

# Prevalence of restless leg syndrome in Mongolian adults: Mon-TimeLine study

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We conducted an epidemiologic study based on survey neuroscience screening for restless leg syndrome in the Mongolian to determine the prevalence of restless leg syndrome. We used baseline data from the Mon-TimeLine study, a multidisciplinary, prospective, population-based cohort study. The total number of participants ( $n = 1572$ ) ranged from 18 to 65 years of age. We found the prevalence of restless leg syndrome to be 6.6% ( $n = 103$ ), among which 4.1% ( $n = 16$ ) were males and 7.3% ( $n = 87$ ) were females. The peak prevalence age for both genders was 45–55, and we found a positive correlation with body mass index ( $P < 0.05$ ). Most cases were mild (44.7%) or moderate (35.9%), but 18.4% and 1% of the cases were severe or very severe, respectively. The severe groups showed a positive association with chronic kidney disease, as well as with gastritis. In conclusion, the prevalence of restless leg syndrome in Mongolia approximates that in other countries.

## Keywords

Restless leg syndrome; Mongolia; Mon-TimeLine study; Survey neuroscience

## 1. Introduction

Restless leg syndrome (RLS) is one of the most common sleep-related disorders that can affect the quality of sleep, which leads to having a significant impact on the quality of life [1–4]. Furthermore, RLS is often characterized by neurodegenerative diseases, such as Parkinson's disease [5, 6]; and specific estimated populations are unaware of the prevalence of RLS in general population studies [7]. In the literature, the prevalence of RLS differs according to racial, ethnic, and gender distinctions [8, 9]. Studies show that RLS occurs in 8.5%–28.2% of the population in Western Europe over 18 and ranges from 0.1% to 12% in the Asia-Pacific population [10]. In Asian countries—such as Singapore, Taiwan, China, and Japan—the average prevalence of RLS is 2%, but in South Korea, the prevalence of RLS among adults is 7.5% [11, 12]. Although numerous previous studies have found

RLS to be more frequent in females in many countries, it has also been more frequent in males in some countries in accordance with their age groups [13]. Moreover, studies have not only shown that several chronic diseases—such as diabetes, chronic kidney diseases, and chronic gastritis—are related to the risk of RLS in the general population; but they have also demonstrated that RLS in the general population is associated with lifestyle choices, diet, exercise, and obesity [14].

In Mongolia, the prevalence of RLS has not been studied in the general population thus far. Therefore, we aimed to study the prevalence of RLS in Mongolia. The study also examined whether the presence of RLS is associated with age, gender, and coexisting conditions. We hypothesize that RLS prevalence in Mongolia and its characteristics, such as age and gender differences, might be similar to other Asian populations [15].

## 2. Materials and methods

### 2.1 Data source and study population

In this cross-sectional study, we used the baseline data from the Mon-TimeLine cohort, including participants aged 18–80 ( $n = 1846$ ). Mon-TimeLine is a multidisciplinary, population-based, prospective cohort study in Mongolia investigating various health problems among Mongolians, especially those associated with oral- and mental-health problems.

The exclusion criteria included any missing data relating to the primary determinant and outcome ( $n = 88$ ), on which we did not have complete data during RLS screening. Furthermore, based on their medical records, participants with a history of psychiatric disorders and any problem with their legs—such as myalgia, arthralgia, peripheral neuropathy, and leg edema—were excluded to prevent potential selection biases ( $n = 88$ ). Additionally, we asked how participants would

assess their health status (inferior, fair, good or excellent). Those who assessed their health status as inferior were excluded ( $n = 98$ ) from our study to rule out possible co-existing diseases. Ultimately, 1572 participants were included in the current study.

According to the Helsinki Declaration, the study was conducted, and the Medical Ethical Committee approved it of the Mongolian National University of Medical Sciences (METC 2020/3-05). All participants provided their written informed consent.

