


BMJ Open Prevalence and correlates of self-reported cardiovascular disease in Mongolia: findings from the 2019 Mongolia STEPS cross-sectional survey

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ABSTRACT

Objective The aim of the study was to estimate the prevalence and correlates of cardiovascular disease (ischaemic heart disease and/or stroke (IHDS)) in Mongolia.

Design Cross-sectional study.

Setting National community-based sample of people aged 15–69 years in Mongolia.

Participants 6654 people (15–69 years, mean 41.3) who participated in the 2019 Mongolia STEPS survey.

Primary and secondary outcome measures Self-reported prevalence of IHDS and biological and social covariates. Determinants of IHDS were estimated with logistic regression.

Results The prevalence of IHDS was 14.0%, 15.6% among women and 12.3% among men. Older age (45–69 years), being married or cohabiting, and urban residence were positively associated, and male sex was negatively associated, with IHDS. Additionally, experience of threats, hypertension, current tobacco use, passive smoking, sedentary behaviour and high physical activity were positively associated with IHDS.

Conclusions Almost one in seven people aged 15–69 years had IHDS in Mongolia. Several factors amenable to public health intervention for IHDS were identified, including experience of threats, hypertension, current tobacco use, passive smoking and sedentary behaviour.

INTRODUCTION

Globally, almost 18 million people died from cardiovascular diseases (CVDs) in 2019, representing 32% of all global deaths, of which more than three-quarters occurred in low-resourced countries.¹ Half (49%) of the worldwide CVD burden in 2016 was attributed to ischaemic heart disease (IHD) and 33% to stroke.² IHD and stroke showed the highest rates of death and morbidity in Mongolia.³ Two in five people (40%) died from CVDs in 2016 in Mongolia,⁴ and in 2018, IHD was 25.8, stroke was 20.4 and arterial hypertension was 0.8 per 10 000 population in men aged 45–64 years. Compared with the mortality rate of women at the same age group, rates of IHD, stroke and arterial hypertension were statistically significantly

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ A large national sample of 6654 adolescents and adults in Mongolia was included.
- ⇒ Various social and biological determinants of cardiovascular disease (ischaemic heart disease and/or stroke (IHDS)) were included in the multivariable logistic regression model.
- ⇒ IHDS was measured by self-report, which may have biased the prevalence of IHDS.
- ⇒ Specific cardiovascular disease type and time since diagnosis were not evaluated.

higher in men than in women.⁵ IHD affected 23.3% of inpatients in 2018 in Mongolia.⁵ In a national population survey among persons 40 years and older in Mongolia in 2009, the prevalence of IHD (diagnosed via Rose questionnaire and electrocardiography) was 16.2%.⁶ A review of epidemiological studies on IHD in Mongolia⁷ from 1970 to 2015 reports a high and increasing mortality rate of IHD in Mongolia. In further review, we could not find more recent national studies on IHD and/or stroke (IHDS) in Mongolia, a lower middle-income country in East Asia.

In urban–rural sites among middle and older aged persons in China, India and Iran, the prevalence rates of CVD by self-report were 7.4%, 2.7% and 6.0%, respectively.⁸ In national community-based studies in Nepal (24–64 years) and Malawi (18–69 years), 2% and 6.5% of the population had IHDS, respectively,^{9 10} and the prevalence rates of CVD by self-report were 3.3% and 3.6% in China (35–74 years),¹¹ and 1.6% (35–74 years) in Thailand.¹¹

Sociodemographic factors associated with CVD by self-report include increasing age,^{12–14} gender,^{12–15} urban residence,¹² ethnicity,^{10 16} lower socioeconomic status^{13–15 17 18} and higher altitude region.⁷ Behavioural factors associated with CVD by self-report include tobacco consumption,^{18 19} physical inactivity,^{17 20} poor



dietary behaviour, such as inadequate vegetable and fruit consumption,^{9 20} high salt intake^{21 22} and psychosocial distress,^{23–25} including suicidal behaviour,¹⁰ and having a history of childhood abuse.²⁶ Biological factors associated with CVD include high blood pressure (BP),^{12 14 16 18–20 27 28} metabolic disorders, including diabetes,^{14 16–20 27} high body mass index^{17–20 27} and elevated cholesterol levels.^{12 15}

The aim of this analysis was to estimate the prevalence and correlates of IHDS among people 15–69 years in a national population-based survey in Mongolia in 2019.

