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National trends in prevalence, awareness, treatment, and control of hypertension among adults in Mongolia from 4 cross-sectional surveys in 2005, 2009, 2013, and 2019

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Abstract

This study aimed to analyze trends in the prevalence, awareness, treatment, and control of hypertension and associated factors in persons 15 years and older from 2005 to 2019 in Mongolia.

National data were analyzed from 21,342 people (≥15 years) who participated in 4 cross-sectional STEPwise Approach to NCD Risk Factor Surveillance surveys in Mongolia (2005, 2009, 2013, or 2019) and had complete blood pressure measurements. The prevalence, awareness, treatment, and control of hypertension were calculated using sociodemographic factors within each study year. Logistic regression was employed to assess the associations between sociodemographic and health factors and status of hypertension, awareness, treatment, and control by study year and pooled sample.

Trend analyzes showed that the prevalence of hypertension decreased significantly from 28.4% in 2005 to 23.2% in 2019 ($P <$ .001). The prevalence of awareness among hypertensives remained unchanged, the treatment among aware decreased, and the control rate increased. In adjusted logistic regression analysis with the pooled sample, male sex (adjusted odds ratio [AOR]: 1.49, 95% confidence intervals [CI]: 1.32–1.68), older age (≥45 years) (AOR: 5.90, 95% CI: 4.90–7.10), obesity (AOR: 4.29, 95% CI: 3.77–4.88), more frequent alcohol use (≥1–2 days/week) (AOR: 1.69, 95% CI: 1.39–2.05) were positively, and higher educational level (≥12 years) (AOR: 0.77, 95% CI: 0.68–0.87) and urban residence (AOR: 0.84, 95% CI: 0.74–0.97) were negatively associated with hypertension prevalence.

The prevalence of hypertension among Mongolian adults has decreased in recent years. Levels of hypertension awareness were unchanged, treatment decreased, and control increased. Increased health promotion, detection, and treatment of hypertension in Mongolia are indicated.

Abbreviations: AOR = adjusted odds ratio, BMI = body mass index, BP = blood pressure, CI = confidence interval, DBP = diastolic blood pressure, LMICs = low- and middle-income countries, NCD = noncommunicable diseases, SBP = systolic blood pressure, STEPS = STEPwise Approach to NCD Risk Factor Surveillance.

Keywords: hypertension care, predictors, repeat cross-sectional survey

1. Introduction

Hypertension is a major medical condition causing premature death and affecting 1.3 billion adults (30–79 years) worldwide, and two-thirds of those are living in low- and middle-income countries (LMICs).[1] Among adults in 44 LMIC, 17.5% had hypertension, and 39.2% were aware, 29.9% under treatment, and 10.3% controlled their hypertension.[2] Trend data from 2000 to 2010 show that awareness, treatment, and control of hypertension increased substantially in high-income countries, while this was to a much lesser degree for LMICs in terms of awareness and control and even decreased for control of hypertension.[3] In LMICs in East and Southeast Asia, for example, in China (adults), the proportion of crude hypertension increased from 14.0% in 1991 to 34.1% in 2015, awareness increased from 29.4% to 43.8%, treatment increased from 19.2% to 39.2% and control increased from 3.5% in 1991 to 8.4% in 2015.[4]

We were unable to identify studies on trends in the prevalence of hypertension, awareness, treatment, and control in Mongolia, a lower middle-income country in East Asia. In a population-based study among adults in Mongolia in 2005, 22.2% had hypertension and 24.2% were daily smokers.[5] In a population survey (≥20 years) in 2017–2018 in Ulaanbaatar, Mongolia, the prevalence of hypertension was 25.6%.[6] The prevalence of obesity (≥27 kg/m^2) increased from 26.4% in 2005 to 38.3%

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The data source is publicly available at the "World Health Organization NCD Microdata Repository (URL: https://extranet.who.int/ncdsmicrodata/index.php/catalog)."

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in 2013 in Mongolia,[7] and the prevalence of low physical activity increased from 10.9% in 2005 to 27.2% in 2013 in Mongolia.[8] In Mongolia in 2019, high systolic blood pressure (BP) and dietary risks made the highest contribution to rates of disability-adjusted-life-years, and cardiovascular diseases (ischemic heart disease and stroke) caused the highest mortality.[9] Information on the trends of the prevalence of hypertension, awareness, treatment, and control, as well as potential risk factors among the general population, are vital for strengthening strategies in preventing and controlling hypertension.[2]

As previously reviewed in Pengpid and Peltzer,[10] some risk factors for hypertension can include an unhealthy lifestyle, such as physical inactivity, alcohol use, tobacco, overweight/obesity, poor diet (e.g., inadequate fruit and vegetable intake), and sociodemographic factors, such as increased age, gender, and lower socioeconomic status. The purpose of the study was to assess national trends in the prevalence, awareness, treatment, and control of hypertension among people 15 years and older in Mongolia from 4 cross-sectional surveys in 2005, 2009, 2013, and 2019.

2. Methods

2.1. Study design and participants

Secondary data from 4 national and cross-sectional STEPwise Approach to NCD Risk Factor Surveillance (STEPS) surveys in Mongolia in 2005, 2009, 2013, and 2019[11] with complete BP measurements were analyzed. The overall response rates were 95.0% in 2005, 95.0% in 2009, 97.4% in 2013, and 98.1% in 2019.[12–15] Mongolia STEPS survey data were obtained from the "World Health Organization NCD Microdata Repository."[11] Using multistage sampling stratification, a person aged 15–64 years in 2005, 2009 and 2013, and 15–69 years in 2019 was randomly chosen per household.[12–15] The inclusion criteria were from those selected at random, those who consented to participate were eligible. According to the STEPS survey protocol, in step 1 socio-behavioral data, including medical history and medication use, were assessed by questionnaire, and in step 2 data on BP and anthropometry were collected.[11] Anthropometric measurements were taken using the "Somatometre-Stanley 04-116 device and electronic scales GIMA."[12–15] Prior to taking BP assessments, participants were requested to sit and rest for 15 minutes, not crossing their legs. Three systolic and diastolic BP assessments were taken per person, with 3 minutes of rest between each measurement.[11] Of the 3 BP measurements using the "OMRON Model M5 automatic BP monitor"[12–15]; the last 2 readings were averaged.[11] The Mongolian Ministry of Health Medical Ethics Committee approved the study and the participants provided their written informed consent.[12–15]

2.2. Measures

2.2.1. Primary outcome measure. Hypertension was defined as "systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg and/or previously or current treatment with antihypertensive drugs."[16]

Table 1

Sample characteristics of participants aged 15 years and older, Mongolia, 2005, 2009, 2013, and 2019.