## 2.2 Restless leg syndrome

The Restless Leg Syndrome Screening Questionnaire is a well-known and frequently used questionnaire in RLS screening and estimate the RLS risk [16, 17]. Its severity was assessed using the International Restless Leg Syndrome Study Group Rating Questionnaire [17]. The researchers completed training on the questionnaires before the initiation of the study. Since the questionnaires have not been validated for Mongolians yet, we conducted a pilot study on 30 participants. Cronbach's  $\alpha$  tested the internal validity of the questionnaire for categories, based on the questions included in questionnaires, separately.

In accordance with the RLS diagnostic criteria [16], participants were screened using four pre-questions (pre-questionnaire). RLS was ultimately defined when people met three of the four essential criteria: (1) Do you have, or have you sometimes experienced, recurrent, uncomfortable feelings or sensations in your legs while sitting or lying down? (2) Do you have, or have you sometimes experienced, a recurrent need or urge to move your legs while sitting or lying down [18]? (3) When present, do these feelings or movements improve or go away when you get up and walk around for as long as you are walking? (4) Plus other questions relating to exercise and whether feelings are more likely to occur when sitting or lying down. Afterwards, the participants continued to answer the International RLS 10 questionnaire (Hendrick, Sleep Disorders Center): (1) Overall, how would you rate the RLS discomfort in your legs or arms? (2) Overall, how would you rate the need to move around because of your RLS symptoms? (3) Overall, how much relief of your RLS (arm or leg discomfort) do you get from moving around? (4) Overall, how severe is your sleep disturbance from your RLS symptoms? (5) Overall, how severe is your sleep disturbance from your RLS symptoms? (6) Overall, how severe is your RLS as a whole? (7) How often do you get RLS symptoms? (8) When you have RLS symptoms, how severe are they on an average day? (9) How severe is the impact of your RLS symptoms on your ability to carry out a satisfactory family, home, social, school, or work-life/overall daily affairs? (10) How severe are your RLS symptoms on mood disturbance (angry, depressed, sad, anxious, or irritable)?

The RLS questionnaire is a self-rating questionnaire for their symptoms. People scored their answers between 0 and 4 for each question as none (0), mild (1), moderate (2), severe (3), and very severe (4). The total scoring defines severity

**Table 1. General characteristics of the study population.**

Characteristics	Total	RLS (N)	RLS (%)	P-value
Number	1572	103	6.6%	
Sex				
Male	388	16	4.1%	0.019
Female	1184	87	7.3%	
Age				
<45 years	849	49	5.8%	0.032
≥45 years	723	54	7.5%	

Note: Data is presented as numbers (percentages, %).

as: 0–10 points for mild, 11–20 points for moderate, 21–30 points for severe, and 31–40 points for very severe.

## 2.3 Other variables and measurements

Education level was categorized as low, medium, and high. A low level of education included those without any formal education and those who only graduated elementary school. People who graduated middle school, high school, and college without a degree were included in the medium education group. The high level of education included those with bachelor's, master's, and doctoral degrees. Participants were classified as married or cohabiting and single as a dichotomous variable. Family income was categorized as low, medium, and high. Current smoking status was categorized as non-smokers and smokers. Alcohol use was questioned and categorized as regular or irregular. Daily fruit, vegetable, and meat intakes were evaluated using the Food Frequency Questionnaire [19], which was then assessed on a scale of 0–4 for each type of food. For instance, meat consumption was rated at 0 if they do not use meat. Furthermore, we asked questions about their history of chronic illnesses, including chronic kidney diseases, chronic gastritis, diabetes etc.

Participants' body weight (in kg) and height (in cm) were measured by well-trained assistants using a standardized protocol, and body mass index (BMI;  $\text{kg}/\text{m}^2$ ) was subsequently calculated. A semi-automatic device was used to measure blood pressure in a half-seated position. The primary data of our study was derived from patients' medical records.