METHODS

Sample and procedures

Secondary data from the 2019 cross-sectional STEPS surveys in Mongolia²⁹ were analysed; the response rate was 98.1%.³⁰ A multistage stratified sampling process (377 sampling units or clusters selected from 21 provinces and 9 districts of Ulaanbaatar) was carried out to randomly select participants from the target population. One individual within the age range of the survey (15–69 years) was randomly selected (using the Kish method) per household.³⁰

Data collection followed the WHO three STEPS methodology: step 1: administration of a structured questionnaire (sociodemographic information, medical history, medication use and health risk behaviour); step 2: BP and anthropometric measurements and step 3: biochemical tests (blood glucose and blood lipids).³⁰ Anthropometric measurements were taken using the Somatometre-Stanley 04-116 device and GIMA electronic scales.³⁰ Of the three BP measurements using OMRON Model M5 automatic BP monitor,³⁰ the last two readings were averaged.³⁰ At the data collection site, total cholesterol (TC) and blood glucose were measured in peripheral (capillary) blood using dry chemical methods, biochemical analysis and automated analyser.³⁰

Measures

Outcome measure: IHDS was assessed with the question, ‘Have you ever had a heart attack or chest pain from heart disease (angina) or a stroke (cerebrovascular accident or incident)?’ (No, Yes).³⁰

Sociodemographic information comprised employment, marital and residence status, sex, age, education, number of adult (≥ 15 years) household members and ethnicity.³⁰

Psychosocial stress included childhood physical abuse (‘Looking back on your childhood (before age 18 years), did a parent or adult in the household ever push, grab, shove, slap, hit, burn or throw something at you?’), childhood sexual abuse (‘Looking back on your childhood, did an adult or anyone at least 5 years older than you ever touch you sexually or try to make you touch them sexually or force you to have sex?’), adult sexual abuse (‘Since your 18th birthday, have you ever experienced a sex act involving either vaginal, oral or anal penetration against your will?’), experience of threats (‘In the past 12 months, have you been frightened for the safety of

yourself or your family because of the anger or threats of another person(s)?’ and ‘During the past 12 months, have you had family problems or problems with your partner due to someone else’s drinking?’).³⁰

Biological measures included measured central obesity (waist circumference ≥ 90 cm in men, ≥ 80 cm in women);³¹ *hypertension/raised BP*: systolic BP ≥ 140 mm Hg and/or diastolic BP ≥ 90 mm Hg or where the participant is currently on antihypertensive medication;³² *diabetes*: fasting plasma glucose levels ≥ 7.0 mmol/L (126 mg/dL) or using insulin or oral hypoglycaemic drugs or having a history of diagnosis of diabetes;³³ *raised TC*: fasting TC ≥ 5.0 mmol/L or currently on medication for raised cholesterol.³³

Behavioural measures included current tobacco use, current heavy episodic drinking (six or more standard drinks in a single drinking occasion), exposure to secondary smoke, daily servings of fruit and vegetable intake, and sedentary behaviour (≥ 8 hours/day) and low, moderate and high physical activity based on the Global Physical Activity Questionnaire.³⁴ *Salt consumption* was sourced from any always or often response from three questions: (1) ‘How often is salt, salty seasoning or a salty sauce added in cooking or preparing foods in your household?’; (2) ‘How often do you add salt or a salty sauce such as soy sauce to your food right before you eat it or as you are eating it?’; (3) ‘How often do you eat processed food high in salt? By processed food high in salt, I mean foods that have been altered from their natural state, such as packaged salty snacks, canned salty food including pickles and preserves, salty food prepared at a fast-food restaurant, cheese, bacon and processed meat’.³⁰ Responses were dichotomised into 0 (never, rarely or sometimes) and 1 (often or always).