Group	Study year				*p* for trend
	2005	2009	2013	2019	
	N = 3388 N (%)	N = 5395 N (%)	N = 5978 N (%)	N = 6585 N (%)	
Sex					
Male	1674 (48.3)	2217 (50.6)	2719 (49.6)	2966 (49.6)	0.482
Age group (yrs)					
15–29	1033 (45.1)	1604 (47.5)	2437 (23.8)	1473 (38.7)	<0.001
30–44	1071 (33.6)	2264 (32.1)	2039 (41.9)	2491 (33.7)	0.678
45–64 or 69*	1307 (21.3)	1570 (20.4)	1537 (34.3)	2690 (27.6)	<0.001
Education (in yrs)					
0–9	1251 (37.3)	1758 (33.0)	1613 (27.2)	1868 (24.8)	<0.001
10–11	915 (28.6)	1654 (31.8)	1899 (31.5)	1712 (25.8)	<0.001
≥12	1245 (34.1)	2026 (35.1)	2501 (41.3)	3074 (49.1)	<0.001
Region					
Urban	1702 (49.7)	2546 (49.2)	2993 (46.9)	4315 (63.1)	0.028
Ethnic group					
Khalkh	2873 (85.0)	4460 (81.9)	4823 (78.5)	5621 (84.1)	0.489
Body mass index					
Normal	1930 (62.5)	2664 (55.6)	2814 (41.9)	2583 (46.2)	<0.001
Underweight	132 (5.0)	157 (4.5)	300 (3.6)	190 (4.6)	0.856
Overweight	904 (22.3)	1704 (27.4)	1731 (34.0)	2257 (30.8)	0.018
Obesity	435 (10.2)	862 (12.5)	1013 (20.5)	1441 (18.5)	<0.001
Current smoking	987 (26.6)	1403 (27.7)	1401 (27.1)	1638 (24.2)	<0.001
Alcohol use					
Never	1084 (33.1)	2227 (42.6)	2499 (35.5)	2774 (44.0)	<0.001
≤3 d/mo	1288 (37.3)	2017 (36.2)	3328 (60.6)	3667 (52.7)	<0.001
1–2 d/wk	827 (24.1)	972 (18.0)	140 (3.1)	147 (2.2)	<0.001
≥3 d/wk	212 (5.5)	217 (4.2)	34 (0.8)	65 (1.2)	<0.001
Physical activity					
Low	320 (8.2)	436 (7.4)	1403 (22.6)	1957 (28.4)	<0.001
Moderate	697 (21.1)	573 (11.5)	1513 (24.4)	1226 (18.0)	0.364
High	2394 (70.7)	4429 (81.0)	3025 (53.0)	3356 (53.6)	<0.001
Fruits/vegetables (<5 servings/d)	2952 (85.1)	4895 (89.2)	5523 (93.8)	5105 (79.5)	<0.001
	M (SD)	M (SD)	M (SD)	M (SD)	
Systolic blood pressure	124.6 (19.0)	125.6 (18.7)	127.0 (19.3)	120.5 (17.6)	<0.001
Diastolic blood pressure	76.9 (13.0)	78.9 (12.8)	79.9 (12.4)	77.3 (11.8)	<0.001

*15–64 years in 2005, 2009 and 2013, and 15–69 years in 2019.

2.2.2. Secondary outcome measures. Hypertension awareness was defined as "having ever been told to have hypertension by a doctor or other healthcare worker" among all hypertensives; in the 2005 survey the reference period for the diagnosed hypertension was only in the past 12 months; therefore, in the trend analysis on awareness only the surveys in 2009, 2013, and 2019 were included. Current hypertension treatment was defined as "respondents who took antihypertensive medication within 2 weeks of the interview among those who were aware of their hypertension status." Control of hypertension was classified as "having a desirable BP level" (i.e., an average systolic blood pressure < 140 mm Hg and an average diastolic blood pressure < 90 mm Hg) among those who had hypertension or among those taking antihypertensive medication."[11,17]

2.2.3. Covariates. Body mass index (BMI) was classified as "underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obesity (≥30.0 kg/m^2)."[11] Smoking status was sourced from the item, "Do you currently smoke tobacco products, such as cigarettes, cigars, or pipes?" (Yes/No). The frequency of having at least 1 standard alcoholic drink in the last 12 months was classified as "1 = never, 2 = less than once a month or 1–3 days per month, 3 = 1–2 days per week, and 4 = 3–4 days or 5–6 days per week or daily."[12–15] Insufficient fruit/vegetable intake included <5 servings/day,[11] and physical activity levels (high, moderate or low) were evaluated with the "Global Physical Activity Questionnaire."[18]

Sociodemographic covariates included age, sex, education in years, residence status, and ethnic group.[11]

2.3. Statistical analysis

All statistical analyses were conducted with STATA software version 14.0 (Stata Corporation, College Station, TX, USA). The weights were applied using the inverse of the probability of participant selection and adjusted for the sex and age distribution of the study sample compared to the target population.[12–15] To analyze linear trends, the study year was used as a categorical variable in logistic regression analyzes, adjusted for gender, education, age group, residence, general body weight status, alcohol, and tobacco use. Logistic regressions were used to assess the associations between sociodemographic and health risk factors and hypertension, awareness, treatment, and control by study year and pooled sample. To account for the multistage sampling and weighting of the sample Taylor linearization methods were applied. *P* values < .05 were considered significant and missing values (<1.0%) were discarded. In 2005 23 (0.7%), in 2009 43 (0.8%), in 2013 39 (0.6%), and in 2019 69 (1.0%) were excluded due to lack of complete BP measurements.

3. Results

3.1. Sample characteristics

The sample with complete BP measurement included 21,342 persons (≥15 years), 3388 in 2005, 5395 in 2009, 5978 in 2013, and 6585 in 2019. The mean age slightly increased from 38.7 years (SD = 14.2) to 41.3 years (SD = 13.7) in 2019. There was an increase in educational level, urban residence, and overweight and obesity from 2005 to 2019, and a decrease of current smoking and alcohol use from 2005 to 2019. No

Table 2

Trends in prevalence of hypertension among adults in the Mongolia STEPS survey, 2005–2019.