## 2.4 Statistical analysis

The study characteristics were expressed as means with a standard deviation (SD) for normally distributed variables and as numbers with percentages in cases of categorical data. The differences between people with and without RLS were compared using the Student's *t*-test for continuous variables. The frequency distributions of categorical variables were analyzed using the Pearson Chi-Square test. We also tested the differences between RLS severity using the Student's *t*-test and Pearson Chi-Square test.

# 3. Results

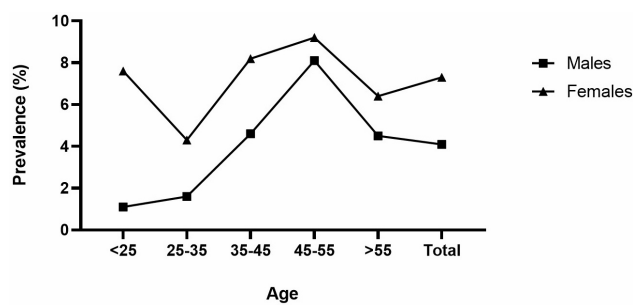
The current study revealed that 6.6% ( $n = 103$ ) of the total population had RLS, among which 4.1% ( $n = 16$ ) of the male population and 7.3% ( $n = 87$ ) of the female population had RLS (Table 1,  $P < 0.01$ ).

**Table 2. General characteristics of the study population, according to the presence of RLS.**

Findings	Presence of RLS		P-value
	Without (n = 1469)	With (n = 103)	
Mean age $\pm$ SD, year	41.9 $\pm$ 14.06	43.6 $\pm$ 12.6	0.022
Sex: male, n (%)	368 (25.3)	16 (15.8)	0.033
Education: lower level, n (%)	141 (15.2)	14 (20.6)	0.448
Mean BMI $\pm$ SD, kg/m <sup>2</sup>	27.0 $\pm$ 5.5	29.1 $\pm$ 5.7	0.004
Marital status: married, n (%)	736 (79.3)	56 (82.4)	0.336
Alcohol use, n (%)	626 (56.5)	49 (60.5)	0.483
Smoking: smokers, n (%)	224 (19.9)	19 (22.4)	0.791
Fruit intake: regular, n (%)	205 (18.2)	15 (17.4)	0.620
Vegetable intake: regular, n (%)	720 (64.5)	52 (59.8)	0.600
Meat intake: don't use, n (%)	35 (3.5)	2 (2.4)	0.201
Physical activity: regular, n (%)	138 (12.7)	8 (9.8)	0.441

Note: Data is presented as means  $\pm$  SD and numbers (percentages, %).

Although numerous previous studies have demonstrated that RLS prevalence increases with age, other studies have shown that RLS may occur at young ages [15, 20]. Our findings show that another age peak was observed in the 18–25 age group (see Fig. 1)



**Fig. 1. Prevalence of RLS by age and gender.** The peak age was 45–55 in both genders. Moreover, another age peak was observed in the 18–25 year age group.

Of the 94.2% of participants with RLS reported leg discomfort, 67% felt discomfort during rest, while 90.3% of participants reported relief when moving around. 74.8% of participants experienced RLS before nighttime, with the severity reported as 43% for mild and 42% for moderate. The duration of clinical symptoms was within one hour for 75% of the participants. RLS-related sleep disturbances have been found in 26.2% of the participants for mild and 39.8% moderate sleep disturbances. Mild (27.2%) and moderate (31.1%) daytime sleep disturbances were shared, among which 27.2% and 29.1% reported mild and moderate impact on daily activities, respectively. Moreover, RLS-related psychiatric conditions were reported as mild in 18.4% and moderate in 34% of the population, respectively.

Regarding the presence of RLS, it was found to be more prevalent in those who were older, female, and who had a high BMI. There were no significant differences in socioeconomic and lifestyle characteristics between those with and

without RLS (Table 2).

