

# Prevalence of major noncommunicable diseases and risk factors by region: Findings from mass screening

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**Objective:** Noncommunicable diseases (NCDs) are the leading causes of morbidity and mortality worldwide, accounting for the majority of premature deaths. Mongolia faces a particularly high burden of cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes, contributing to over 80% of total deaths. This study aimed to examine the prevalence of major NCDs and associated risk factors among the adult population of Mongolia by region. **Methods:** This study utilized large-scale screening data from the mass screening program of adults aged over 18 years. **Results:** A total of 447,409 adults were included in the analyses. High prevalence of NCD risk factors was observed, including smoking (16.6–19.1%), alcohol use (5.9–11.7%), physical inactivity (76%–80%), and insufficient fruit and vegetable intake (63%–79%). Regional comparison showed that the Northern region had the highest rates of smoking (19.2%), alcohol use (13.4%), and obesity (24.7%) ( $p<0.001$ ). In contrast, Ulaanbaatar reported notably higher rates of chronic gastritis and peptic ulcer disease (82.2%–18.5%) compared to other rural regions ( $p<0.001$ ). **Conclusion:** NCD risk factors are common across all regions of Mongolia, with clear differences between them. Notably, the urban population has higher rates of stomach and esophageal inflammation and ulcers, likely linked to lifestyle factors and obesity.

**Keywords:** Mass screening, Noncommunicable diseases, Risk factors, Region

## Introduction

Mongolia's long-term development policy, "Vision-2050", sets forth the objective of fostering healthy habits and active lifestyles among citizens and establishing an effective health system with high-quality, equitable access to services. Furthermore, Resolution No. 64 of 2024 of the State Great Khural of Mongolia, which approved the Regional Development

Concept of Mongolia, emphasizes balanced development of competitive regions with stable settlement patterns and population distribution, as well as integrated regional economic development.<sup>1,2</sup>

In 2021, worldwide, deaths caused by non-communicable diseases (NCDs) reached 43 million, accounting for 75 percent of all non-pandemic-related deaths. Of these, 18 million occurred before age 70 and were mainly seen in populations of low- and middle-income countries, reflecting health inequality.<sup>6</sup> Cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes are the main causes of death, and by 2025, mortality from NCDs is expected to increase by 15 percent.<sup>6</sup> In Mongolia, in 2020, the leading causes of morbidity were diseases of the digestive, respiratory, and cardiovascular systems, genitourinary diseases, and external injuries, while the main causes of mortality were cardiovascular diseases, cancers, and injuries/poisoning.<sup>3,4</sup> According to the results of national studies conducted between 2005 and 2019, the prevalence of risk factors of NCDs, such as alcohol, tobacco, unhealthy diet, and physical inactivity, has remained consistently high among the population aged 15-64.<sup>2</sup> Specifically, half of the population is overweight or obese, one-third have high blood pressure, one-quarter are physically inactive, half of men smoke, one-third consume alcohol, and one in ten engage in heavy drinking.<sup>5</sup> The proportion of people at risk of high blood sugar and lipid levels is also high, which shows that the risk spectrum of NCDs is expanding.<sup>5</sup>

Therefore, it is essential to study in detail the distribution of NCD risk factors at the regional level and to develop prevention policies and programs tailored to the lifestyle, behavior, and healthcare characteristics of the region's population, which is an important condition for reducing morbidity and premature mortality from NCDs. Involving the population in age, sex, and risk-based preventive, screening, and diagnosis (hereinafter referred to as screening) aims to prevent complications, deaths, and the economic and financial burden on families and the country, by identifying NCDs at an early stage, which reduce life expectancy, quality of life, and lead to loss of working capacity.

## Materials and Methods

### Study Design and Participants

This study employed a cross-sectional study design to assess noncommunicable disease risk factors at the regional level. A total

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of 447,409 adults aged 18 years and older who participated in the mass screening program during May 1, 2022, and November 16, 2023, were included in this study.

Within the study, data were collected on multiple risk factors, including tobacco use, alcohol consumption, physical activity, fruit and vegetable intake, body mass index (BMI), and organ system changes, based on results of early NCD screening. Information on tobacco use, alcohol consumption, physical activity, and fruit and vegetable intake was collected using standardized questionnaires. Weight and height were measured according to the standard protocols, and BMI was calculated by dividing an adult's weight in kilograms by their height in meters squared. Hypertension (HTN) was defined as systolic BP  $\geq 130$  mmHg, diastolic BP  $\geq 80$  mmHg, or use of antihypertensive medication within the past 14 days.

