



RESEARCH



Investigation of the Frequency of Restless Leg Syndrome Based on the Measurement of the Amount of Tris Elements in Hemodialysis Patients of Mustafa Hospital in Ilam City in 1400

Mahsa Rizehbandi¹ · Mina Radmard² · Elham Alizadeh³ · Leila Naseri^{3,4}

Received: 28 December 2024 / Revised: 10 June 2025 / Accepted: 14 June 2025
© The Author(s), under exclusive licence to Springer Nature Switzerland AG 2025

Abstract

Objective Restless leg syndrome can impact a person's performance, causing discomfort and disruption in work activities and family life. Hemodialysis patients are more susceptible to this syndrome, making it important to investigate its causes and provide solutions for improvement or treatment. Therefore, this study aimed to explore the connection between the level of trace elements and restless leg syndrome in hemodialysis patients.

Materials and methods In 1400, a descriptive and analytical study was conducted on hemodialysis patients at Mustafa Khomeini Hospital in Ilam. The study involved recording the tris element levels of all patients. The data was analyzed using SPSS.V.24 software with a significance level of 5%.

Results Out of the 59 patients who were assessed, 29 were found to have restless leg syndrome. The mean concentrations of iron, plumbum, cobalt, selenium, cadmium, arsenic, and zinc were 523.98, 32.27, 0.74, 55.40, 1.1, 57.044, and 305.72 µg/l, respectively. All patients had levels of iron and zinc that were below the normal range. The lead and arsenic levels in the blood of all patients were within the normal range. In 72.88% of patients, one patient exhibited a normal cadmium level and showed no signs of foot syndrome, while the remaining patients had elevated cadmium levels. Additionally, 98.30% of the patients had normal cobalt levels, with only one patient displaying higher than normal cobalt levels but no symptoms of foot syndrome, indicating a statistically significant variance. No observations were made with a P-value greater than 0.05. The patients had selenium levels that were lower than normal.

Conclusion This study found that restless leg syndrome is much more common in patients on hemodialysis than in the general population. Many of these patients also have low levels of important nutrients and high levels of harmful substances. These issues can be linked to the changes in these elements and the discomfort the patients' experience. Proper treatment is important to address these problems.

Keywords Restless leg syndrome · Trace elements · Hemodialysis

Introduction

Hemodialysis is the foremost common treatment for ESRD. This strategy includes the dissemination of blood over a semi-permeable film, encouraging the expulsion of undesirable substances from the circulatory system, counting urea, creatinine, and excess water, especially when the kidneys are not working successfully. Schedule hemodialysis is ordinarily conducted for a term of 4 h, three times week by week, for patients with end-stage renal illness (ESRD) who are stable [1]. Hemodialysis has been a lifesaving treatment for millions; in any case, it went by different physical side impacts, counting weariness, rest unsettling influences, and tingling, as well as mental impacts such as discouragement,

✉ Leila Naseri
naseri-l@medilam.ac.ir

¹ Department of Internal Medicine, School of Medicine, Shahid Mostafa Khomaeini Hospital, Ilam University of Medical Sciences, Ilam, Iran

² Department of Dentistry, Ilam University of Medical Sciences, Ilam, Iran

³ Clinical Research Development Unit, Shahid Mostafa Khomeini Hospital, Ilam University of Medical Sciences, Ilam, Iran

⁴ Department of Anatomical Sciences, School of Medicine, Ilam University of Medical Sciences, Ilam, Iran