	Study year				*p* for trend*
Variable	**2005**	**2009**	**2013**	**2019**	
	N = 3388 N (% 95% CI)	N = 5395 N (% 95% CI)	N = 5978 N (% 95% CI)	N = 6585 N (% 95% CI)	
All	**1261 (28.4, 26.1–30.7)**	**1739 (27.3, 25.0–29.7)**	**1347 (27.4, 25.6–29.3)**	**1922 (23.2, 21.8–24.6)**	**<0.001**
Sex					
Female	623 (26.9, 23.6–30.4)	930 (23.1, 20.7–25.7)	643 (24.6, 22.6–26.7)	992 (21.0, 19.4–22.8)	<0.001
Male	638 (30.0, 27.4–32.7)	809 (31.4, 28.3–34.6)	704 (30.3, 27.3–33.4)	930 (25.3, 23.3–27.5)	<0.001
Age group (yrs)					
15–29	111 (10.5, 8.6–12.6)	196 (12.3, 9.4–16.1)	192 (8.3, 7.1–9.7)	122 (8.2, 6.5–10.4)	0.036
30–44	358 (32.7, 29.3–36.3)	657 (30.4, 27.7–33.4)	427 (22.3, 19.8–25.0)	527 (21.5, 19.5–23.5)	<0.001
45–64 or 69†	792 (59.7, 56.1–63.2)	886 (57.2, 54.2–60.2)	728 (47.0, 43.7–50.3)	1273 (46.2, 43.6–48.7)	<0.001
Education (in years)					
0–9	468 (26.6, 23.6–29.9)	629 (31.0, 27.5–34.8)	384 (27.7, 24.6–30.1)	655 (30.3, 27.8–33.1)	0.003
10–11	317 (27.2, 23.7–31.0)	505 (24.8, 21.5–28.4)	405 (27.4, 24.8–30.2)	557 (25.7, 23.4–28.2)	0.019
≥12	476 (31.4, 28.2–34.7)	605 (26.0, 23.5–28.7)	558 (27.2, 24.8–30.2)	710 (18.2, 16.5–20.1)	<0.001
Region					
Rural	627 (28.7, 25.3–32.4)	952 (29.3, 26.2–32.5)	687 (28.1, 25.6–30.9)	745 (25.7, 23.1–28.5)	0.008
Urban	634 (28.0, 25.2–31.0)	787 (25.2, 22.0–28.8)	660 (26.6, 24.1–29.2)	1177 (21.7, 20.1–23.3)	<0.001
Body mass index					
Normal	514 (20.0, 18.0–22.2)	586 (18.8, 16.2, 21.8)	360 (15.9, 13.3–18.8)	406 (11.4, 10.1–12.9)	<0.001
Underweight	20 (9.3, 5.7–14.3)	16 (7.6, 3.7–15.0)	18 (10.8, 6.7–17.0)	18 (7.4, 3.8–13.7)	0.610
Overweight	443 (42.2, 38.0–46.4)	639 (35.1, 31.4–38.9)	502 (32.3, 28.5–36.3)	722 (28.1, 25.8–30.5)	<0.001
Obesity	284 (60.2, 53.8–66.3)	484 (55.1, 59.4–59.7)	454 (47.5, 44.3–50.8)	757 (49.8, 46.3–53.3)	<0.001
Current smoking					
No	845 (26.0, 23.0–29.1)	1241 (25.6, 23.1–28.2)	998 (27.3, 25.7–29.0)	1401 (21.7, 20.2–23.4)	<0.001
Yes	416 (35.1, 39.6–39.8)	498 (31.7, 28.6–35.0)	349 (27.7, 23.7–32.1)	521 (27.7, 25.0–30.5)	<0.001
Alcohol use					
Never	366 (23.4, 19.6–27.6)	678 (23.9, 21.0–27.0)	468 (23.4, 21.0, 25.8)	818 (21.9, 19.8–24.1)	0.832
≤3 d/mo	464 (28.0, 25.2–31.1)	614 (26.3, 23.7–29.1)	809 (28.9, 26.6–31.4)	1019 (23.8, 22.1–25.5)	<0.001
1–2 d/wk	326 (32.8, 29.5–36.3)	361 (35.4, 31.0–40.1)	60 (44.4, 36.5–52.7)	60 (33.0, 24.8–42.5)	<0.001
≥3 d/wk	105 (41.6, 34.8–48.9)	85 (34.8, 28.0–42.3)	10 (30.8, 13.5–55.8)	25 (26.6, 16.6–39.8)	<0.001

Key findings in bold.

*Trends were tested using multivariable logistic regression adjusted for socioeconomic and health variables.

†15–64 years in 2005, 2009 and 2013, and 15–69 years in 2019.

significant changes were found regarding sex and ethnicity. Systolic and diastolic BP significantly decreased from 2005 to 2019 (see Table 1).

3.2. Trends in the prevalence of hypertension

Trend analyzes showed that the prevalence of hypertension decreased significantly from 28.4% in 2005 to 23.2% in 2019 ($P < .001$). The prevalence of hypertension decreased among both men and women, rural and urban residents, all age groups, and those with higher educational levels (10 or more years) but increased from 26.6% in 2005 to 30.3% in 2019 among those with lower education (0–9 years) (see Table 2).

3.3. Trends in the prevalence of awareness among hypertensive individuals and treatment among aware individuals

The prevalence of awareness among hypertensive patients increased from 49.3% in 2009 to 53.0% in 2019 but was not significant ($P = .796$). This did not differ for both sexes, age group, and educational level. However, among urban residents, the prevalence of awareness among hypertensives increased significantly from 48.7% in 2009 to 58.2% in 2019 ($P = .036$) and remained unchanged among rural residents.

The prevalence of treatment among aware significantly decreased from 44.1% in 2009 to 31.5% in 2019 ($P = .002$); this decrease was higher among women ($P = .005$) than among men ($P = .056$), and the decrease was higher among younger age groups (15–29 and 30–44 years) ($P = .010$ and $P < .001$) and those with higher education (≥12 years) ($P = .021$), but there was no significant change among the older age group (45–69 years) and those with lower education (0–9 years). The prevalence of treatment among aware significantly decreased among both rural and urban residents (see Table 3).

3.4. Trends in the prevalence of hypertension control

Trend analyzes showed that the prevalence of the control rate among hypertensives increased significantly from 21.6% in 2005 to 26.5% in 2019 ($P < .001$), and the control rate among treated increased significantly from 43.6% in 2005 to 52.9% in 2016 ($P < .001$). The control rate among hypertensives and/or control rate among treated increased among both men and women, in all age groups, all educational levels and both rural and urban residents (see Table 4).

Table 3

Trends in the prevalence of awareness among hypertensives and treatment among aware among adults in the Mongolia STEPS survey, 2009–2019.

