)		176 (10.8)		380 (15.2)		192 (17.7)		456 (27.6)		148 (8.3)	
60–69	310 (9.2)		154 (13.8)		339 (20.1)		50 (8.8)		356 (40.0)		112 (10.3)	
70+	351 (13.1)		188 (13.9)		351 (23.3)		55 (10.0)		595 (55.3)		52 (7.6)	
Sex		<0.001		<0.001		<0.001		0.013		0.172		0.011
Female	625 (10.2)		312 (16.0)		617 (22.1)		221 (18.8)		906 (41.6)		206 (10.4)	
Male	351 (5.7)		206 (9.6)		453 (15.6)		76 (7.4)		501 (34.8)		106 (6.8)	
Marital status		<0.001		<0.001		0.075		0.234		<0.001		0.634
Married	806 (7.6)		257 (10.7)		758 (17.9)		240 (14.9)		700 (32.9)		169 (8.6)	
Unmarried	169 (9.8)		256 (15.4)		312 (21.4)		57 (9.6)		706 (47.7)		142 (9.3)	
Area of residence		0.047		<0.001		0.970		0.973		0.448		0.589
Rural	482 (7.1)		365 (15.0)		729 (18.8)		65 (13.6)		406 (42.8)		117 (9.5)	
Urban	493 (9.1)		154 (9.2)		341 (18.7)		232 (13.4)		1001 (37.5)		195 (8.4)	
Level of education		0.014		<0.001		<0.001		0.254		<0.001		0.108
None	279 (10.0)		367 (16.7)		619 (21.3)		41 (10.9)		14 (56.7)		76 (10.6)	
Less than primary	157 (6.6)		47 (11.2)		124 (20.9)		163 (19.3)		31 (64.8)		100 (10.8)	
Primary	201 (7.8)		47 (10.2)		152 (18.5)		61 (11.5)		119 (56.9)		71 (9.0)	
Secondary	288 (7.2)		44 (5.1)		154 (14.6)		27 (9.9)		1074 (40.4)		51 (5.8)	
Tertiary	51 (9.5)		10 (6.7)		21 (6.6)		5 (2.7)		167 (25)		12 (5.6)	
Wealth quintile		0.025		<0.001		0.013		0.102		0.337		0.108
I (poorest)	173 (8.5)		113 (15.2)		242 (24.0)		64 (19.2)		220 (36.1)		44 (6.2)	
II	200 (8.9)		111 (14.2)		175 (16.0)		30 (5.5)		323 (45.9)		69 (9.7)	
III	223 (9.2)		131 (15.4)		243 (22.7)		103 (28.3)		299 (44.0)		67 (10.2)	
IV	200 (7.0)		102 (12)		213 (18.4)		39 (10.7)		268 (36.2)		81 (11.6)	
V (wealthiest)	170 (6.4)		61 (7.0)		193 (14.3)		60 (10.2)		297 (33.7)		51 (6.8)	
BM		0.052		0.149		0.906		0.181		0.299		0.368
Normal/underweight	344 (7.1)		366 (13.1)		785 (18.6)		42 (9.3)		282 (34.7)		67 (7.5)	
Overweight/obese	574 (8.6)		131 (11.2)		223 (18.8)		247 (15.2)		959 (40.1)		208 (8.6)	
Physical activity		<0.001		0.252		0.199		0.333		0.098		0.157
High/moderate	593 (6.9)		394 (13.1)		734 (17.9)		204 (15.6)		972 (37.0)		139 (10.4)	
Low activity	383 (10.5)		125 (11.4)		334 (21)		91 (10.4)		432 (44.0)		173 (7.9)	
Smoking		<0.001		0.236		0.192		0.007		0.761		0.560
Not daily smoker	820 (9.2)		468 (12.4)		610 (20.0)		280 (14.6)		1132 (39.4)		238 (8.5)	
Daily smoker	154 (4.6)		49 (15.3)		460 (17.4)		17 (5.9)		270 (36.9)		69 (9.5)	
Alcohol consumption		<0.001		0.042		0.612		0.797		0.120		0.086
Never consumed	730 (9.0)		251 (14.5)		899 (18.6)		125 (12.6)		325 (33.1)		213 (8.0)	
Ever consumed	243 (5.9)		267 (11.4)		171 (19.8)		172 (14.2)		1077 (41.0)		94 (10.9)	
Fruit & vegetable intake		0.146		<0.001		0.572		0.236		0.577		0.703
Inadequate	370 (8.6)		402 (14.3)		978 (18.9)		260 (14.6)		1079 (38.2)		215 (9.0)	
Adequate	605 (7.6)		116 (9.1)		92 (17.2)		37 (8.7)		328 (41.5)		96 (8.4)	
Depression		<0.001		0.312		<0.001		<0.001		<0.001		<0.001
No	912 (7.6)		480 (12.9)		688 (15.0)		162 (8.6)		1264 (37.4)		256 (7.6)	
Yes	57 (23.3)		38 (10.3)		381 (34.7)		135 (42.6)		143 (60.5)		55 (31.3)	
Hypertension		<0.001		0.326		<0.001		0.284		<0.001		0.648
No	241 (5.0)		228 (13.2)		603 (16.6)		153 (17.3)		162 (16.6)		63 (8.2)	
Yes	703 (10.2)		280 (12.0)		444 (23.1)		121 (10.0)		1190 (47.6)		247 (9.0)	
Diabetes		<0.001		0.610		0.036		0.765		<0.001		<0.001
No	867 (7.5)		496 (12.6)		971 (18.3)		250 (13.8)		1243 (37.0)		237 (7.3)	
Yes	107 (14.6)		22 (14.2)		98 (24.8)		47 (12.1)		164 (63.6)		75 (23.7)	