Data analysis

Statistical analyses were conducted with STATA software V.14.0 (Stata Corporation, College Station, Texas, USA), by considering the multistage sampling design. Analysis weights were calculated by taking the inverse of the probability of selection of each participant adjusted for differences in the age–sex composition of the sample population as compared with the target population.³⁰ Unadjusted and adjusted logistic regression with variables statistically significant in the unadjusted models determined the prevalence of IHDS. The multivariable model included the following covariates: age, sex, marital status, residence status, region, threats, central obesity, hypertension, diabetes status, current tobacco use, passive smoking, sedentary behaviour, physical activity and salt consumption. The dependent variable was IHDS (yes or no). $P < 0.05$ was accepted as statistically significant, and only complete cases were included in the analyses (missing values $< 0.2\%$). *Svy* commands in STATA were applied to adjust for sampling design, sampling weights and stratification, and the calculation of SEs. Taylor linearisation methods were used for variance estimation in which linear approximates (ie, the estimated variance) of a non-linear

function (ie, the true variance) are derived by taking the first-order Taylor series of the approximation.

Patient and public involvement

Participants were not involved in the design of the study, recruitment or conduct of the study.

RESULTS

Participant characteristics

In total, 6654 people (15–69 years, mean 41.3, SD=13.7) were included in the sample, and 55.4% were women. The prevalence of IHDS was 14.0%, 12.3% among men and 15.6% among women. Tables 1 and 2 provide further sample information regarding sociodemographic factors, psychosocial stress, biological measures and behavioural risk factors.

Associations with IHDS prevalence

In the final logistic regression model, older age (45–69 years) (adjusted OR (AOR): 1.68, 95% CI: 1.24 to 2.28), being married or cohabiting (AOR: 1.26, 95% CI: 1.01 to 1.58) and urban residence (AOR: 1.46, 95% CI: 1.13 to 1.88) were positively associated, and male sex (AOR: 0.66, 95% CI: 0.53 to 0.82) was negatively associated with IHDS. Furthermore, threats (AOR: 2.14, 95% CI: 1.58 to 3.18), hypertension (AOR: 1.38, 95% CI: 1.12 to 1.71), current tobacco use (AOR: 1.27, 95% CI: 1.01 to 1.58), passive smoking (AOR: 1.39, 95% CI: 1.13 to 1.69), sedentary behaviour (AOR: 1.48, 95% CI: 1.16 to 1.89) and high physical activity (AOR: 1.35, 95% CI: 1.07 to 1.71) were positively associated with IHDS. Frequent salt intake was marginally associated with IHDS (see table 3). The logistic regression on IHDS gave an adequate fit to the model (Hosmer-Lemeshow goodness-of-fit statistic=10.78 with 8 df, p=0.22).

DISCUSSION

In this national study among people 15–69 years in Mongolia, we found a high prevalence of IHDS (14.0%), and associated factors included female sex, older age, being married or cohabiting, urban residence, threats, hypertension, current tobacco use, passive smoking, sedentary behaviour and high physical activity. The found prevalence of IHDS in 2019 in Mongolia (14.0%, 15–69 years, 18.1%, ≥40–69 years) was higher than among persons 40 years and older in Mongolia in 2009 (16.2%),⁶ and 35–70 years in China (7.4%), India (2.7%) and Iran (6.0%),⁸ as well as in China (35–74 years; <3.5%),¹¹ in Nepal (24–64 years; 2%),⁹ in Thailand (35–74 years; 1.6%)¹¹ and in Malawi (18–69 years; 6.5%).¹⁰ The high prevalence of IHDS in Mongolia may be attributed to rapid urbanisation,⁷ including high rates of CVD risk factors (tobacco use, unhealthy diet, physical inactivity, harmful use of alcohol, overweight/obesity, raised BP, hyperglycaemia and hyperlipidaemia).³