	Study year			*p* for trend*
Group	**2009**	**2013**	**2019**	
Awareness among hypertensives	N = 1739 N (% 95% CI)	N = 1347 N (% 95% CI)	N = 1922 N (% 95% CI)	
All	**936 (49.3, 44.5–54.0)**	**766 (58.9, 54.6–63.0)**	**1152 (53.0, 49.0–57.0)**	**0.796**
Sex				
Female	614 (63.8, 59.3–68.2)	426 (66.0, 59.4–72.1)	673 (61.0, 56.1–65.7)	0.133
Male	322 (38.9, 33.0–45.1)	340 (52.9, 48.2–57.6)	479 (46.3, 41.8–51.0)	0.101
Age group (yrs)				
15–29	52 (25.5, 17.1–36.2)	40 (23.3, 16.5–31.9)	33 (18.2, 11.8–27.0)	0.209
30–44	310 (45.0, 39.9–50.3)	209 (48.9, 42.8–55.1)	236 (43.2, 37.7–48.9)	0.160
45–64 or 69†	574 (64.7, 60.0–69.1)	517 (69.0, 63.8–73.8)	883 (67.3, 63.5–70.8)	0.751
Education (in years)				
0–9	326 (47.1, 40.1–54.3)	270 (56.6, 49.0–63.9)	340 (52.5, 46.3–58.5)	0.776
10–11	222 (50.2, 43.5–56.9)	238 (63.6, 57.4–69.3)	306 (56.2, 50.3–61.8)	0.650
≥12	390 (50.8, 44.9–56.7)	306 (56.7, 49.5–63.6)	423 (51.2, 45.4–57.0)	0.684
Region				
Rural	522 (49.7, 42.2–57.2)	403 (60.2, 54.6–65.5)	401 (45.7, 38.8–52.8)	0.113
Urban	414 (48.7, 43.7–53.8)	363 (57.2, 50.8, 63.4)	751 (58.2, 53.7–62.5)	0.036
Treatment among aware	N = 1378	N = 1536	N = 2026	
All	**629 (44.1, 39.8–48.4)**	**285 (20.8, 17.1–25.1)**	**721 (31.5, 28.8–34.2)**	**0.002**
Sex				
Female	452 (48.1, 43.1–53.2)	171 (20.3, 16.0–25.5)	468 (33.8, 30.6–37.2)	0.005
Male	177 (38.9, 33.4–44.7)	114 (21.5, 17.2–26.5)	253 (28.6, 25.1–32.4)	0.056
Age group (years)				
15–29	29 (23.2, 15.1–34.1)	3 (1.4, 0.4–4.5)	17 (8.4, 4.7–14.4)	0.010
30–44	180 (35.3, 30.2–40.6)	61 (11.6, 8.1–16.3)	117 (19.5, 16.0–23.5)	<0.001
45–64 or 69†	420 (59.6, 53.7–65.3)	221 (29.3, 24.2–34.9)	587 (45.4, 41.8–49.0)	0.104
Education (in yrs)				
0–9	215 (44.6, 37.5–52.0)	76 (21.3, 15.4–28.7)	240 (33.8, 29.3–38.7)	0.087
10–11	184 (46.9, 40.2–53.6)	90 (19.8, 15.3–25.4)	212 (34.3, 29.6–39.3)	0.186
≥12	230 (41.3, 34.6–48.4)	119 (21.3, 16.5–27.0)	269 (27.9, 24.4–31.8)	0.021
Region				
Rural	351 (42.9, 36.3–49.7)	144 (21.1, 16.2–27.0)	246 (32.6, 28.0–37.6)	0.021
Urban	278 (45.6, 41.1–50.3)	141 (20.5, 15.2–26.9)	475 (30.9, 27.7–34.2)	0.026

Key findings in bold.

*Trends were tested using multivariable logistic regression adjusted for socioeconomic and health variables.

†15–64 years in 2005, 2009 and 2013, and 15–69 years in 2019.

CI = confidence interval.

Table 4

Trends in prevalence of control of hypertension among adults in the Mongolia STEPS survey, 2005–2019.

	Study year				*p* for trend*
Group	**2005**	**2009**	**2013**	**2019**	
Control rate among hypertensives	N = 3388 N (% 95% CI)	N = 5395 N (% 95% CI)	N = 5978 N (% 95% CI)	N = 6585 N (% 95% CI)	
All	**261 (21.6, 18.4–25.2)**	**236 (13.3, 11.0–16.0)**	**93 (7.5, 5.4–10.2)**	**516 (26.5, 23.9–29.2)**	**<0.001**
Sex					
Female	189 (32.0, 27.4–37.0)	182 (21.4, 18.0–25.2)	63 (10.0, 7.0–14.1)	339 (34.1, 30.4–38.0)	<0.001
Male	72 (11.7, 9.1–14.8)	54 (7.5, 4.9–11.4)	30 (5.3, 3.2–8.8)	177 (20.1, 16.9–23.7)	<0.001
Age group (yrs)					
15–29	21 (18.8, 12.0–28.0)	26 (14.8, 8.3–24.9)	6 (2.7, 1.0–7.2)	35 (33.9, 24.8–44.3)	0.021
30–44	88 (25.1, 20.2–30.8)	93 (12.2, 9.2–15.9)	25 (6.6, 4.1–10.4)	122 (23.6, 19.0–27.9)	<0.001
45–64 or 69†	152 (19.8, 16.8–29.9)	117 (13.4, 10.8–16.6)	62 (8.5, 5.7–12.7)	359 (26.6, 23.7–30.0)	<0.001
Education (in yrs)					
0–9	77 (16.1, 11.8–21.7)	78 (11.4, 8.0–16.1)	24 (6.4, 3.9–10.3)	158 (25.4, 21.0–30.3)	<0.001
10–11	68 (22.3, 17.4–28.3)	66 (13.8, 10.6–17.7)	30 (6.8, 4.1–10.9)	157 (25.9, 21.8–30.5)	<0.001
≥12	116 (26.2, 22.2–30.7)	92 (14.9, 12.2–18.1)	39 (8.7, 5.6–13.3)	201 (27.9, 24.0–32.1)	<0.001
Region					
Rural	126 (20.0, 15.5–25.2)	141 (13.9, 10.6–18.2)	50 (8.2, 5.2–12.7)	165 (23.9, 19.6–28.8)	0.003
Urban	135 (23.5, 19.0–28.5)	95 (12.5, 9.6–16.0)	43 (6.5, 4.2–10.1)	351 (28.3, 25.3–31.5)	<0.001
Control rate among treated	N = 684	N = 713	N = 340	N = 994	
All	**261 (43.6, 40.0–47.8)**	**236 (34.2, 29.5–39.2)**	**93 (26.4, 20.5–33.4)**	**516 (52.9, 48.9–56.8)**	**<0.001**
Sex					
Female	189 (48.6, 43.5–53.6)	182 (39.6, 34.0–45.4)	63 (29.1, 21.2–38.4)	339 (56.8, 51.9–61.6)	<0.001
Male	72 (34.3, 29.3–40.2)	54 (26.8, 18.6–37.0)	30 (23.2, 15.2–33.7)	177 (48.1, 41.7–54.5)	<0.001
Age group (yrs)					
15–29	21 (68.2, 49.5–82.0)	26 (58.7, 37.7–76.9)	6 (42.2, 18.3–70.3)	35 (63.4, 49.2–75.5)	0.747
30–44	88 (53.1, 46.0–60.0)	93 (38.4, 31.6–45.6)	25 (35.3, 21.9–51.5)	122 (62.8, 55.2–69.9)	<0.001
45–64 or 69†	152 (33.2, 29.1–37.3)	117 (26.0, 21.4–31.2)	62 (23.5, 16.2–32.6)	359 (46.8, 42.4–51.2)	<0.001
Education (in yrs)					
0–9	77 (37.0, 30.2–44.5)	78 (31.7, 23.3–41.5)	24 (25.5, 17.5–35.6)	158 (52.2, 45.2–59.1)	<0.001
10–11	68 (45.0, 37.1–53.4)	66 (33.6, 27.3–40.1)	30 (23.6, 15.6–36.0)	157 (51.0, 44.0–57.9)	<0.001
≥12	116 (47.5, 42.0–53.3)	92 (37.3, 31.5–43.4)	39 (29.0, 20.0–40.0)	201 (54.8, 48.9–61.0)	<0.001
Region					
Rural	126 (43.6, 37.7–49.8)	141 (36.7, 30.0–44.0)	50 (29.3, 20.7–40.0)	165 (46.0, 39.4–52.8)	0.027
Urban	135 (43.9, 38.4–49.3)	95 (31.3, 25.1–38.3)	43 (23.0, 15.8–32.1)	351 (58.0, 53.2–62.5)	<0.001