Fibrosis and cirrhosis were defined using the Fibrosis-4 (FIB-4) index, a non-invasive score calculated from routine clinical and laboratory parameters (age, AST, ALT, and platelet count). The FIB-4 index is widely used to estimate the stage of liver fibrosis in chronic liver diseases such as viral hepatitis, non-alcoholic fatty liver disease (NAFLD/NASH), and alcohol-related liver disease. In this study, a FIB-4 value of  $<1.3$  was considered indicative of minimal or no fibrosis, values between 1.3 and 2.67 were categorized as moderate fibrosis (requiring further assessment), and values  $>2.67$  were interpreted as consistent with advanced fibrosis or cirrhosis. Laboratory results used for screening were cross-checked against verified diagnostic data and against electronic databases of examinations and tests to ensure the accuracy and reliability of the information. In processing the study results, the distribution of risk factors at the regional level was compared and evaluated, and analyses were conducted to identify chronicity and complications, and to identify potential directions for preventing NCDs.

### Statistical Analysis

The collected data were compiled using Microsoft Excel, and pre-processing procedures were performed, including data cleaning and formatting. Duplicate entries were removed, and incomplete or erroneous data were checked and corrected. Descriptive statistics, including frequencies, proportions, and mean values, were calculated for each risk factor, and regional comparisons were conducted. Both descriptive and inferential statistical analyses were performed. Statistical analysis was performed in R. Depending on the data distribution, mean

values and standard deviations were calculated, and t-tests and ANOVA were used. A *p*-value <0.05 was considered statistically significant.

### Ethical Statement

This study received approval from the Ethical Review Committee of the Ministry of Health, Mongolia (Approval No 23/042, July 05, 2023). All procedures followed national ethical guidelines and the principles of the Declaration of Helsinki. Participation in this mass screening, organized by the Government of Mongolia, was voluntary. Confidentiality and anonymity were strictly maintained, and no identifying information was included in the analyses or publications.

## Results

Among a total of 447,409 adults aged 18 years who participated in the mass screening program, participation was higher in Ulaanbaatar City (n=247,795) compared to rural provinces (n=199,614). Overall, 17.6% of the screened population reported smoking, with a slightly higher prevalence in Ulaanbaatar (18.3%) than in other regions (16.7%). The prevalence of daily smoking was 25.4%, more common in rural

areas (32.9%) compared to Ulaanbaatar (21.7%). By region, the highest smoking prevalence was observed in the Northern region (19.23%, 95% CI: 18.79–19.68), followed by Ulaanbaatar (19.14%, 95% CI: 18.98–19.31). The lowest prevalence was in the Western region (15.17%, 95% CI: 14.86–15.48) and the Eastern region (15.20%, 95% CI: 14.77–15.64).

Regarding alcohol consumption, 8% of all adults reported drinking more than the standard drink amount in the past 30 days. Alcohol use in the past month varied significantly across regions. The highest rate was observed in the Northern region (13.39%, 95% CI: 13.00–13.77), followed by the Gobi region (11.73%, 95% CI: 11.32–12.14). The lowest rates were recorded in the Eastern (5.44%, 95% CI: 5.17–5.72), Western (5.89%, 95% CI: 5.68–6.09), and Central regions (5.95%, 95% CI: 5.68–6.23). In Ulaanbaatar, alcohol use was 6.51% (95% CI: 6.41–6.61), which was lower than in some rural areas and significantly less than in the Northern region.

**Table 1.** Alcohol and Smoking Consumption of the adult population by Region

Region	Smoking***			Alcohol use in the past 30 days***		
	n	%	CI 95%	n	%	CI 95%
Khangai	6230	16.59	16.21-16.96	2906	7.74	7.47-8.01
Western	7798	15.17	14.86-15.48	3025	5.89	5.68-6.09
Northern	5799	19.23	18.79-19.68	4037	13.39	13.00-13.77
Central	4987	17.52	17.08-17.97	1694	5.95	5.68-6.23
Eastern	3951	15.20	14.77-15.64	1414	5.44	5.17-5.72
Gobi	4114	17.61	17.12-18.09	2741	11.73	11.32-12.14
Ulaanbaatar	41891	19.14	18.98-19.31	14250	6.51	6.41-6.61