uneasiness, and impacts on by and large quality of life [1]. Patients enduring from unremitting kidney malady and accepting hemodialysis may be at risk for either a lack or an overabundance of trace elements. The hemodialysis prepares subjects patients to a considerable volume of water, surpassing 120 l per week. Whereas the concentrations of particular particles, counting potassium and calcium, are fastidiously controlled amid dialysis; the levels of various other particles are occasionally evaluated. Consequently, substances present in lower concentrations during dialysis may be eliminated from the body. On the other hand, toxic trace elements found in water, which are absent in the bloodstream, may accumulate and lead to poisoning. Given that essential trace elements are crucial for various biological systems, particularly in immune defense against oxidative stress and infections, it has been proposed that the heightened morbidity and mortality observed in hemodialysis patients may be, in part, attributable to imbalances in trace elements that have yet to be recognized. An afterward exact overview has shown that, compared to sound individuals, hemodialysis patients basically lower blood levels of zinc, manganese, and selenium. However, blood lead levels are likely to build up. Taking other trace elements, such as mercury and arsenic, is naturally a conceivable cause of the overabundance of mortality in dialysis patients [2]. Restless leg syndrome (RLS) may be a common complaint of uremic patients encountering hemodialysis, additionally known as Willis-Ekbom sickness (WED) [3], a common improvement clutter characterized by cumbersome, and in a few cases, troublesome sensations inside the legs with changes day by day and release with improvement, characterized by a wild need to move. The pathophysiology is because it was to some degree caught on, and an innate component with dopaminergic dysregulation and brain pressure plays a crucial role [2, 3]. Inside the common people, the prevalence of RLS shifts between 3% and 9% depending on age and sex, be that it may, the prevalence of RLS in end-stage renal disease (ESRD), which is characterized as enduring hardship of kidney work that requires renal substitution treatment or dialysis (6.6)–70%, is much more than the common people; this clutter is characterized by a wild need to move the legs, the signs of which are fundamentally at night or while resting. Clinical depictions consolidate torment, shivering, creeping, or creeping torment that settle with advancement. RLS has an unfavorable effect on quality of life and can be related with personality clutters such as uneasiness and disheartening [4, 5]. Restless leg syndrome debilitates a person's performance, causes trouble, and has an unsettling influence in work, workout, and family life. Hemodialysis patients persevere from this clutter more than others, and the tall number of hemodialysis patients inside the nation showed that they have to consider related issues, mental prosperity, and quality of life in these patients. In show disdain toward of the nearness of this issue,

there have not been various considers approximately on the cause of the occasion of this wonder in hemodialysis patients compared to other people inside the society. Hence, analyzing the causes of this wonder in hemodialysis patients and giving courses of action to form strides or treat this disorder can contribute to the progression of restorative data and increase the quality and life expectation of this accumulation of patients. Considering that changes inside the level of tris, trace elements are more common in hemodialysis patients, restless leg syndrome is more common in hemodialysis patients. Therefore, in this study, we investigate the level of association between trace elements and restless leg syndrome in dialysis patients.

Materials and Methods

In this analysis, 59 patients, 20 women and 39 men, who were undergoing hemodialysis and had gone to Mustafa Khomeini Clinic in Ilam City in 1400, were investigated. This may be a clear, interpretive, and cross-sectional analysis, which was conducted on all patients (84 people) undergoing hemodialysis treatment at the Hemodialysis Center of Mustafa Khomeini Clinic, Ilam in 1400. The sampling method was census-based, and all patients referred to the hemodialysis center of Mostafa Khomeini Hospital were examined. In this analysis, 25 patients were dodged from the study due to passing, development, non-cooperation, and in dialysis term of less than 3 months. In organizing to accumulate recognitions, a researcher made an overview and laid out three parts: the essential parcel related to measurement characteristics, checking sex, age, term of dialysis treatment, number of dialysis sessions per week, length of each session in hours, and history of crucial diseases. The two-question range of the overview included the widespread study of Pay by Clutter, which included four questions, and a four-point Likert scale was utilized (0 = never, 1 = rarely, 2 = most of the time, and 3 = always) [6] and the patients were apportioned into three bunches. were classified as: nonappearance of restless legs (score less than four), tender degree of restless (score between 4 and 8) and extraordinary irritable leg clutter (score between 8 and 12). The third parcel included the rating scale of irritable leg clutter, which included ten questions and a five-level Likert scale (0 = none, 1 = delicate, 2 = coordinate, 3 = genuine, and 4 = outstandingly extraordinary) was utilized. On a very basic level, the patients were separated into five bunches. Non-appearance of restless leg syndrome (score zero), tender degree of restless (score between 1 and 10), coordinated degree of clutter (score between 11 and 20), extraordinary degree of restless leg syndrome (score between 21 and 30), and outstandingly genuine restless leg syndrome (score between 31 and 40). Sometime recently in filling the survey, the subject of

the infection was clarified by the analyst to be quiet. After that, the levels of trace elements such as press, lead, cobalt, selenium, cadmium, arsenic, and zinc were assessed within the patients. This assessment was done utilizing a nuclear assimilation gadget. It ought to be known that the estimation of these trace elements was done sometime recently by hemodialysis, and 2–5 cm³ of the plasma of these individuals was tested. After checking the blood level of the specified trace elements, at last, the gotten information was entered into the SPSS.V.24 computer program and analyzed, utilizing combined T, Mann–Whitney, and Key two tests. The noteworthiness levels in this were decided at $P > 0.05$.