Among those with RLS in the general population, most cases were mild (44.7%) and moderate (35.9%), while 18.4% and 1% were severe and very severe, respectively. Although there were no significant differences between the RLS severity groups from the descriptive analysis, those with severe RLS were more likely to have a history of chronic kidney diseases and gastritis. In the severe RLS group, 36.3% (n = 24) and 30.3% (n = 20) had a history of chronic kidney diseases and gastritis; compared to 32.4% (n = 12) and 29.7% (n = 11) in the mild RLS group ( $P > 0.05$ ).

#### 4. Discussion

We found the prevalence of RLS to be 6.6% among Mongolian adults, which is similar to the prevalence reported in studies in other countries. Furthermore, we compared our results to those of other countries that utilized similar methodologies to define RLS. Our findings have determined that RLS prevalence in the Mongolian population is higher than RLS prevalence in Japan and Taiwan, which is 1.6% and 1.8%, respectively, and the lowest prevalence of RLS in Asia [12, 21]. On the other hand, the prevalence of RLS in Mongolia is significantly less than that of Pakistan, which has the highest prevalence rate with 23.6% [22].

The prevalence and characteristics of the RLS population (n = 5000) in South Korean adults reported that 7.5% of the population met the criteria of definite or probable RLS groups, 3.9% fulfilled the criteria of definite RLS, and 3.6% fulfilled the criteria of probable RLS [11]. The prevalence of RLS in Han Chinese was found to be 7.2% [23].

Older people of both genders were more likely to have RLS. A Korean population (n = 5000) found that the initial RLS symptoms tended to start before 45 years of age [10]. In the Italian population RLS was shared in older people within the 50–89 year age group [24]. Five modern industrialized western countries reported that men have RLS mostly when their age varied between 80–89 [25]. Regarding gender, we show women more afflicted with RLS, which mirrors the re-

sults in other populations. In Germany, a sample population of 369 with RLS has reported that females (13.9%) are twice as likely to have RLS than males (6.1%) [26].

Our survey neuroscience shows that weight gain might be a risk to developing RLS, which is in tandem with the findings of previous studies that have also demonstrated that an unhealthy lifestyle is a risk for RLS. For instance, a study involving men ( $n = 51529$ ) and women ( $n = 116430$ ) aged 40–75 who have high BMIs, use tobacco and alcohol, and engage in unhealthy diets has shown that 4.6% and 5.6% of these participants developed RLS within 6 and 4 years, respectively [27]. The pathophysiology of RLS concerning obesity remains unclear; however, the potential mechanisms of this relationship have been explained in previous studies. In [28] reviewed that the concept of RLS is a complex cortical-subcortical network disorder that goes far beyond dopaminergic impairment. Obesity and being overweight in proportion with their obesity may affect the dopaminergic function due to the lack of dopamine D2 receptor, as reported in [29]. Moreover, research has shown that people with obesity tend to have systemic iron deficiency, which results in iron deficiency in the brain [30], thereby contributing to RLS development.

In our survey neuroscience, 16% of the participants were classified as having severe RLS. In a Han Chinese population, 40.7% ( $n = 144$ ) of the population had RLS syndrome, of which 68 had moderate symptoms, and 28 had severe symptoms [23]. According to a United States study of 791 participants aged 50–89, 10.6% had RLS. Of these people, 33.8% had mild symptoms, 44.6% had moderate symptoms, and 21.6% had severe symptoms [9]. Although the main aim of our survey neuroscience was not to study the risk factors of RLS, our findings suggest that people with a history of kidney disease or gastrointestinal disorders are more likely to have and develop RLS. Therefore, it may be appropriate to routinely undertake RLS-screening questionnaires for people with these disorders.

The main strength of our survey neuroscience is our utilization of nationwide data being the first undertaking for the prevalence of RLS in Mongolia.

## 5. Conclusions

The prevalence of RLS was 6.6% in the Mongolian population, similar to the prevalence rate reported in other countries. RLS was found to be more prevalent in women and both genders aged 45 and above. The fact that RLS has been diagnosed in the population through survey neuroscience suggests that routine screening for RLS in primary healthcare organizations is deemed complementary to understand RLS etiology.