Key findings in bold.

*Trends were tested using multivariable logistic regression adjusted for socioeconomic and health variables.

†15–64 years in 2005, 2009 and 2013, and 15–69 years in 2019.

CI = confidence interval.

3.5. Associations with hypertension prevalence

In the final adjusted model with the pooled sample, male sex (adjusted odds ratio [AOR]: 1.49, 95% confidence intervals [CI]: 1.32–1.68), older age (≥45 years) (AOR: 5.90, 95% CI: 4.90–7.10), obesity (AOR: 4.29, 95% CI: 3.77–4.88), more frequent alcohol use (≥1–2 days/week) (AOR: 1.69, 95% CI: 1.39–2.05) were positively associated, and higher educational level (≥12 years) (AOR: 0.77, 95% CI: 0.68–0.87) and urban residence (AOR: 0.84, 95% CI: 0.74–0.97) were negatively associated with the prevalence of hypertension. Older age and obesity were associated with hypertension prevalence in all 4 surveys, and alcohol use was associated with hypertension prevalence in the last 3 surveys. Higher education was negatively associated with the prevalence of hypertension in 2005 and 2019 (see Table 5).

3.6. Associations with hypertension awareness

In the adjusted pooled analysis, older age (≥45 years) (AOR: 6.01, 95% CI: 4.31–8.37), obesity (AOR: 1.67, 95% CI: 1.37–2.03), frequent alcohol use (≥3 days/week) (AOR: 2.11, 95% CI: 1.26–3.52), moderate physical activity (AOR: 1.51, 95% CI: 1.20–1.59), and inadequate fruit and vegetable intake (AOR: 1.39, 95% CI: 1.06–1.84) were positively, and male sex (AOR: 0.51, 95% CI: 0.44–0.60) negatively associated with awareness among hypertensives. Furthermore, urban residence (AOR: 1.63, 95% CI: 1.17–2.28) and high physical activity (AOR: 1.58, 95% CI: 1.22–2.03) were associated with awareness among hypertensive individuals in 2019. Only female sex, older age, and obesity were associated with hypertension awareness in all 3 surveys (see Table 6).

3.7. Associations with hypertension treatment

In the adjusted model of the pooled sample, older age (≥45 years) (AOR: 4.55, 95% CI: 3.03–6.83), overweight (AOR: 1.23, 95% CI: 1.01–1.51) and obesity (AOR: 1.59, 95% CI: 1.25–2.01), and high physical activity (AOR: 1.27, 95% CI: 1.01–1.59) were positively, and infrequent alcohol use (≤3 days/month) (AOR: 0.79, 95% CI: 0.66–0.95) was negatively associated with treatment among those who are aware. Furthermore, insufficient fruit/vegetable intake was inversely associated with treatment among those aware in 2019. Only older age was associated with treatment among those who are aware in all 3 surveys, and obesity and nonalcohol use were associated with treatment among those who are aware in 2009 and 2019 (see Table 7).

3.8. Associations with hypertension control among treated

In the analysis of the pooled sample, male sex (AOR: 0.60, 95% CI: 0.46–0.80), 45 or more-year-olds (AOR: 0.38, 95% CI: 0.23–0.62), obesity (AOR: 0.46, 95% CI: 0.34–0.62), moderate

Table 5

Associations between sociodemographic and health factors and hypertension prevalence among adults in the Mongolia STEPS survey, 2005–2019.