\**p*<0.05, \*\**p*<0.01, \*\*\**p*<0.001

Regarding physical activity, the proportions of individuals who exercised at least 5 days per week or achieved 10,000 steps per day were similar between urban (17.8%) and rural (17.7%) populations. The prevalence of regular physical activity was

relatively similar across regions, with 24.5% in rural provinces and 23.4% in Ulaanbaatar (*p*<0.001). The prevalence of physical inactivity across all regions was above 70%, indicating that insufficient physical activity is a crucial issue nationwide. Overall,

high levels of inactivity were observed among the population, exceeding 75% in many regions. Specifically, the Eastern region had the highest level of inactivity at 80.33%, followed by the Central region at 79.59%, the Khangai region at 77.90%, the Northern region at 77.40%, and the Gobi region and Ulaanbaatar city at 77.28% and 76.27%, respectively. The lowest prevalence was recorded in the Western region ( $p<0.001$ ).

Inadequate fruit and vegetable consumption was common across all regions. The adult population in the Khangai region

had the highest rate of inadequate intake at 79.08%, followed by the Western region with 78.01%, and the Eastern region with 70.70%. Conversely, residents of the Northern region (47.94%, 95% CI: 47.37-48.50) were more likely to consume fruits and vegetables, with a significantly lower rate than in other regions. In Ulaanbaatar city, the proportion of the population with inadequate fruit and vegetable intake was 63.37% (95% CI: 63.17-63.57), similar to levels seen in several rural regions (Table 2).

**Table 2. Physical Activity and Fruit-Vegetable Consumption by Region**

Region	Physically inactive***			Inadequate fruit/vegetable intake***		
	n	%	CI 95%	n	%	CI 95%
Khangai	29258	77.90	77.49-78.32	29701	79.08	78.67-79.50
Western	36565	71.15	70.75-71.54	40090	78.01	77.65-78.36
Northern	23337	77.40	76.93-77.87	14454	47.94	47.37-48.50
Central	22650	79.59	79.13-80.06	18610	65.40	64.84-65.95
Eastern	20875	80.33	79.85-80.81	18372	70.70	70.14-71.25
Gobi	18058	77.28	76.74-77.81	15694	67.16	66.56-67.76
Ulaanbaatar	166919	76.27	76.09-76.45	138680	63.37	63.17-63.57

\* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$

Analysis of the regional distribution of BMI categories in Mongolia showed that the Western region had the highest percentage of people with normal weight (50.27%, 95% CI: 49.81-50.74) compared to other areas. In contrast, the Northern region had the lowest prevalence of individuals with normal weight (37.46%, 95% CI: 36.94-37.99). The rate of overweight was notably high overall. In the Northern region, the prevalence reached 37.86%, while the Central (36.83%), Khangai (36.48%), Gobi (35.55%), and Eastern (35.30%) regions had similar levels. In Ulaanbaatar, the prevalence was 37.07%, similar to that in rural areas.

The prevalence of obesity was highest in the Eastern region (25.45%, 95% CI: 24.90-25.99), followed by the Northern region (24.68%, 95% CI: 24.21-25.15), the Central region (23.10%), and the Gobi region (23.04%). In contrast, the lowest proportion was recorded in Ulaanbaatar city (19.97%, 95% CI: 19.80-20.14), which was relatively lower compared to several rural regions (Table 3).

Overall, the findings indicate that NCD risk factors are widely prevalent across all regions of Mongolia, posing a substantial burden on population health. In Ulaanbaatar, smoking (19.14%) and physical inactivity (76.27%) were recorded at high levels, although obesity (19.97%) was lower than in several rural regions. This may reflect differences in environmental conditions, mobility patterns, food availability, and educational levels between urban and rural settings.

Of the 447,409 adults who participated in the screening, 203,442 (43.2%) had recorded blood pressure (BP) measurements. Among them, 61.4% (n=124,909) were found to have hypertension (HTN), defined as systolic BP  $\geq 130$  mmHg, diastolic BP  $\geq 80$  mmHg, or use of antihypertensive medication within the past 14 days. The prevalence of HTN was 62.4% (n=39,718) in Ulaanbaatar and 61.0% (n=73,851) in rural areas ( $p<0.05$ ).