Table 1 Sample and IHDS characteristics—social factors

Variable	Sample	IHDS
	N (unweighted %)	N (weighted %)
Sociodemographic factors		
All	6654	14.0
Age (years)		
15–29	1473 (22.1)	9.8
30–44	2491 (37.4)	14.9
45–69	2690 (40.4)	18.7
Sex		
Female	3688 (55.4)	15.6
Male	2966 (44.6)	12.3
Education (in years)		
0–9	1868 (28.1)	15.3
10–11	1712 (25.7)	12.9
≥12	3074 (46.2)	13.9
Marital status		
Not married	1859 (28.0)	10.9
Married/cohabiting	4787 (72.0)	15.9
Household adult members		
1–2	3680 (55.9)	14.8
3 or more	2906 (44.1)	13.5
Employed		
No	2472 (37.2)	13.5
Yes	4176 (62.8)	14.3
Residence		
Rural	2339 (35.2)	11.3
Urban	4315 (64.8)	15.5
Ethnic group		
Other	1005 (15.2)	14.8
Khalkh	5621 (84.8)	13.8
Region		
Central	1066 (16.0)	8.9
Eastern	641 (9.6)	23.3
Khangai	1257 (18.9)	10.5
Ulaanbaatar city	2857 (42.9)	17.0
Western	833 (12.5)	12.2
Psychosocial stress		
Childhood physical abuse		
No	4049 (63.8)	13.5
Yes	2302 (36.2)	15.4
Childhood sexual abuse		
No	6241 (96.1)	13.8
Yes	256 (3.9)	18.1
Adult sexual abuse		
No	6097 (95.7)	13.9

Continued

Table 1 Continued

Variable	Sample	IHDS
	N (unweighted %)	N (weighted %)
Yes	277 (4.3)	16.5
Threats		
No	6130 (93.5)	13.1
Yes	427 (6.5)	27.8
Alcohol family problem		
No	5930 (89.1)	13.5
Yes	723 (10.9)	17.7

IHDS, ischaemic heart disease and/or stroke.

In agreement with previous studies,^{12–15} we found an association between older age and urban residence with IHDS. Furthermore, female sex was positively associated with IHDS, which agrees with some studies, for example, in the USA¹³ and Iran,¹² but not with some other studies, for example, in Greece¹⁴ and some African countries,¹⁵ and no sex difference was found in a 2009 community survey in Mongolia.⁶ Globally, the incidence of CVD among women is often lower than in men, and women have a higher mortality and worse prognosis after acute cardiovascular events than men.³⁵ However, the mortality rate of IHD in Mongolia seems to be statistically significantly higher in men than in women.⁵ Participants from the Eastern region (23.3%) and Ulaanbaatar city (17.0%) had a higher prevalence of IHDS than participants from the Central region (8.9%). Regional differences were also found for the mortality rate due to CVDs in Mongolia, with higher rates in the Khangai, Central and Western regions, and lower in the Eastern region.⁵ Some of these regional differences may be attributed to altitude-related physical conditions,^{7 36} lifestyle, socio-economic and healthcare system aspects.⁷ In a study in Singapore, ethnicity was associated with IHDS,¹⁶ while we did not find ethnic differences in the prevalence of IHDS. Some studies^{13–15 17 18} showed that lower socio-economic status was associated with IHDS, while in our study, three or more adult household members (as a proxy for lower economic status), education and employment status were not statistically significantly associated with IHDS.

In line with previous research on psychosocial distress,^{10 23–26} this study showed that threats (a type of psychosocial stress) were positively associated with IHDS. Stress can increase the cerebrovascular disease risk by modulating sympathetic activity, affecting the BP reactivity, cerebral endothelium, coagulation or heart rhythm.²⁵ Sedentary behaviour and high physical activity were both found to be positively associated with IHDS in this study, while this is confirmed for sedentary behaviour in previous studies^{10 17 20} but not with