Variable	Study year 2005 AOR (95% CI)	Study year 2009 AOR (95% CI)	Study year 2013 AOR (95% CI)	Study year 2019 AOR (95% CI)	Pooled 2005–2019 AOR (95% CI)
Sex					
Female	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Male	**1.26 (1.02–1.56)***	**1.34 (1.07–1.68)****	**0.98 (0.81–1.19)**	**0.95 (0.81–1.11)**	**1.49 (1.32–1.68)*****
Age group (yrs)					
15–29	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
30–44	3.05 (2.32–4.02)***	2.19 (1.66–2.90)***	2.71 (2.20–3.35)***	1.93 (1.57–2.39)***	2.08 (1.73–2.01)***
45–64 or 69†	**8.80 (6.82–11.34)*****	**6.22 (4.93–7.84)*****	**7.57 (5.93–9.66)*****	**5.07 (4.13–6.22)*****	**5.90 (4.90–7.10)*****
Education (in yrs)					
0–9	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
10–11	0.86 (0.67–1.12)	0.92 (0.74–1.13)	1.05 (083–1.32)	0.88 (0.73–1.05)	0.90 (0.79–1.03)
≥12	0.78 (0.61–0.98)*	0.90 (0.72–1.12)	1.01 (0.85–1.20)	0.74 (0.62–0.89)***	0.77 (0.68–0.87)***
Region					
Rural	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Urban	1.02 (0.81–1.29)	0.84 (0.66–1.08)	0.80 (0.64–0.99)*	0.89 (0.75–1.07)	0.84 (0.74–0.97)*
Ethnic group					
Other	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Khalkh	1.11 (0.88–1.40)	0.80 (0.63–1.02)	1.14 (0.87–1.50)	1.05 (0.85–1.30)	0.99 (0.83–1.20)
Body mass index					
Normal	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Underweight	0.61 (0.35–1.05)	0.54 (0.27–1.08)	1.03 (0.60–1.75)	0.69 (0.41–1.18)	0.71 (0.47–1.07)
Overweight	2.01 (1.63–2.47)***	1.91 (1.54–2.36)***	1.95 (1.40–2.70)***	2.00 (1.70–2.35)	2.02 (1.75–2.34)***
Obesity	**3.96 (2.98–5.26)*****	**3.67 (2.77–4.85)*****	**3.81 (2.94–4.93)*****	**5.26 (4.30–6.42)*****	**4.29 (3.77–4.88)*****
Current smoking	1.13 (0.82–1.54)	0.95 (0.77–1.18)	0.96 (0.77–1.20)	1.24 (1.03–1.50)*	0.98 (0.86–1.12)
Alcohol use					
Never	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
≤3 d/mo	1.03 (0.80–1.34)	1.08 (0.90–1.31)	1.12 (0.95–1.32)	1.25 (1.06–1.46)**	0.95 (0.86–1.06)
1–2 d/wk	1.20 (0.88–1.62)	**1.26 (1.04–1.53)***	**2.28 (1.45–3.57)*****	**1.98 (1.23–3.20)****	**1.69 (1.39–2.05)*****
≥3 d/wk	1.41 (0.97–2.04)	1.19 (0.82–1.73)	2.65 (1.28–5.49)**	2.35 (1.02–5.40)*	1.39 (1.06–1.83)*
Physical activity					
Low	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Moderate	0.72 (0.51–1.01)	1.07 (0.72–1.60)	0.86 (0.68–1.10)	1.04 (0.85–1.27)	0.88 (0.75–1.05)
High	0.76 (0.56–1.04)	1.05 (0.82–1.36)	0.92 (0.74–1.14)	1.05 (0.89–1.25)	0.99 (0.87–1.13)
Fruits/vegetables (<5 servings/d)	0.97 (0.73–1.28)	1.13 (0.90–1.42)	1.06 (0.79–1.41)	0.99 (0.81–1.21)	0.94 (0.80–1.11)

Key findings in bold.

***$P < .001$;

**$P < .01$;

*$P < .05$.

†15–64 years in 2005, 2009 and 2013, and 15–69 years in 2019.

AOR = adjusted odds ratio; CI = confidence interval.

alcohol use (1–2 days/week) (AOR: 0.50, 95% CI: 0.27–0.93), and insufficient fruit/vegetable intake (AOR: 0.68, 95% CI: 0.49–0.95) decreased the odds of control of hypertension among treated. Hypertension control among treated was only higher among women in 2009 and 2019 and among younger participants in 2005 and 2009 (see Table 8).

4. Discussion

Trend analyses showed for the first time from repeat surveys that the prevalence of hypertension decreased significantly from 28.4% in 2005 to 23.2% in 2019 ($P < .001$) in Mongolia. Awareness among hypertensives remained unchanged, the treatment among aware decreased, and the control rate increased. In the analysis of the pooled sample, male sex, older age (≥30 years), overweight and obesity, and more frequent alcohol use increased, and higher educational level (≥12 years) and urban residence decreased the odds of hypertension prevalence. Older age, female sex, obesity, frequent alcohol use, moderate physical activity, and inadequate fruit/vegetable consumption increased the odds of awareness among hypertensives. Older age, obesity and high physical activity were associated with treatment among aware. Male sex, 45 or more-year-olds, obesity, moderate alcohol use, and insufficient fruit/vegetable intake decreased the odds of controlling hypertension among the treated.

The found prevalence of hypertension (28.4% to 23.2%) is higher than among adults in 44 LMICs (17.5%).[2] Although several previous studies in the study region found an increasing trend in the prevalence of hypertension (e.g., 14.0% in 1991 to 34.1% in 2015 in China,[4] 23.0% in 1991/1994 to 42.2% in 2010/2012 in urban India,[19] 32.9% in 1996 to 43.5% in 2011 in Malaysia[20]), this study found a decreasing trend in hypertension prevalence. Like in our study, among older adults in Malaysia, the prevalence of hypertension decreased significantly.[17] Possible reasons for the decrease in hypertension in Mongolia can be attributed to better control of hypertension, a decrease in current smoking, a decrease in frequent alcohol use, and an increase in fruit and vegetable consumption, despite an increase in overweight/obesity and physical inactivity. In Mongolia, the reduction of smoking, the reduction of high BP, and the reduction of poor fruit and vegetable intake can be attributed to tobacco demand-reduction measures, the increase in tobacco excise taxes, national salt/sodium policies, the management of major noncommunicable diseases, and the "drug therapy counseling for high-risk persons."[21,22] The reduction of frequent alcohol use can be attributed to the strengthening of the national alcohol prevention and control programme

Table 6

Associations between sociodemographic and health factors and hypertension awareness among adults in the Mongolia STEPS survey, 2009–2019.

Variable	Study year 2009 AOR (95% CI)	Study year 2013 AOR (95% CI)	Study year 2019 AOR (95% CI)	Pooled 2009–2019 AOR (95% CI)
Sex				
Female	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Male	**0.49 (0.36–0.67)*****	**0.57 (0.43–076)*****	**0.49 (0.38–0.62)*****	**0.51 (0.44–0.60)*****
Age group (yrs)				
15–29	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
30–44	2.00 (1.20–3.34)**	2.83 (1.72–4.70)***	2.93 (1.69–5.07)***	2.47 (1.79–3.42)***
45–64 or 69†	**4.46 (2.56–7.76)*****	**6.93 (3.96–12.14)*****	**7.52 (4.36–12.98)*****	**6.01 (4.31–8.37)*****
Education (in yrs)				
0–9	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
10–11	1.11 (0.80–1.54)	1.48 (0.94–2.32)	1.05 (0.77–1.45)	1.17 (0.96–1.43)
≥12	0.99 (0.69–1.40)	0.93 (0.58–1.48)	1.00 (0.72–1.38)	0.93 (0.75–1.14)
Region				
Rural	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Urban	0.70 (0.47–1.05)	0.87 (0.55–1.37)	1.63 (1.17–2.28)**	1.04 (0.85–1.28)
Ethnic group				
Other	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Khalkh	1.41 (0.80–2.48)	1.04 (0.71–1.51)	0.86 (0.55–1.37)	1.03 (0.79–1.34)
Body mass index				
Normal	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Underweight	0.90 (0.29–2.81)	1.36 (0.35–5.25)	0.34 (0.08–1.45)	0.74 (0.37–1.47)
Overweight	0.91 (0.66–1.25)	1.19 (0.79–1.78)	1.60 (1.15–2.21)**	1.19 (0.98–1.46)
Obesity	**1.88 (1.26–2.80)****	**2.06 (1.47–2.89)*****	**1.60 (1.15–2.23)****	**1.67 (1.37–2.03)*****
Current smoking	1.11 (0.93–1.78)	1.27 (0.85–1.89)	1.22 (0.91–1.65)	1.07 (0.89–1.29)
Alcohol use				
Never	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
≤3 d/mo	0.93 (0.65–1.34)	1.00 (0.66–1.52)	1.43 (1.10–1.88)**	1.23 (1.01–1.50)*
1–2 d/wk	0.66 (0.46–0.96)*	1.00 (0.52–1.92)	1.91 (1.00–3.66)	0.93 (0.68–1.26)
≥3 d/wk	1.66 (0.91–3.03)	2.01 (0.39–10.43)	3.29 (0.90–11.99)	2.11 (1.26–3.52)**
Physical activity				
Low	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Moderate	1.13 (0.80–1.61)	1.23 (0.82–1.86)	1.60 (1.12–2.29)*	1.51 (1.20–1.90)***
High	0.66 (0.41–1.06)	1.00 (0.50–2.03)	1.58 (1.22–2.03)***	1.20 (0.90–1.59)
Fruits/Vegetables (<5 servings/d)	0.77 (0.41–1.46)	1.18 (0.67–2.06)	1.65 (1.20–2.27)**	1.39 (1.06–1.84)*