At the regional level, significant variation in hypertension

**Table 3.** Distribution of overweight and obesity among adults by region in Mongolia

Region	Normal weight***		Overweight***		Obese***	
	%	CI 95%	%	CI 95%	%	CI 95%
Khangai	41.51	41.00 – 42.02	36.48	35.98 – 36.97	22.02	21.59 – 22.45
Western	50.27	49.81 – 50.74	34.74	34.30 – 35.18	18.59	18.22 – 18.95
Northern	37.46	36.94 – 37.99	37.86	37.33 – 38.39	24.68	24.21 – 25.15
Central	40.06	39.51 – 40.62	36.83	36.29 – 37.38	23.10	22.63 – 23.58
Eastern	39.25	38.64 – 39.87	35.3	34.70 – 35.90	25.45	24.90 – 25.99
Gobi	41.41	40.76 – 42.06	35.55	34.92 – 36.18	23.04	22.48 – 23.60
Ulaanbaatar	42.96	42.75 – 43.17	37.07	36.86 – 37.27	19.97	19.80 – 20.14

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001

prevalence was observed. The Eastern region recorded the highest prevalence at 47.24% (95% CI: 46.61–47.87), followed by the Gobi region (45.93%, 95% CI: 45.27–46.59) and the Western region (44.18%, 95% CI: 43.71–44.64). In the Khangai region, the prevalence was 36.31% (95% CI: 35.81–36.81), and in the Central region it was 31.95% (95% CI: 31.43–32.48),

both considered mid-level compared to the national average. The Northern region recorded 24.33% (95% CI: 23.86–24.79), while Ulaanbaatar city had the lowest prevalence at 18.88% (95% CI: 18.72–19.05), suggesting that hypertension is less common in the capital than in rural regions (Table 4).

**Table 4.** Prevalence of Hypertension by Region

Region***	n	%	CI 95%
Khangai	12982	36.31	35.81 -36.81
Western	19640	44.18	43.71-44.64
Northern	7807	24.33	23.86-24.79
Central	9600	31.95	31.43-32.48
Eastern	11491	47.24	46.61-47.87
Gobi	10047	45.93	45.27-46.59
Ulaanbaatar	39718	18.88	18.72-19.05

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001

Among the screened population, 78,615 individuals underwent FIB-4 assessment. Of these, 67,118 (85.4%) had a FIB-4 score <1.3, indicating no fibrosis; 10,189 (13.0%), a score between 1.3 and 2.67, indicating liver fibrosis; and 1,308 (1.7%), a score >2.67, suggesting cirrhosis.

Regional analysis of liver fibrosis (FIB-4 = 1.3–2.67) and cirrhosis (FIB-4 > 2.67) demonstrated notable differences

(p<0.001). The highest prevalence of fibrosis was observed in the Gobi region, where 17.2% (95% CI: 16.3–18.1) of the population fell within the fibrosis range. This was followed by the Northern region (15.8%, 95% CI: 15.0–16.6) and Ulaanbaatar (16.0%, 95% CI: 15.5–16.4), all exceeding the national average. The lowest prevalence of fibrosis was reported in the Khangai region (9.0%, 95% CI: 8.6–9.5).

Regarding cirrhosis, the Northern region had the highest prevalence, with 3.0% (95% CI: 2.6–3.4) of the population classified as high-risk (FIB-4 > 2.67). This was followed by Ulaanbaatar (2.1%, 95% CI: 2.0–2.3) and the Central region

(1.9%, 95% CI: 1.6–2.1). The lowest prevalence of cirrhosis was found in the Khangai region (1.0%, 95% CI: 0.9–1.2), consistent with its lower fibrosis prevalence (Table 5).

**Table 5. Prevalence of liver Fibrosis and Cirrhosis by region**

Region	Fibrosis***			Cirrhosis		
	n	%	CI 95%	n	%	CI 95%
Khangai	1469	9.0	8.6-9.5	167	1.0	0.9-1.2
Western	1006	12.1	11.4-12.8	100	1.2	1.0-1.4
Northern	1315	15.8	15.0-16.6	250	3.0	2.6-3.4
Central	1759	12.5	11.9-13.0	262	1.9	1.6-2.1
Eastern	1115	11.9	11.2-12.5	131	1.4	1.2-1.6
Gobi	1231	17.2	16.3-18.1	88	1.2	1.0-1.5
Ulaanbaatar	4825	16.0	15.5-16.4	642	2.1	2.0-2.3

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001

A total of 56,861 individuals underwent endoscopic screening. Among them, 24,534 (43.1%) were diagnosed with chronic esophagitis, while 1,450 (2.6%) displayed ulcerative changes in the esophagus. The remaining 32,327 (56.9%) individuals were reported as normal with no esophageal abnormalities.