Results

The relationship between taking trace elements and restless leg syndrome in dialysis patients was examined. The test included 59 steady dialysis patients. The ordinary age of the tested people was 60 a long time with a run of 17 to 96 a long time. Sixty-six percent of the 39 people tested were men and 34% of 20 people were women. Of these, 29 patients (49.2%) met the criteria for restless leg syndrome, after checking, 19 cases (48.7%) of men and 10 cases (50%) of women and 30 patients did not have any side effects of the restless leg syndrome. The disclosures showed that the incidence of the ailment is the same in both sexes, and there was no basic relationship between the two trace elements of sexual introduction and the illness of restless leg syndrome ($P = 0/926$). One hundred percent of patients had iron, and zinc levels were below normal. The level of lead and arsenic within the blood of all patients was ordinary. Of the patients, 72.88% (42 individuals) had lower typical levels of selenium; 23 patients were with syndrome; and 20 patients were without side effects of restless leg syndrome; and 16 patients had typical levels of selenium; 6 patients were with indications of restless leg syndrome; and 10 patients were without indications of this syndrome. Cadmium was standard without side effects of the restless leg syndrome, and the rest of the patients had higher than commonplace cadmium levels; the number of patients in two bunches with and without restless leg syndrome was the same. Of the patients, 98.30% had standard cobalt levels, and the number of patients in two bunches was the same without restless leg syndrome; 1 was determined to have distant better; a much better; a higher; a stronger; an improved > a higher ordinary cobalt level and no signs of restless leg syndrome; and no quantifiably basic refinement was observed ($P > 0.05$). Concurring to the sensitive restless leg overview, 30 patients had no clutter; 19 patients had a tender level of restlessness; and 10 patients had a genuine level of the restless leg syndrome; and concurring to the

Table 1 Investigation of restless legs syndrome according to age

	RLS	N	Mean	Std. Deviation	P-value
Age	Yes	29	62.93	11.202	0.106
	No	30	57.40	15.932	

Table 2 Investigating restless leg syndrome according to age and gender group

			RLS		P-value
			Yes	No	
Age group	< 50	Count	5	8	0.234
		% within age group	38.5%	61.5%	
	50–64	Count	9	13	
		% within age group	40.9%	59.1%	
	> 64	Count	15	9	
		% within age group	62.5%	37.5%	
Gender	Male	Count	19	20	0.926
		% within gender	48.7%	51.3%	
	Female	Count	10	10	
		% within gender	50.0%	50.0%	

rating scale of the restless leg syndrome, 16 patients had no side effects of the restless leg syndrome; 9 patients had a tender level; 21 patients had an ordinary level; 11 patients had extraordinary level; and 2 patients had an uncommonly genuine level of the restless leg syndrome. The normal number of months for the dialysis test was 39 months. Of the patients, 66.10% had tall blood weight; 33.89% had diabetes; and 22% had blood lipids; and none of the hemodialysis patients had a history of COPD, cirrhosis, Parkinson’s, Alzheimer’s, or bipolar.

The average age of people with restless leg syndrome was 62.93 years, and people without this syndrome were 57.4 years old. There is no age difference between the two groups with and without syndrome ($P = 0/106$) (Table 1).

As can be seen, with expanding age, the number of individuals with restless leg syndrome increases, but measurably, there was no critical relationship between age and the predominance of restless leg syndrome ($P = 0.234$) (Table 2).

The mild type of restless leg syndrome according to the international questionnaire of restless leg syndrome is more common in people older than 64 years. The average type of restless leg syndrome based on the rating scale of restless leg syndrome is more at an older age of 64 years.

The discoveries have shown that the dispersion of the illness was the same in both genders (there is no significant relationship between the two variables of gender and restless leg syndrome($P = 0.926$) (Table 2).