*Weighted distributions; *p* values for Chi-squared test adjusted for sampling design; numbers may not add to total sample size due to missing values.

Depression was associated with increased odds of angina for all countries except Ghana, with ORs ranging from 2.4 in Russia to 5.5 in South Africa ($p < 0.001$). In Ghana, those with depression had lower odds of angina (OR 0.57; 95% CI 0.35–0.91; $p = 0.018$). The odds of angina were higher for those with hypertension in China (OR 1.9; 95% CI 1.6–2.3; $p < 0.001$), India (OR 1.4; 95% CI 1.1–1.8; $p = 0.002$) and Russia (OR 3.7; 95% CI 2.3–6.0; $p < 0.001$). Diabetes was statistically significantly associated with higher odds of angina in China (OR 1.6; 95% CI 1.2–2.1; $p = 0.005$), Russia (OR 2.5; 95% CI 1.6–3.9; $p < 0.001$) and South Africa (OR 4.1; 95% CI 2.5–6.9; $p < 0.001$).

4. Discussion

Using nationally representative data from the WHO Study on global AGEing and adult health (SAGE), this study examined the prevalence of angina and its relationship with other risk factors and related chronic conditions for cardiovascular disease, among older adults in six LMICs. Its importance is underscored by the increasing burden of cardiovascular disease mortality and morbidity within lower income countries [1,2,4]. WHO SAGE provides a timely opportunity to assess the potential burden of CVD within LMICs by examining the prevalence of angina, a common symptom of cardiovascular disease, among older adults.

Angina was most prevalent in Russia, and least prevalent in China and South Africa. Although there are limited studies on angina, specifically, among older adults in the countries included in this study, existing studies show a high prevalence of angina among the working age Russian population with coronary heart disease [35]. Moreover, current patterns of ischaemic heart disease mortality position Russia among countries with the largest number of deaths in 2010 along with the United States of America and the Ukraine [36]. Given the age-related patterns of increasing ischaemic heart disease mortality with increasing age, there is likely to be a higher prevalence of angina among older Russians. Previous studies among Chinese older adults indicate a comparatively lower prevalence of angina, although also increasing with age [37].

Few of the lifestyle risk factors commonly associated with angina were found to be important in this study, in the presence of chronic

Table 3
Multivariable logistic regression results for the association between experiencing angina and sociodemographic characteristics, risk factors and chronic conditions by country: SAGE Wave 1 2007/10.