## Abbreviations

BMI, Body Mass Index; RLS, Restless Leg Syndrome; SD, Standard Deviation.

## Author contributions

BD, OB, and AD conceived and designed the study. AD, MM, SJ and PB collected data. OB, AD, PB, SJ, MM and MO analyzed the data. BD, OB, AD, DB, TJ and MO wrote the paper. TJ, DB, and BD reviewed and edited the paper.

## Ethics approval and consent to participate

The Medical Ethical Committee approved of the Mongolian National University of Medical Sciences (METc 2020/3-05). All participants provided their written informed consent.

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## Conflict of interest

The authors declare no conflict of interest.

## References

- [1] Abetz L, Allen R, Follet A, Washburn T, Early C, Kirsch J, *et al.* Evaluating the quality of life of patients with restless legs syndrome. *Clinical Therapeutics*. 2004; 26: 925–935.
- [2] Chervin RD, Archbold KH, Dillon JE, Pituch KJ, Panahi P, Dahl RE, *et al.* Associations between symptoms of inattention, hyperactivity, restless legs, and periodic leg movements. *Sleep*. 2002; 25: 213–218.
- [3] Ramsey C, Walld R, Delaive K, Forget E, Prior HJ, Kryger M. Healthcare utilization among obese patients with and without obstructive sleep apnea (pp. 221–229). *American Thoracic Society 2009 International Conference*. May 15–20, 2009, San Diego, California: Springer. 2009.
- [4] Rutkove SB, Matheson JK, Logigian EL. Restless legs syndrome in patients with polyneuropathy. *Muscle & Nerve*. 1996; 19: 670–672.
- [5] Trenkwalder C, Walters AS, Hening W. Periodic limb movements and restless legs syndrome. *Neurologic Clinics*. 1996; 14: 629–650.
- [6] Wong JC, Li Y, Schwarzschild MA, Ascherio A, Gao X. Restless legs syndrome: an early clinical feature of Parkinson disease in men. *Sleep*. 2014; 37: 369–372.
- [7] Hening WA, Allen RP, Thanner S, Washburn T, Heckler D, Walters AS, *et al.* The Johns Hopkins telephone diagnostic interview for the restless legs syndrome: preliminary investigation for validation in a multi-center patient and control population. *Sleep Medicine*. 2003; 4: 137–141.
- [8] Phillips B, Young T, Finn L, Asher K, Hening WA, Purvis C. Epidemiology of restless legs symptoms in adults. *Archives of Internal Medicine*. 2000; 160: 2137–2141.
- [9] Högl B, Kiechl S, Willeit J, Saletu M, Frauscher B, Seppi K, *et al.* Restless legs syndrome: a community-based study of prevalence, severity, and risk factors. *Neurology*. 2005; 64: 1920–1924.
- [10] Koo BB. Restless leg syndrome across the globe: epidemiology of the restless leg syndrome/Willis-Ekbom disease. *Sleep Medicine Clinics*. 2015; 10: 189–205.
- [11] Kim J, Choi C, Shin K, Yi H, Park M, Cho N, *et al.* Prevalence of