According to the international questionnaire, the mild type of restless leg syndrome is more common in men than in women. The average type of restless leg syndrome is more common in men than in women based on the rating scale of restless leg syndrome (Table 2).

One hundred percent of patients had press and zinc levels below the typical. The levels of lead and arsenic within the blood of all patients were typical. Forty-two patients had selenium levels lower than the ordinary. One of the examined patients had ordinary cadmium levels, and the rest of the patients had cadmium levels over the typical. Of the patients, 98.30% had ordinary cobalt levels, and 1 persistent case had higher than the ordinary cobalt levels (Table 3).

In hemodialysis patients with and without restless leg syndrome, the average of Pb, As, Co, Cd, Se, Zn, Fe, and the duration of hemodialysis (months) were investigated, and the results are given in the table. It did not happen ($P > 0.05$) (Table 4) (Diagram 1).

Table 3 Different levels of trace elements in the blood serum of the studied sample

Variables	Analyzable population ($n = 59$)
Iron, $\mu\text{g/l}$	
< 600 decrease	(100%) 59
600–1700 normal	0 (0%)
> = 1700 increase	0 (0%)
Plumbum, $\mu\text{g/l}$	
< 100 normal	(100%) 59
> = 100 increase	0 (0%)
Cobalt, $\mu\text{g/l}$	
< 1.8 normal	58 (30.98%)
> = 1.8 increase	1 (7.1%)
Selenium, $\mu\text{g/l}$	
< 70 decrease	43 (88.72%)
70–150 normal	16 (11.27%)
> = 150 increase	0 (0%)
Cadmium, $\mu\text{g/l}$	
< 0.19 decrease	0 (0%)
0.19–0.39 normal	1 (70.1%)
> = 0.39 increase	58 (30.98%)
Arsenic, $\mu\text{g/l}$	
< 50 decrease	(%) 0 (0%)
50–200 normal	59 (100%)
> = 200 increase	0 (0%)
Zinc, $\mu\text{g/l}$	
< 700 decrease	(100%) 59
700–1250 normal	0 (0%)
> = 1250 increase	0 (0%)

Table 4 Comparison of hemodialysis patients with and without restless leg syndrome according to clinical findings

	Disease	N	Mean	Std. deviation	P
Se	Yes	29	51.056	24.75	0.999
	No	30	59.60	22.78	
Zn	Yes	29	301.37	24.75	0.999
	No	30	309.92	22.78	
Fe	Yes	29	519.50	25.49	0.999
	No	30	528.30	23.46	
Pb	Yes	29	32.28	0.28	0.383
	No	30	32.265	0.44	
As	Yes	29	57.054	0.27	0.383
	No	30	57.035	0.42	
co	Yes	29	0.758	0.32	0.383
	No	30	0.736	0.49	
cd	Yes	29	1.11	0.44	0.383
	No	30	1.089	0.68	
Time_dialysis 30	Yes	0.313	37.70	36.00	29
	No	33.54	42.60	30	
Duration 31	Yes	29	0.351	2.86	0.761

Nineteen patients with restless leg syndrome and 10 patients without syndrome had HTN, and this relationship was not statistically significant ($P > 0.05$) (Table 5).

The mild type of restless leg syndrome according to the International Restless Legs Syndrome Questionnaire is more common in people with HTN.

Ten of the patients with restless leg syndrome and 10 of the people without the syndrome had diabetes, and this relationship was not statistically significant ($P > 0.05$) (Table 5).

The mild type of restless leg syndrome is more common in non-diabetic people based on the international questionnaire of restless leg syndrome. The average type of restless leg syndrome based on the rating scale of restless leg syndrome is more common in non-diabetics (Table 5).

Individuals who experienced dialysis for one to three for a long time had the most elevated number of restless leg syndrome. Patients had the syndrome (14 people) (Table 6).

Eight of the patients with restless leg syndrome and 5 of the people without the syndrome had HLP disease, and this relationship was not statistically significant $P > 0.05$ (Table 6).

The mild type of restless leg syndrome based on the international questionnaire of restless leg syndrome is more common in people who did not have HLP disease. The average type of restless leg syndrome according to the rating scale of restless leg syndrome is higher in people who did not have HLP disease.

NL: Nondeterministic Logarithmic-space, Yes: Restless legs syndrome, No: No restless legs syndrome.