Table 2 Sample and IHDS characteristics—biological and behavioural factors

Variable	Sample	IHDS
	N (unweighted %)	N (weighted %)
Biological risk factors		
Central obesity		
No	2494 (38.4)	12.5
Yes	3995 (61.6)	15.6
Hypertension		
No	4663 (70.8)	12.7
Yes	1922 (29.2)	18.4
Diabetes status		
No	4523 (72.1)	13.7
Pre-diabetes	1145 (18.3)	14.7
Diabetes	604 (9.6)	17.5
Raised total cholesterol		
No	4481 (69.0)	14.0
Yes	2016 (31.0)	14.7
Behavioural risk factors		
Current tobacco use		
No	4973 (74.7)	13.4
Yes	1681 (25.3)	15.8
Passive smoking		
No	3733 (56.1)	11.6
Yes	2921 (43.9)	17.0
Heavy episodic drinking		
No	5136 (78.6)	13.5
Yes	1397 (21.4)	15.9
Sedentary behaviour		
No	5726 (87.0)	13.4
Yes	856 (13.0)	19.1
Physical activity		
Low	1957 (29.9)	12.0
Moderate	1226 (18.7)	14.5
High	3356 (51.3)	14.7
Salt consumption		
Low	3864 (58.7)	12.4
High	2716 (41.3)	16.3
Vegetable/fruit consumption/servings a day		
≥5	1230 (19.4)	14.7
<5	5105 (80.6)	14.0

IHDS, ischaemic heart disease and/or stroke.

high physical activity.^{17 20} Consistent with previous findings,^{14 19 21 22} this study showed an association between current tobacco use, passive smoking, frequent salt

Table 3 Logistic regression with ischaemic heart disease and/or stroke (ICHS)

Variable	COR (95% CI)	P value	AOR (95% CI)	P value
Sociodemographic factors				
Age (years)				
15–29	1 (reference)		1 (reference)	
30–44	1.62 (1.27 to 2.07)	<0.001	1.31 (0.99 to 1.73)	0.059
45–69	2.13 (1.67 to 2.71)	<0.001	1.68 (1.24 to 2.28)	<0.001
Sex				
Female	1 (reference)		1 (reference)	
Male	0.76 (0.64 to 0.90)	<0.001	0.66 (0.53 to 0.82)	<0.001
Education (in years)				
0–9	1 (reference)		—	
10–11	0.81 (0.65 to 1.02)	0.074		
≥12	0.89 (0.72 to 1.09)	0.246		
Marital status				
Not married	1 (reference)		1 (reference)	
Married/cohabiting	1.55 (1.27 to 1.89)	<0.001	1.26 (1.01 to 1.58)	0.043
Household adult members				
1–2	1 (reference)		—	
3 or more	0.89 (0.76 to 1.05)	0.183		
Employed				
No	1 (reference)		—	
Yes	1.08 (0.90 to 1.19)	0.425		
Residence				
Rural	1 (reference)		1 (reference)	
Urban	1.44 (1.13 to 1.83)	0.003	1.46 (1.13 to 1.88)	0.004
Ethnic group				
Other	1 (reference)		—	
Khalkh	0.92 (0.70 to 1.20)	0.538		
Psychosocial stress				
Childhood physical abuse				
No	1 (reference)		—	
Yes	1.17 (0.97 to 1.40)	0.098		
Childhood sexual abuse				
No	1 (reference)		—	
Yes	1.39 (0.90 to 2.14)	0.139		
Adult sexual abuse				
No	1 (reference)		—	
Yes	1.21 (0.83 to 1.80)	0.316		
Threats				
No	1 (reference)		1 (reference)	
Yes	2.56 (1.90 to 3.45)	<0.001	2.24 (1.58 to 3.18)	<0.001
Alcohol family problem				
No	1 (reference)		—	
Yes	1.14 (0.92 to 1.41)	0.217		
Biological risk factors				
Central obesity				