- restless legs syndrome and associated factors in the Korean adult population: the Korean Health and Genome study. *Psychiatry and Clinical Neurosciences*. 2005; 59: 350–353.
- [12] Nomura T, Inoue Y, Kusumi M, Uemura Y, Nakashima K. Prevalence of restless legs syndrome in a rural community in Japan. *Movement Disorders*. 2008; 23: 2363–2369.
  - [13] Wali SO, Abaalkhail B. Prevalence of restless legs syndrome and associated risk factors among middle-aged Saudi population. *Annals of Thoracic Medicine*. 2015; 10: 193–198.
  - [14] Rothdach AJ, Trenkwalder C, Haberstock J, Keil U, Berger K. Prevalence and risk factors of RLS in an elderly population: the MEMO study. Memory and morbidity in Augsburg elderly. *Neurology*. 2000; 54: 1064–1068.
  - [15] Xue R, Liu G, Ma S, Yang J, Li L. An epidemiologic study of restless legs syndrome among Chinese children and adolescents. *Neurological Sciences*. 2015; 36: 971–976.
  - [16] Stiasny-Kolster K, Möller JC, Heinzel-Gutenbrunner M, Baum E, Ries V, Oertel WH. Validation of the restless legs syndrome screening questionnaire (RLSSQ). *Somnologie - Schlafforschung und Schlafmedizin*. 2009; 13: 37–42.
  - [17] Walters AS, LeBrocq C, Dhar A, Hening W, Rosen R, Allen RP, *et al*. Validation of the International Restless Legs Syndrome Study Group rating scale for restless legs syndrome. *Sleep Medicine*. 2003; 4: 121–132.
  - [18] Allen RP, Walters AS, Montplaisir J, Hening W, Myers A, Bell TJ, *et al*. Restless legs syndrome prevalence and impact: REST general population study. *Archives of Internal Medicine*. 2005; 165: 1286–1292.
  - [19] World Health Organization. Mongolian STEPS survey on the prevalence of noncommunicable disease risk factors. 2015. Available at: <https://www.who.int/ncds/surveillance/steps/mongolia/en/> (Accessed: 21 January 2021).
  - [20] Shi Y, Yu H, Ding D, Yu P, Wu D, Hong Z. Prevalence and risk factors of restless legs syndrome among Chinese adults in a rural community of Shanghai in China. *PLoS ONE*. 2015; 10: e0121215.
  - [21] Chen N, Chuang L, Yang C, Kushida CA, Hsu S, Wang P, *et al*. The prevalence of restless legs syndrome in Taiwanese adults. *Psychiatry and Clinical Neurosciences*. 2010; 64: 170–178.
  - [22] Mahmood K, Farhan R, Surani A, Surani AA, Surani S. Restless legs syndrome among Pakistani population: a cross-sectional study. *International Scholarly Research Notices*. 2015; 2015: 762045.
  - [23] Li L, Chen H, Zhang L, Wang Z, Wang C. A community-based investigation on restless legs syndrome in a town in China. *Sleep Medicine*. 2012; 13: 342–345.
  - [24] Ohayon MM, Roth T. Prevalence of restless legs syndrome and periodic limb movement disorder in the general population. *Journal of Psychosomatic Research*. 2002; 53: 547–554.
  - [25] Hening W, Walters AS, Allen RP, Montplaisir J, Myers A, Ferini-Strambi L. Impact, diagnosis and treatment of restless legs syndrome (RLS) in a primary care population: the REST (RLS epidemiology, symptoms, and treatment) primary care study. *Sleep Medicine*. 2004; 5: 237–246.
  - [26] Berger K, Luedemann J, Trenkwalder C, John U, Kessler C. Sex and the risk of restless legs syndrome in the general population. *Archives of Internal Medicine*. 2004; 164: 196–202.
  - [27] Batool-Anwar S, Li Y, De Vito K, Malhotra A, Winkelman J, Gao X. Lifestyle factors and risk of restless legs syndrome: prospective cohort study. *Journal of Clinical Sleep Medicine*. 2016; 12: 187–194.
  - [28] Lanza G, Ferri R. The neurophysiology of hyperarousal in restless legs syndrome: hints for a role of glutamate/GABA. *Advances in Pharmacology*. 2019; 84: 101–119.
  - [29] Salas RE, Gamaldo CE, Allen RP. Update in restless legs syndrome. *Current Opinion in Neurology*. 2010; 23: 401–406.
  - [30] Piao Y, Lian T, Hu Y, Zuo L, Guo P, Yu S, *et al*. Restless legs syndrome in Parkinson disease: clinical characteristics, abnormal iron metabolism and altered neurotransmitters. *Scientific Reports*. 2017; 7: 10547.