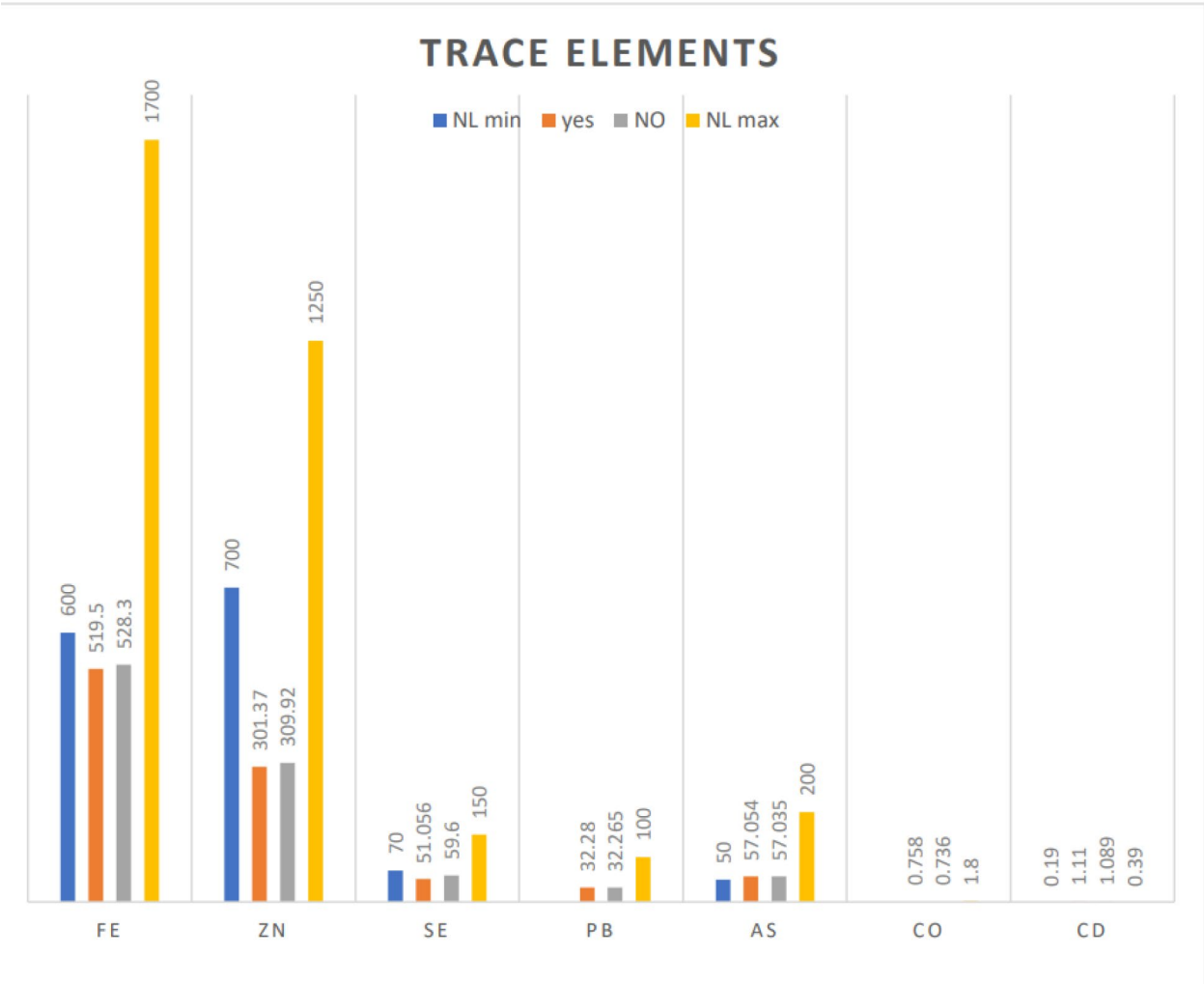


Diagram 1 Investigating the relationship between restless leg syndrome and trace element levels. *NL* non-deterministic logarithmic-space, *Yes* restless leg syndrome, *No* no restless leg syndrome

Two patients with restless leg syndrome and 4 patients without syndrome had thyroid disease (Table 6).