At the regional level, the prevalence of esophagitis was higher

in the Central region (53.0%), the Eastern region (44.6%), and Ulaanbaatar city (45.6%), while it was relatively lower in the Western region (30.8%). Ulcerative changes of the esophagus were most common in Ulaanbaatar city (3.4%), the Gobi region (3.0%), and the Khangai region (3.1%), with the lowest prevalence recorded in the Western region (0.7%) (p<0.001).

**Table 6. Prevalence of esophagitis and ulcerative changes by region**

Region	Esophagitis*			Esophageal ulcer		
	n	%	CI 95%	n	%	CI 95%
Khangai	2374	37.9	36.7-39.1	99	1.6	1.3-1.9
Western	2673	30.8	29.9-31.8	58	0.7	0.5-0.8
Northern	2536	40.4	39.1-41.6	87	1.4	1.1-1.7
Central	4897	53.0	52.0-54.1	215	2.3	2.0-2.6
Eastern	1773	44.6	43.0-46.1	36	0.9	0.6-1.2
Gobi	3284	36.9	35.9-37.9	172	1.9	1.6-2.2
Ulaanbaatar	12815	45.6	45.0-46.2	948	3.4	3.2-3.6

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001

Out of 446,548 individuals screened, 15,004 (3.4%) underwent endoscopic examination. Among these, chronic gastritis, gastric ulcers, and duodenal ulcers were commonly observed. The prevalence of chronic gastritis was 80.7% (n=12,110), while gastric ulcers were diagnosed in 11.7% (n=1,760), and duodenal ulcers in 12.8% (n=1,922). The remaining 19.3% (n=2,894) were diagnosed as normal. Regional comparisons showed the highest prevalence of chronic gastritis in the Western (97.2%), Eastern (89.7%), and Central (91.1%) regions, while the lowest rates were found in Ulaanbaatar (82.2%) and the Khangai region (85.7%).

The highest prevalence of gastric ulcer was observed in the Eastern (5.4%) and Western (5.0%) regions, while it was notably

higher in the Khangai (8.4%) and Ulaanbaatar (17.0%) regions. The prevalence of duodenal ulcer was highest in Ulaanbaatar (18.5%), the Khangai region (9.6%), and the Western region (5.9%), whereas the lowest prevalence was in the Eastern region (2.5%).

At the provincial and capital levels, the highest number of cases was recorded in Ulaanbaatar, with 6,391 cases of chronic gastritis, 1,320 gastric ulcers, and 1,435 duodenal ulcers. This was followed by the Western region (3,069 chronic gastritis, 159 gastric ulcers, 185 duodenal ulcers) and the Central region (1,551 chronic gastritis, 86 gastric ulcers, 51 duodenal ulcers) (Table 7).

**Table 7.** Prevalence of chronic gastritis, gastric ulcer, and duodenal ulcer by region

Region	Chronic gastritis***			Gastric ulcer***			Duodenal ulcer***		
	n	%	CI 95%	n	%	CI 95%	n	%	CI 95%
Khangai	753	85.7	83.3-88.0	74	8.4	6.6-10.3	84	9.6	7.6-11.5
Western	3069	97.2	96.6-97.8	159	5.0	4.3-5.8	185	5.9	5.0-6.7
Northern	1557	85.1	83.4-86.7	121	6.6	5.5-7.8	91	5.0	4.0-6.0
Central	1551	91.1	89.8-92.5	86	5.1	4.0-6.1	51	3.0	2.2-3.8
Eastern	1341	89.8	88.2-91.3	80	5.4	4.2-6.5	37	2.5	1.7-3.3
Gobi	822	81.7	79.3-84.1	87	8.6	6.9-10.4	47	4.7	3.4-6.0
Ulaanbaatar	6391	82.2	81.4-83.1	1320	17.0	16.2-17.8	1435	18.5	17.6-19.3

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001

From these results, it can be concluded that the prevalence of chronic gastritis, gastric ulcer, and duodenal ulcer varies across regions, with populations in urban areas being at greater risk.