Characteristics	China, N = 11,282		Ghana, N = 3859		India, N = 5407		Mexico, N = 1926		Russia, N = 3028		South Africa, N = 3141	
	OR (95% CI)	*p*-Value	OR (95%CI)	*p*-Value	OR (95%CI)	*p*-Value	OR (95%CI)	p-Value	OR (95% CI)	*p*-Value	OR (95%CI)	*p*-Value
Age (50–59)		<0.001		0.813		<0.001		0.209		<0.001		0.229
60–69	1.78 (1.37–2.29)		1.05 (0.78–1.39)		1.45 (1.08–1.96)		0.64 (0.34–1.19)		1.39 (0.99–1.95)		1.16 (0.72–1.86)	
70+	2.60 (1.92–3.53)		0.96 (0.71–1.30)		1.69 (1.32–2.17)		0.92 (0.37–2.33)		2.52 (1.74–3.67)		0.76 (0.46–1.25)	
Sex (female)												
Male	0.60 (0.52–0.69)	<0.001	0.70 (0.54–0.91)	0.009	0.63 (0.45–0.88)	0.007	0.51 (0.20–1.31)	0.160	0.84 (0.54–1.32)	0.449	0.59 (0.40–0.89)	0.011
Marital status (married)												
Unmarried	0.77 (0.64–0.94)	0.011	1.17 (0.91–1.51)	0.230	0.75 (0.53–1.07)	0.115	0.47 (0.23–0.97)	0.040	1.58 (0.93–2.70)	0.094	0.69 (0.46–1.02)	0.062
Area of residence (rural)												
Urban	1.28 (0.96–1.71)	0.087	0.76 (0.54–1.07)	0.116	0.98 (0.52–1.87)	0.957	0.79 (0.44–1.41)	0.419	0.65 (0.38–1.09)	0.102	0.82 (0.51–1.32)	0.408
Level of education (none)		0.448		<0.001		0.054		0.187		0.035		0.011
Less than primary	0.92 (0.70–1.21)		0.64 (0.41–1.00)		1.15 (0.74–1.77)		1.67 (0.64–4.39)		0.72 (0.10–5.05)		0.74 (0.40–1.37)	
Primary	1.14 (0.81–1.61)		0.70 (0.47–1.04)		1.00 (0.70–1.42)		1.37 (0.46–4.02)		0.76 (0.13–4.32)		0.47 (0.25–0.87)	
Secondary	1.21 (0.88–1.67)		0.36 (0.24–0.55)		0.93 (0.67–1.29)		1.24 (0.34–4.53)		0.67 (0.14–3.19)		0.34 (0.17–0.70)	
Tertiary	1.49 (0.85–2.63)		0.55 (0.26–1.16)		0.44 (0.24–0.79)		0.39 (0.12–1.31)		0.39 (0.08–1.92)		0.45 (0.17–1.19)	
Wealth quintile (I)		0.011		0.269		0.040		0.004		0.730		0.526
II	1.10 (0.93–1.30)		1.10 (0.77–1.56)		0.62 (0.45–0.87)		0.21 (0.09–0.40)		1.37 (0.85–2.21)		1.46 (0.73–2.94)	
III	1.13 (0.96–1.34)		1.31 (0.92–1.88)		0.92 (0.65–1.29)		0.64 (0.27–1.48)		1.34 (0.74–2.44)		1.78 (0.88–3.61)	
IV	0.82 (0.66–1.03)		1.12 (0.78–1.61)		0.73 (0.48–1.12)		0.42 (0.18–0.98)		1.29 (0.69–2.43)		1.82 (0.88–3.77)	
V	0.76 (0.56–1.05)		0.82 (0.52–1.29)		0.58 (0.36–0.94)		0.28 (0.11–0.70)		1.29 (0.58–2.88)		1.52 (0.66–3.51)	
BMI (normal/underweight)												
Overweight to obese	1.09 (0.90–1.32)	0.384	1.01 (0.77–1.32)	0.936	1.08 (0.80–1.46)	0.632	1.47 (0.80–2.71)	0.217	1.11 (0.75–1.65)	0.595	1.28 (0.88–1.86)	0.189
Physical activity (high/moderate)												
Low activity	1.26 (1.04–1.55)	0.023	0.91 (0.78–1.23)	0.547	1.04 (0.81–1.33)	0.766	0.56 (0.27–1.14)	0.108	1.36 (1.00–1.85)	0.052	0.74 (0.48–1.14)	0.175
Smoking status (not daily smoker)												
Daily smoker	0.81 (0.60–1.09)	0.166	1.09 (0.71–1.69)	0.686	0.89 (0.69–1.15)	0.368	0.62 (0.30–1.30)	0.204	1.30 (0.73–2.31)	0.370	1.02 (0.65–1.60)	0.927
Alcohol consumption (never)												
Ever consumed	0.93 (0.77–1.12)	0.424	0.83 (0.63–1.08)	0.169	1.33 (0.93–1.92)	0.121	1.23 (0.55–2.76)	0.616	1.92 (1.23–2.99)	0.004	1.87 (1.20–2.93)	0.006
Fruit & vegetable intake (inadequate)												
Adequate	1.04 (0.87–1.25)	0.653	0.56 (0.40–0.77)	<0.001	1.11 (0.75–1.65)	0.614	0.72 (0.26–1.98)	0.524	1.29 (0.73–2.28)	0.380	1.18 (0.77–1.81)	0.447
Depression (no)												
Yes	3.17 (1.98–5.09)	<0.001	0.57 (0.35–0.91)	0.018	2.67 (2.14–3.34)	<0.001	4.52 (2.33–8.78)	<0.001	2.36 (1.70–3.28)	<0.001	5.53 (3.13–9.80)	<0.001
Hypertension (no)												
Yes	1.89 (1.59–2.25)	<0.001	1.01 (0.80–1.27)	0.951	1.42 (1.14–1.78)	0.002	0.92 (0.51–1.66)	0.773	3.74 (2.33–6.00)	<0.001	1.09 (0.67–1.76)	0.728
Diabetes (no)												
Yes	1.58 (1.15–2.15)	0.005	1.46 (0.83–2.57)	0.191	1.36 (0.92–2.03)	0.127	1.19 (0.58–2.42)	0.636	2.47 (1.57–3.87)	<0.001	4.14 (2.49–6.88)	<0.001

Analyses adjusted for all variables included in the table, and for the sampling design; p values from adjusted Wald test for the overall variable.

conditions. Despite being well-established risk factors for cardiovascular disease, BMI and smoking were unrelated to older adults' odds of experiencing angina in all countries. It is possible that BMI and smoking may present as risk factors for further progressed cardiovascular diseases rather than early stage symptoms such as angina among older adults in these countries. Low physical activity was associated with increased odds of experiencing angina among older adults in China and Russia only.