The mild type of restless leg syndrome based on the international questionnaire of restless leg syndrome is more common in non-thyroid people. The moderate type of restless leg syndrome according to the rating scale of restless leg syndrome is more common in non-thyroid people.

Two of the patients with restless leg syndrome and 1 of the people without the syndrome had depression (Table 6).

The mild type of restless leg syndrome is more common in non-depressed people based on the international questionnaire of restless leg syndrome.

The moderate type of restless leg syndrome according to the rating scale of restless leg syndrome is more common in non-depressed people.

Two patients with restless leg syndrome and 3 patients without the syndrome had CVA (Table 6).

The mild type of restless leg syndrome according to the International Restless Leg Syndrome Questionnaire is more common in people without CVA. The moderate type of restless leg syndrome according to the rating scale of restless leg syndrome is more common in non-CVA subjects.

None of the hemodialysis patients had a history of COPD, cirrhosis, Parkinson's, Alzheimer's, or bipolar.

Table 5 Investigating the relationship between restless leg syndrome and high blood pressure and diabetes.

			Disease		<i>P</i>
			YES	NO	
HTN	YES	Count	19	20	0.926
		% within HTN	48.7%	51.3%	
	NO	Count	10	10	
		% within HTN	50.0%	50.0%	
	Total	Count	29	30	
		% within HTN	49.2%	50.8%	
Diabetic		Count	10	10	0.926
		% within Diabetic	50.0%	50.0%	
		Count	19	20	
		Count	29	30	
		% within Diabetic	49.2%	50.8%	

Discussion

This descriptive-analytical, cross-sectional study was conducted on chronic hemodialysis patients referred to the Hemodialysis Department of Shahid Mostafa Khomeini Hospital in Ilam in 2011. The foremost reason of this analysis is to look at the relationship between restless leg syndrome and the level of trace elements in hemodialysis patients.

In this analysis, 20 female patients and 39 male patients were reviewed and evaluated. The foremost reason of this think around is to see the relationship between restless leg syndrome and the level of trace elements in hemodialysis patients. In this analysis, 20 female patients and 39 male patients were surveyed and assessed. The revelations showed that the incidence of the sickness is the same in both sexual orientations, and there is no essential relationship between the two trace elements of sex and restless leg syndrome. In the study of Lin et al., it was found that ESRD patients who are ladies and expend on liquor are revealed to there is distant better;a much better;a higher;a stronger;an improved"> a much better danger for RLS, which is not solid with our analysis [5]. In 2017, the prevalence of restless leg syndrome in patients encountering hemodialysis was inspected in the study of Reza Qanei Qashaleq et al., utilizing an exact meta-analysis, which showed that the prevalence of this clutter was 50% in Iran and 30% in all inclusive databases based on the articles found. It is steady with our analysis [7]. The normal age of the tested individuals was 60 with a run of 17 to 96 in a long period of time. The normal age of individuals with restless leg syndrome was 62.93 in a long time period, and individuals without this syndrome was 57.4 a long time ago. There is no contrast in age between the two bunches with and without the syndrome. Moreover, the outcome of the study showed that with expanding age, the predominance