## Discussion

Our study shows that the main risk factors for NCDs, including smoking, alcohol use, physical inactivity, low fruit and vegetable intake, obesity, metabolic syndrome, and hypertension, are widespread across all regions of Mongolia. This aligns with findings from other developing countries. Notably, the high rate of behavioral risk factors is similar to reports from other Asian countries such as China, Kazakhstan, and Vietnam.<sup>13,14,17</sup>

Among the seven regions included in the study, the Northern

region demonstrated the highest prevalence of multiple risk factors. Smoking (19.23%), alcohol consumption (13.39%), physical inactivity (77.40%), and obesity (24.68%) were all higher in this region, indicating a considerable overall risk for NCDs among its population.

In the Eastern region, physical inactivity (80.33%) and obesity (25.45%) had the highest prevalence, with insufficient fruit and vegetable consumption (70.70%) also notably high, further raising health risks for this population. In the Central region, physical inactivity (79.59%) and obesity (23.10%) were similarly prevalent, indicating the coexistence of multiple risk factors.

The Gobi region reported higher-than-average levels of alcohol consumption (11.73%), physical inactivity (77.28%), and obesity (23.04%). In contrast, the Western and Khangai

regions exhibited relatively lower rates of behavioral risk factors such as smoking and alcohol use; however, insufficient fruit and vegetable intake (79.08% and 78.01%, respectively) and physical inactivity (77.90% and 71.15%) remained significantly high in both regions.

Regarding smoking, the overall prevalence was 17.6%, and daily smoking was 27.0%, which is similar to the global average of 22.3% reported by WHO, although slightly lower than in the European and Southeast Asian regions.<sup>16</sup> In terms of alcohol consumption, our study found that 8.0% of participants reported alcohol use in the past 30 days, with the Northern region showing the highest prevalence at 13.4%. This aligns with the high levels of alcohol consumption reported in neighboring countries like Russia and Kazakhstan.<sup>11</sup> Additionally, the Northern region also had a higher prevalence of liver fibrosis (15.8%) and cirrhosis (3.0%), consistent with findings from other international studies.<sup>9</sup>

The prevalence of physical inactivity in our study exceeded 70% overall and reached 80% in some regions, more than double the WHO-reported average of 35% in the Asia-Pacific region.<sup>7</sup> This highlights the lack of policies and supportive environments to promote physical activity in Mongolia, and compared to other countries, indicates that a healthy lifestyle environment has not yet been adequately established.

Inadequate fruit and vegetable intake was also observed at different levels across regions, reaching up to 79% in some areas, which is higher compared to the global average (52%) and other Asian countries.<sup>15</sup> Low consumption of fruits and vegetables may be directly linked to food security, purchasing power, and education levels. The prevalence of hypertension in our study averaged 61.4%, nearly twice the global average of 31.1%, and was especially high in the Eastern and Gobi regions. This is a concerning finding when compared with other countries.<sup>15</sup> Conversely, the prevalence of hypertension in Ulaanbaatar city was 18.9%, perhaps related to better health literacy, higher quality screening, and greater access to treatment within the urban population. However, despite Ulaanbaatar having the lowest prevalence, a total of 39,718 individuals were diagnosed with hypertension. This reflects the impact of population density, age structure, lifestyle, and screening quality in urban areas. In contrast, the Northern (n=7,807), Central (n=9,600), and Gobi (n=10,047) regions with smaller populations still exhibited high proportions, indicating that hypertension is linked not only to urbanization but also to regional social, environmental, dietary,

and health literacy factors.

Levels of overweight and obesity varied across regions but were generally high, comparable to those reported in high-income countries such as the United States and the European Union.<sup>12</sup> This is likely associated with urbanization, sedentary lifestyles, and increased consumption of fast food.

Regarding gastrointestinal diseases, the prevalence of esophagitis (43.1%), chronic gastritis (80.7%), gastric ulcer (11.7%), and duodenal ulcer (12.8%) in our study aligns with patterns seen in Asian countries, especially in Northeast Asia, which shares similarities with Mongolia.<sup>8</sup> This may be due to the high rates of *Helicobacter pylori* infection and high salt intake.