Despite the wide variation in the prevalence of alcohol consumption among older adults in Russia and South Africa, 73% and 24%, respectively, alcohol consumption was positively associated with angina among older adults in both countries. Although these patterns do not differentiate the frequencies of alcohol consumption, which may arguably be a more informed risk factor for angina, Russia is characterized by high levels of alcohol consumption, exceeding neighbouring European countries, which is partly attributed to the availability and

affordability of alcohol to the general population [38]. In South Africa, estimates of risky alcohol consumption among older adults is shown to be quite low [39], with a relatively low prevalence of heavy episodic drinking in the general population [40].

Consistent with existing research [41], adequate fruit and vegetable consumption was shown to lower the odds of angina among older adults in Ghana. Although only one-third of older adults in Ghana indicated they fulfilled WHO's guidelines of five servings or more in a day, this inverse association points to the possible value of public health interventions to reduce cardiovascular disease.

Notably, the selected risk factor and chronic conditions were shown to be associated with angina among older adults in these six countries. Hypertension was positively associated with angina in China, India, and Russia. Diabetes was associated with increased odds of angina among older adults in China, Russia and South Africa. Depression was associated with angina across all countries, independent of other chronic conditions, lifestyle risk factors, and socio-demographic characteristics. This finding complements existing studies, which demonstrate that depression is an independent and common risk factor for cardiovascular disease and mortality due to cardiovascular disease [14,16,17]. Although a positive association between depression and angina was observed in China, India, Mexico, Russia and South Africa, the association was reversed among older adults in Ghana. While the current study cannot offer a definitive explanation for this pattern, it is possible that depression may present as mood-related among older adults in Ghana while older adults in other countries experience more somatic effects that can influence their experience of angina more directly. For instance, in China where depression carries a heavy social stigma, depression is more likely to be expressed with complaints of physical pain [42] and among older Mexican Americans depression is a significant predictor of exertion induced chest pains [43]. Future research can distinguish the association between somatic and mood symptoms of depression and their relationship to cardiovascular diseases, across LMICs, and with longitudinal study designs.

4.1. Strengths and limitations

The data provide a unique opportunity to compare health conditions and lifestyle behaviors of older adults in six LMICs that offer variation in levels of economic development but are experiencing similarities in their respective epidemiological transitions. More importantly, given lower income countries rarely collect data on angina [44], this study fills a gap on the global prevalence of angina using a standard questionnaire among nationally representative samples of older adults in six countries. The study is not without limitations. Causal direction cannot be determined with these cross-sectional data. This is particularly relevant to the associations between depression and angina. Depression is associated with morbidity and mortality of chronic conditions and longitudinal studies show that major depressive disorder predicts the onset of cardiovascular diseases, diabetes and other chronic diseases [45]. Likewise, the causal ordering of lifestyle behaviors such as alcohol consumption and physical activity are limited. Response rates in the 50+ age group were generally high (75% to 93%) for most countries [21]. The lower overall response rate for Mexico (53%) is attributed to the limited time frame for adequate contact attempts. While all analyses incorporated sampling weights which also accounted for non-response, prevalence estimates for Mexico should be interpreted cautiously.

5. Conclusions

The results of this study contribute a better understanding of CVD and co-morbidity patterns in the evolving demographic and health transitions in a number of LMICs. The findings identify potential public health interventions for countries with a high prevalence of angina among older adults, notably Russia, such as the regulation of alcohol consumption, improving physical activity education programs or access to facilities to encourage physical activity, management of hypertension and diabetes, and, improved public awareness of depression. Importantly, our findings provide some evidence to support the adherence to existing clinical guidelines in China [46], India [47], Russia [48], and South Africa [49], for identifying patients at risk of acute coronary syndromes, such as angina, and risk factor management for these conditions. Moreover, risk factors and other chronic conditions associated with angina among older adults have to be understood and interpreted within social contexts. This is especially relevant when examining depression, which is not only culturally sensitive but challenging where LMIC health care systems have limited resources to address mental health [50]. Improving awareness and data collection, coupled with prevention and treatment of chronic conditions and mental health are paramount to sustainable population health and development.

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Conflicts of interest

The authors report no relationships that could be construed as a conflict of interest.

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