restless leg syndrome increases, but there was no factually critical relationship between age and the predominance of fretful leg syndrome. The study of Rohani et al., which was conducted in 2015, examined the recurrence of RLS and its related variables in persistent kidney problem, and was such a disappointment to patients treated with hemodialysis. The normal age gathered within the RLS (65.2 ± 9.3) was essentially distinctive from those without restless leg syndrome (59.0 ± 14.7 ; $P = 0.004$) which was higher and not steady in our analysis. In Lin's study, the reason for the increased incidence of this disease in women was stated The high level of estrogen during pregnancy could trigger RLS.[8] In the study, based on the restless leg syndrome survey, 30 patients had no syndrome; 19 patients had a gentle level of the syndrome; and 10 patients had a serious level of the restless leg syndrome; and based on the rating scale of the restless legs syndrome, 16 patients had no side effects of the syndrome; 9 patients had a gentle level; and 21 patients had a tall level of the syndrome. Normally, 11 patients had a serious level of restless leg syndrome; and 2 patients had exceptionally extreme level of restless leg syndrome. The normal values of press, plumbum, cobalt, selenium, cadmium, arsenic, and zinc were 523.98, 32.27, 0.74, 55.40, 1.1, 57.044, and 305.72 $\mu\text{g/l}$, separately, and the normal values in two bunches of individuals with fretful leg syndrome and individuals without syndrome were nearly breakeven. No genuinely basic difference was observed. In the study, all patients had press levels lower than the conventional, which was not genuinely basic, and it is in line with the study of Allen in 2015 [9]. In the study, all patients had zinc levels lower than the typical, which was not truthfully basic and was not consistent with the study of Chen et al. [10]. In the analysis, 72.88% of patients (42 individuals) had lower than the typical levels of selenium; 23 patients were with syndrome; 20 patients were without side effects of the restless leg syndrome; 16 patients were with ordinary levels of selenium; 6 patients with side effects of the restless leg syndrome; and 10 patients were without side effects of this syndrome, which may be a measurably critical distinction. This was not observed and was not reliable in the study of Jiménez et al. [11]. In our analysis, one of the inspected patients had an ordinary cadmium level without indications of restless leg syndrome, and the rest of the patients had a better than ordinary cadmium level; and the number of patients within the two bunches with and without restless leg syndrome was the same. In Jiménez et al.'s study, none of the subjects had cadmium levels higher than the typical, which was not steady with analysis [11]. In the study, all patients had ordinary levels of lead and arsenic, and 98.30% of patients had ordinary levels of cobalt; the number of individuals in two bunches with and without restless legs syndrome was the same; 1 persistent case had a better level of ordinary cobalt and no

Table 6 Investigating the relationship between restless legs syndrome and years under dialysis, high blood pressure (HLP), thyroid, depression, and stroke (CVA)

			Disease		Total
			YES	NO	
Time dialysis 32	< 1	Count	6	5	11
		% within Time_ dialysis	55.4%	45.5%	100.0%
	1–3	Count	14		25
		% within Time_ dialysis	56.0%	100.0%	
	3–10	Count	7	11	18
		% within Time_ dialysis	38.9%	61.1%	100.0%
	> 10	Count	2	3	5
		% within Time_ dialysis	40.0%	60.0%	100.0%
	Total	Count	29	30	59
		% within Time_ dialysis	49.2%	50.8%	100.0%
HLP	YES	Count	8	5	0.312
		% within HLP	61.5%	38.5%	
	NO	Count	21	25	
		% within HLP	45.7%	54.3%	
	Total	Count	29	30	59
		% within HLP	49.2%	50.8%	100.0%
Thyroid	YES	Count	2	4	6
		% within thyroid	33.3%	66.7%	100.0%
	NO	Count	27	26	53
		% within Thyroid	50.9%	49.1%	100.0%
	Total	Count	29	30	59
		% within thyroid	49.2%	50.8%	100.0%
Depression	YES	Count	2	1	3
		% within depression	66.7%	33.3%	100.0%
	NO	Count	27	29	56
		% within depression	48.2%	51.8%	100.0%
	Total	Count	29	30	59
		% within depression	49.2%	50.8%	100.0%
CVA	YES	Count	2	3	5
		% within CVA	40.0%	60.0%	100.0%
	NO	Count	27	27	54
		% within CVA	50.0%	50.0%	100.0%
	Total	Count	29	30	59
		% within CVA	49.2%	50.8%	100.0%

indications of the restless leg syndrome, which could be a measurably noteworthy contrast not observed. Nineteen of the patients with restless leg syndrome and 10 of the individuals without the syndrome had HTN, and the normal sort of restless leg syndrome agreeing to the rating scale of restless leg syndrome was higher in individuals with HTN; and this relationship was not measurably critical. In the study by Araujo et al. in 2015, which was conducted with the point of examining the clinical trace elements related to RLS in ESRD patients experiencing hemodialysis, it was

found that tall blood weight is related with moderate/severe RLS, which is steady with our analysis [12]. Ten of the patients with restless leg syndrome and 10 of the individuals without the syndrome had diabetes, and this relationship was not measurably noteworthy. In the study of Rafie et al. in 2016, which was conducted with the point of deciding the predominance and chance variables of RLS, it was found that diabetic patients may have suffered 2.25 times more than non-diabetic individuals from RLS, which was not reliable with our analysis [13].