This extensive screening of 447,409 adults in Mongolia highlights a significant and widespread burden of non-communicable disease (NCD) risk factors across regions, with particularly high levels of physical inactivity and tobacco use in the capital city. The results agree with existing national surveillance showing substantial exposure to behavioral and metabolic risks in Mongolia and emphasize that cardiovascular disease remains a leading cause of morbidity and mortality in the region<sup>18-20</sup>

In the urban setting of Ulaanbaatar, smoking prevalence (19.14%) and physical inactivity (76.27%) were notably high, while obesity (19.97%) was lower than in several rural regions. This pattern of urban–rural differences is seen in international data: for example, in China, physical inactivity and obesity are significantly higher in urban areas compared to rural ones, although smoking prevalence does not always follow the same trend.<sup>21</sup> Similar patterns are observed in other low- and middle-income countries experiencing rapid urbanization, where sedentary lifestyles and access to tobacco increase in cities, while rural areas may experience different nutritional changes and access to services.<sup>22-24</sup>

Out of 203,442 participants with recorded blood pressure measurements (43.2% of the screened adult group), 61.4% met the criteria for hypertension. Although this prevalence exceeds some previous estimates in Mongolia, using a lower BP threshold and the screened sample may explain the higher figure. Globally, hypertension affects about one-third of adults aged 30–79 years, with low- and middle-income countries bearing the largest share of untreated cases.<sup>25</sup> A modeling study projecting global hypertension prevalence to 2040 indicated that South-East Asia and Africa will face the highest burdens, suggesting that Mongolia's high prevalence is part of a broader regional

challenge.<sup>26</sup>

The urban–rural differences in obesity, inactivity, and smoking seen in our data likely result from multiple interacting factors: urban residents often face built-environment barriers that limit physical activity (such as reliance on commuting and lack of open spaces), increased exposure to processed food markets, and potentially higher educational levels that influence behavior but also bring time pressures leading to inactivity. In contrast, rural populations may engage in more occupational physical activity but face rising access to processed and calorie-rich foods, which contributes to higher obesity rates despite lower levels of physical inactivity. Similar patterns have been observed in China, where urban residents have higher rates of physical inactivity and obesity even though they smoke less compared to rural residents.<sup>21</sup> These differences highlight the importance of customizing interventions to fit local contexts instead of applying a one-size-fits-all approach.

From a health systems perspective, the coexistence of very high hypertension rates and widespread behavioral risk factors highlights the urgent need to expand both upstream preventive measures and downstream clinical care pathways. Population-level strategies such as salt reduction campaigns, tobacco control initiatives, promotion of active travel, and improvements in food environments are crucial. At the same time, detection, connection to care, and sustainable treatment of hypertension must be reinforced. The adoption of lower diagnostic thresholds (e.g.,  $\geq 130/80$  mmHg) in recent guidelines increases sensitivity but also means a larger number of individuals will need follow-up care.<sup>27</sup> International studies indicate that global targets for hypertension control are still far from being achieved; for example, treatment and control rates among African bank workers were very low in a systematic review, illustrating the challenge of expanding care in resource-limited settings.

However, the current screening effort has notable limitations. First, only 43.2% of screened adults had documented blood pressure (BP) measurements, which may introduce measurement and selection biases for example, those who agreed to measurement might differ systematically. Second, hypertension classification was based on a single screening visit rather than multiple measurements or ambulatory monitoring, potentially overestimating prevalence due to the white-coat effect or blood pressure variability. Third, comparisons with earlier studies are limited by differences in age ranges, sampling methods, and

diagnostic thresholds (e.g.,  $\geq 140/90$  mmHg versus  $\geq 130/80$  mmHg). Future reports should include age-standardized prevalence, broken down by sex and region (urban/rural), and should also estimate awareness, treatment, and control rates among hypertensive individuals to inform operational priorities.

## Conclusion

In conclusion, these data reinforce that Mongolia faces a dual burden of high behavioral risk exposure and very high hypertension prevalence among screened individuals. The high prevalence of chronic gastritis, esophagitis, and ulcerative diseases in urban areas indicates the influence of factors such as lifestyle, obesity, and unhealthy dietary habits. Policy responses should combine strengthened surveillance, geographically tailored preventive strategies, and pragmatic health-system reforms to close the detection-to-treatment gap. Given the strong contribution of elevated blood pressure and poor lifestyle behaviors to the national burden of cardiovascular disease, investments in these areas are likely to yield substantial health gains in the coming decade.

## Conflicts of Interest

All authors have no potential or non-potential financial conflicts of interest.

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