Key findings in bold.

***$P < .001$;

**$P < .01$;

*$P < .05$.

†15–64 years in 2005, 2009 and 2013, and 15–69 years in 2019.

AOR = adjusted odds ratio; CI = confidence interval.

in 2005,[23] and the "Together for Alcohol-Free Mongolia" campaign in 2011,[24] and an increase in body weight and physical inactivity can in part be attributed to no change in public awareness of diet and/or physical activity.[21] Furthermore, as part of the Millennium Challenge Corporation programme (2008–2013) in Mongolia, the screening for hypertension increased,[25] and a multisector Better Hearts Better Cities initiative with focus on hypertension control was implemented in Ulaanbaatar, Mongolia.[26]

Consistent with previous research,[10] we found that older age was associated with hypertension, and higher education in 2005 and 2019 was inversely associated with hypertension, as found in a systematic review.[27] We found a weak negative association between urban residence and hypertension in 2013 and in the pooled sample, while some previous results[28] found a positive association between urban residence and hypertension, but similar results were found in China.[4] Some reasons for this may include the increase in obesity (≥30 kg/m^2) in rural areas (12.3%) compared to urban areas (9.4%) in Mongolia.[29] Overweight/obesity increased the odds of having hypertension, which is in line with previous research.[28,30] Obesity can be independently associated with hypertension, but it can also be mediated by physical inactivity and a poor diet.[31] We found in line with a prior systematic review,[32] that frequent alcohol use increased the odds of hypertension. Another review found that there is a linear relationship between alcohol consumption and hypertension risk.[33]

Contrary to some previous results, we could not find a significant association between physical inactivity,[28] insufficient fruit/vegetable consumption,[34] current smoking,[35] and hypertension. It cannot be ruled out that participants who were aware of their hypertension status adopted positive health behaviors (stopped smoking, a healthy diet and physical activity) to control their BP.[36]

The prevalence of awareness among hypertensives (49.3% in 2009 to 53.0% in 2019), the prevalence of treatment among aware (44.1% in 2009 to 31.5% in 2019), and the prevalence of the control rate among hypertensives (21.6% in 2005 to 26.5% in 2019) were higher than in the 44 LMICs study (aware: 39.2%, treatment: 29.9% and control: 10.3%),[2] and lower in terms of awareness (69.7%) and treatment (46.8%) but not control (24.0%) in a previous study in Ulaanbaatar in 2017–2018.[6] In China,[4] Iran,[37] and Malaysia[17] awareness, treatment and control increased significantly over time,[4,37] in urban India awareness, treatment, and control rates of hypertension remained unchanged,[19] and in this study awareness was unchanged, treatment decreased, and control increased. Consistent with previous findings,[2,6] the older age group and being a woman were associated with awareness, and control.

Table 7

Associations between sociodemographic and health factors and hypertension treatment among adults in the Mongolia STEPS survey, 2009–2019.

Variable	Study year 2009 AOR (95% CI)	Study year 2013 AOR (95% CI)	Study year 2019 AOR (95% CI)	Pooled 2009–2019 AOR (95% CI)
Sex				
Female	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Male	0.98 (0.66–1.44)	1.01 (0.76–1.35)	0.79 (0.6–1.04)	0.86 (0.71–1.04)
Age group (yrs)				
15–29	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
30–44	1.80 (1.06–3.05)*	4.09 (2.30–7.28)***	2.62 (1.41–4.88)**	1.63 (1.10–2.40)*
45–64 or 69†	**4.27 (2.23–8.14)*****	**7.53 (3.67–15.44)*****	**10.11 (5.44–18.77)*****	**4.55 (3.03–6.83)*****
Education (in yrs)				
0–9	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
10–11	1.22 (0.85–1.75)	1.02 (0.73–1.41)	0.89 (0.66–1.21)	0.96 (0.77–1.19)
≥12	0.95 (0.65–1.37)	0.92 (0.67–1.26)	0.77 (0.56–1.03)	0.85 (0.67–1.07)
Region				
Rural	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Urban	1.11 (0.83–1.49)	0.95 (0.67–1.33)	0.93 (0.71–1.22)	1.02 (0.81–1.28)
Ethnic group				
Other	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Khalkh	1.18 (0.68–2.06)	1.02 (0.74–1.20)	0.80 (0.53–1.19)	1.15 (0.87–1.58)
Body mass index				
Normal	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Underweight	0.38 (0.09–1.61)	0.71 (0.28–1.82)	0.71 (0.27–1.85)	0.82 (0.38–1.77)
Overweight	0.98 (0.72–1.35)	0.94 (0.66–1.33)	1.20 (0.90–1.60)	1.23 (1.01–1.51)*
Obesity	**1.82 (1.15–2.88)***	**1.21 (0.82–1.78)**	**1.45 (1.07–1.97)***	**1.59 (1.25–2.01)*****
Current smoking	0.57 (0.37–0.88)*	0.76 (0.48–1.20)	1.11 (0.83–1.49)	0.90 (0.70–1.15)
Alcohol use				
Never	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
≤3 d/mo	0.87 (0.60–1.26)	1.26 (0.99–1.60)	0.74 (0.56–0.98)*	0.79 (0.66–0.95)*
1–2 d/wk	0.54 (0.33–0.89)*	1.25 (0.65–2.38)	0.73 (0.34–1.57)	1.27 (0.88–1.84)
≥3 d/wk	0.56 (0.28–1.13)	1.15 (0.29–4.56)	0.69 (0.15–3.17)	0.91 (0.53–1.56)
Physical activity				
Low	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Moderate	1.58 (0.77–3.20)	1.07 (0.74–1.54)	1.07 (0.77–1.48)	1.12 (0.88–1.42)
High	1.55 (0.80–3.01)	1.36 (0.78–2.39)	1.14 (0.88–1.49)	1.27 (1.01–1.59)*
Fruits/vegetables (<5 servings/d)	0.88 (0.42–1.87)	0.62 (0.38–1.02)	0.68 (0.49–0.93)*	0.91 (0.69–1.21)

Key findings in bold.