Conclusion

According to the findings of this study, it can be concluded that the prevalence of restless leg syndrome in hemodialysis patients is much higher than in the general population, and most of these patients have a deficiency of essential elements and an excessive increase of toxic elements, which can be considered. These cases and proper treatment are among the complications caused by the change in the level of elements and discomfort of patients.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s42399-025-01952-x>

Authors' Contributions L.N and M.R were primarily responsible for the conceptualization and design of the study, data collection, and initial drafting of the manuscript. M.R contributed to the data analysis, interpretation of the results, and critically revised the manuscript for intellectual content. E.A Kow provided oversight of the study, contributed to the methodology, supervised the data analysis, and was involved in the critical review and final approval of the manuscript. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Funding It has not received any financial support.

Data Availability The data that support the findings of this study are available from the corresponding author, Leila naseri, upon reasonable request. Due to the sensitive nature of the patient data, access to the data will be provided in accordance with ethical guidelines and institutional policies to ensure the confidentiality and privacy of the participants are maintained.

Code Availability Not applicable.

Declarations

Ethics Approval This study has the ethics code IR.MEDILAM.REC.1400.160.

Consent to Participate Written consent was obtained from the patients, and they were free to participate in the study and withdraw from it at any time.

Written Consent for Publication Written consent was obtained from patients for publication of data without mentioning their names or characteristics.

Competing interest The authors declare no competing interests.

References

1. Bouya S, Ahmadidarehsima S, Badakhsh M, Balouchi A. Effect of aromatherapy interventions on hemodialysis complications: a systematic review. *Complement Ther Clin Pract*. 2018;32:130–8.
2. Takaki J, Nishi T, Nangaku M, Shimoyama H, Inada T, Matsuyama N, et al. Clinical and psychological aspects of restless legs syndrome in uremic patients on hemodialysis. *Am J Kidney Dis*. 2003;41(4):833–9.
3. Klingelhofer L, Bhattacharya K, Reichmann H. Restless legs syndrome. *Clin Med*. 2016;16(4):379–82.
4. Scherer JS, Combs SA, Brennan F. Sleep disorders, restless legs syndrome, and uremic pruritus: diagnosis and treatment of common symptoms in dialysis patients. *Am J Kidney Dis*. 2017;69(1):117–28.
5. Lin X-W, Zhang J-F, Qiu M-Y, Ni L-Y, Yu H-L, Kuo S-H, et al. Restless legs syndrome in end stage renal disease patients undergoing hemodialysis. *BMC Neurol*. 2019;19:1–7.
6. Group IRLSS. Validation of the international restless legs syndrome study group rating scale for restless legs syndrome. *Sleep medicine*. 2003;4(2):121–32.
7. Gheshlagh RG, Farajzadeh M, Zarei M, Baghi V, Dalvand S, Sayehmiri K. The prevalence of restless legs syndrome in patients undergoing hemodialysis: a systematic review and meta-analysis study. *Basic Clin Neurosci*. 2017;8(2):105.
8. Rohani M, Aghaei M, Jenabi A, Yazdanfar S, Mousavi D, Miri S. Restless legs syndrome in hemodialysis patients in Iran. *Neurol Sci*. 2015;36:723–7.
9. Allen RP. Restless leg syndrome/Willis-Ekbom disease pathophysiology. *Sleep Med Clin*. 2015;10(3):207–14.
10. Chen P, Bornhorst J, Patton S, Bagai K, Nitin R, Miah M, et al. A potential role for zinc in restless legs syndrome. *Sleep*. 2021;44(4):zsaa236.
11. Jiménez-Jiménez FJ, Ayuso P, Alonso-Navarro H, Calleja M, Díez-Fairén M, Álvarez I, et al. Serum trace elements concentrations in patients with restless legs syndrome. *Antioxidants*. 2022;11(2): 272.
12. Araujo SMHA, de Bruin VMS, Nepomuceno LA, Maximo ML, de Francesco DE, Ferrer DPC, et al. Restless legs syndrome in end-stage renal disease: clinical characteristics and associated comorbidities. *Sleep Med*. 2010;11(8):785–90.
13. Rafie S, Jafari M, Azizi M, Bahadoram M, Jafari S. Restless legs syndrome in hemodialysis patients. *Saudi J Kidney Dis Transplant*. 2016;27(2):326–30.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.