Continued

**Table 3** Continued

Variable	COR (95% CI)	P value	AOR (95% CI)	P value
No	1 (reference)		1 (reference)	
Yes	1.29 (1.08 to 1.55)	0.005	0.90 (0.74 to 1.10)	0.310
Hypertension				
No	1 (reference)		1 (reference)	
Yes	1.55 (1.29 to 1.86)	<0.001	1.38 (1.12 to 1.71)	0.003
Diabetes status				
No	1 (reference)		1 (reference)	
Pre-diabetes	1.09 (0.88 to 1.35)	0.432	0.97 (0.77 to 1.24)	0.836
Diabetes	1.34 (1.02 to 1.76)	0.038	1.28 (0.95 to 1.72)	0.107
Raised total cholesterol				
No	1 (reference)		—	
Yes	1.06 (0.89 to 1.27)	0.494		
Behavioural risk factors				
Current tobacco use				
No	1 (reference)		1 (reference)	
Yes	1.21 (1.01 to 1.46)	0.039	1.27 (1.01 to 1.59)	0.042
Passive smoking				
No	1 (reference)		1 (reference)	
Yes	1.57 (1.30 to 1.88)	<0.001	1.39 (1.13 to 1.69)	<0.001
Heavy episodic drinking				
No	1 (reference)		—	
Yes	1.21 (0.97 to 1.51)	0.090		
Sedentary behaviour				
No	1 (reference)		1 (reference)	
Yes	1.53 (1.21 to 1.94)	<0.001	1.48 (1.16 to 1.89)	0.002
Physical activity				
Low	1 (reference)		1 (reference)	
Moderate	1.24 (0.97 to 1.60)	0.090	1.16 (0.89 to 1.52)	0.276
High	1.27 (1.02 to 1.59)	0.036	1.35 (1.07 to 1.71)	0.013
Salt consumption				
Low	1 (reference)		1 (reference)	
High	1.38 (1.16 to 1.63)	<0.001	1.20 (1.00 to 1.44)	0.054
Vegetable/fruit consumption/servings a day				
≥5	1 (reference)		—	
<5	0.95 (0.77 to 1.16)	0.586		

AOR, adjusted OR; COR, crude OR.

intake and IHDS. However, contrary to previous findings,^{9 20} poor diet (low vegetable/fruit intake) was not statistically significantly associated with IHDS. Tobacco use may have reduced in Mongolia due to tobacco demand-reduction measures and an increase in excise taxes on tobacco, however, more needs to be done to initiate and control tobacco use.^{37 38} The high salt consumption in the general population in Mongolia has been recognised and a national salt reduction strategy has been instituted to reduce salt intake.³⁹ An

unexpected finding was that participants with high physical activity had higher odds of IHDS. This result may be explained by people with IHDS having implemented physical activity advice by their health worker. People with IHDS in this study had been more likely advised to do physical activity by a healthcare provider (20.0%) than those without IHDS (16.5%; $p<0.001$).

Consistent with several studies,^{12 14 16–20 27 28} we found an association between hypertension and in unadjusted analysis between diabetes and IHDS. Contrary to previous

studies,^{12 15 17 19 20 27} this STEPS survey did not find statistically significant associations between central obesity, raised TC and IHDS. It is possible that because of the high prevalence of central obesity (61.6%) and TC (31.0%), no statistically significant associations with IHDS were found. Although progress has been made in the reduction of CVD risk factors such as high BP, smoking and drug therapy counselling for high-risk persons,^{37 38} more needs to be done in controlling body weight, smoking cessation, healthy diets, and screening and control of high levels of BP and blood sugar,⁴⁰ and consequently prevent and control CVD in Mongolia.

Study limitations include the self-report of IHDS, which, however, was found valid for epidemiological surveys.⁴¹ It is likely that people had died from CVD prior to the study, which highlights that our estimates are likely an underestimate.⁴² The 2019 STEPS survey in Mongolia used only one question on CVD, which hinders us to know the type of CVD and the length of suffering from specific CVDs. Moreover, the cross-sectional study design prevents drawing causative conclusions.

CONCLUSION

Almost one in seven people aged 15–69 years had IHDS in Mongolia. Several associated factors for IHDS, such as female sex, older age, being married or cohabiting, urban residence, threats, hypertension, current tobacco use, passive smoking and sedentary behaviour, were found that can help in targeting public health interventions.

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Patient consent for publication Obtained.

Ethics approval This study involves human participants and was approved by the Ministry of Health Medical Ethical Committee, Mongolia (no approval number). Participants provided written informed consent.

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Data availability statement Data are available in a public, open access repository. The data source is publicly available at the WHO NCD Microdata Repository (URL: <https://extranet.who.int/ncdsmicrodata/index.php/catalog>).

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