***$P < .001$;

**$P < .01$;

*$P < .05$.

†15–64 years in 2005, 2009 and 2013, and 15–69 years in 2019.

AOR = adjusted odds ratio; CI = confidence interval.

Women may be more likely to be aware and/or controlled than men because they have better health-seeking behavior.[38] Higher education did not influence awareness, treatment and/or control, as found in the multi-country study.[2]

Awareness, treatment and control remain suboptimal, especially among younger age groups and men, and needs to be improved by increasing screening programmes for hypertension, including annual workplace screening for hypertension,[6] public awareness campaigns on hypertension,[38] standardized education, and training of primary care providers on early identification, and improved management,[39,40] and expansion of the implementation of the WHO HEARTS programme.[6] Further research may include a longitudinal study to identify potential predictors of hypertension awareness, treatment, and control, and implementation research to scale-up health system interventions for hypertension control in Mongolia.

The study strengths include the use of nationally representative samples and standardized STEPS methodology and measures. Some variables were evaluated by self-report, which may have biased responses, and the cross-sectional design precludes causative conclusions between the evaluated variables. For the participants 15–17 years, the classification of hypertension may have been an underestimate.[41] Furthermore, hypertension was only assessed in noninstitutionalized adults. Another limitation could be the potential temporal differences in the conduct of the surveys. The definition of hypertension did not use clinical criteria but the 1 commonly used in population surveys.

In conclusion, the prevalence of hypertension among Mongolian adults has decreased in recent years. Levels of hypertension awareness were unchanged, treatment decreased, and control increased. Increased health promotion, detection, and treatment of hypertension in Mongolia are indicated.

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Author contributions

All authors fulfill the criteria for authorship. SP and KP conceived and designed the research, performed statistical analysis, drafted the article, and made critical revision of the article for key intellectual content. All authors read and approved the final

Table 8

Associations between sociodemographic and health factors and hypertension control among treated adults in the Mongolia STEPS survey, 2005–2019.

Variable	Study year 2005 AOR (95% CI)	Study year 2009 AOR (95% CI)	Study year 2013 AOR (95% CI)	Study year 2019 AOR (95% CI)	Pooled 2005–2019 AOR (95% CI)
Sex					
Female	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Male	**0.67 (0.44–1.02)**	**0.42 (0.23–0.76)****	**0.95 (0.49–1.85)**	**0.53 (0.35–0.80)****	**0.60 (0.46–0.80)*****
Age group (yrs)					
15–29	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
30–44	0.55 (0.25–1.20)	0.39 (0.15–1.02)	0.57 (0.11–3.06)	1.14 (0.56–2.31)	0.62 (0.36–1.08)
45–64 or 69†	**0.24 (0.11–0.53)*****	**0.26 (0.11–0.62)****	**0.38 (0.07–2.11)**	**0.56 (0.32–1.01)**	**0.38 (0.23–0.62)*****
Education (in yrs)					
0–9	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
10–11	1.18 (0.70–1.96)	1.10 (0.64–1.86)	0.91 (0.41–2.02)	0.91 (0.61–1.36)	1.01 (0.78–1.31)
≥12	1.56 (0.96–2.55)	1.52 (0.87–2.65)	1.10 (0.52–2.36)	1.16 (0.77–1.76)	1.14 (0.86–1.51
Region					
Rural	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Urban	1.03 (0.73–1.45)	0.73 (0.44–1.21)	0.79 (0.39–1.56)	1.67 (1.16–2.38)**	1.20 (0.91–1.57)
Ethnic group					
Other	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Khalkh	0.80 (0.53–1.21)	0.81 (0.42–1.56)	1.08 (0.39–2.99)	1.04 (0.66–1.65)	0.95 (0.67–1.45)
Body mass index					
Normal	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Underweight	–	0.46 (0.08–2.78)	0.90 (0.14–5.88)	–	1.14 (0.45–2.96)
Overweight	0.78 (0.52–1.17)	0.57 (0.37–0.86)**	0.79 (0.41–1.54)	0.54 (0.34–0.87)*	0.62 (0.47–0.82)***
Obesity	**0.65 (0.40–1.08)**	**0.43 (0.26–0.72)****	**1.09 (0.48–2.48)**	**0.29 (0.18–0.45)*****	**0.46 (0.34–0.62)*****
Current smoking	0.77 (0.51–1.16)	1.35 (0.84–2.16)	0.93 (0.47–1.85)	1.09 (0.68–1.56)	1.15 (0.84–1.40)
Alcohol use					
Never	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
≤3 d/mo	0.90 (0.56–1.43)	1.06 (0.64–1.74)	0.91 (0.51–1.63)	1.06 (0.76–1.46)	1.04 (0.82–1.32)
1–2 d/wk	0.76 (0.44–1.33)	0.81 (0.38–1.72)	0.04 (0.004–0.34)**	0.67 (0.20–2.20)	0.50 (0.27–0.93)*
≥3 d/wk	0.82 (0.33–2.08)	2.53 (0.64–9.99)	–	0.46 (0.12–1.72)	0.90 (0.39–2.14)
Physical activity					
Low	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Moderate	0.89 (0.46–1.74)	0.99 (0.30–3.32)	1.16 (0.50–2.70)	0.80 (0.49–1.31)	0.83 (0.60–1.14)
High	1.17 (0.66–2.08)	0.88 (0.29–2.68)	1.50 (0.79–2.87)	1.01 (0.68–1.49)	0.85 (0.65–1.12)
Fruits/vegetables (<5 servings/d)	1.11 (0.69–1.80)	0.68 (0.43–1.04)	0.35 (0.12–1.04)	1.02 (0.67–1.56)	0.68 (0.49–0.95)**

Key findings in bold.

***$P < .001$;

**$P < .01$;

*$P < .05$.

†15–64 years in 2005, 2009 and 2013, and 15–69 years in 2019.

AOR = adjusted odds ratio; CI = confidence interval.

version of the article and have agreed to authorship and order of authorship for this article.

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