

Current status of hemodialysis in Iraq

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ABSTRACT

Background: The progressive and permanent damage associated with chronic kidney disease (CKD) makes it a major global health concern. Hemodialysis (HD) is a vital renal replacement therapy; however, its prevalence and adequacy remain understudied in Iraq. **Aim:** This study aims to assess the current situation of HD in Iraq, focusing on the prevalence and causes of CKD. **Patients and Methods:** This cross-sectional study included all Iraqi cities and examined patients receiving HD from January 1 to December 31, 2023. Data was collected through a structured questionnaire at governorate centers across Iraq. **Results:** A total of 10,721 HD patients from various regions of Iraq were included in the study, revealing a male-to-female ratio of 1.27:1. Baghdad had the highest patient population undergoing HD (27.0%), followed by Basra (10.5%), Karbala (8.1%), Erbil (6.4%), Dohuk (3.2%), Salah-al-Din (2.0%), Anbar (4.4%), Diyala (4.5%), Wasit (3.6%), Najaf (2.8%), Maysan (3.2%), Al-Muthanna (2.3%), Nasiriyah (3.9%), Ninawa (6.2%), Kerkuk (3.8%), Babil (4.1%), and Diwaniyah (2.2%). Sulaymaniyah had the least number of patients undergoing HD (1.8%). A total of 7,918 (73.9%) were married, comprising 4,234 (39.49%) males and 3,684 (34.36%) females. Meanwhile, 2,803 (26.1%) were single, comprising 1,762 (16.44%) males and 1,041 (9.71%) females. A total of 7,695 (71.8%) patients received two HD sessions each week, comprising 4,378 (40.84%) males and 3,317 (30.94%) females. A total of 3,026 (28.2%) had three sessions per week, comprising 1,618 (15.09%) males and 1,408 (13.13%) females. Assessment of the etiological factors leading to renal disease among patients undergoing HD revealed that 3,467 (32.3%) patients had diabetes mellitus. Among them, 1,834 (17.1%) were males and 1,633 (15.2%) were females. Patients with hypertension comprised 4,317 (40.3%) individuals—2,389 (22.3%) males and 1,928 (18%) females. A total of 271 (2.6%) patients had polycystic kidney disease—125 (1.2%) males and 146 (1.4%) females. Glomerulonephritis was identified in 164 (1.5%) patients—88 (0.8%) males and 76 (0.7%) females. Patients with other etiological factors contributing to kidney disease totaled 2,502 (23.3%)—1,560 (14.6%) males and 942 (8.8%) females. **Conclusion:** The study underscores the burden of end-stage renal disease (ESRD) in Iraq and emphasizes the critical need for access to renal replacement therapies. Regional disparities in HD prevalence call for targeted interventions to address healthcare infrastructure, disease management, and awareness. Additionally, gender-related differences in CKD risk factors and management warrant further investigation to enhance patient outcomes and resource allocation.

Keywords: hemodialysis (HD), CKD, Iraq.

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INTRODUCTION

Chronic kidney disease (CKD) is a clinical condition characterized by persistent changes in kidney function and/or structure, marked by its irreversible and gradual progression over time. CKD is associated with elevated

risks of complications and mortality, particularly cardiovascular complications.^{1,2} Diagnosis of CKD in adults requires the presence of specific criteria for at least three months.³

- Either a glomerular filtration rate (GFR) lower than 60 ml/min/1.73 m² or
- A GFR higher than 60 ml/min/1.73 m² accompanied by evidence of renal structural damage.

Indicators of renal injury may include albuminuria, abnormalities in renal imaging, hematuria/leukocyturia, persistent electrolyte imbalances, histological changes observed in renal biopsy, and a history of kidney transplantation.^{4,5}

Albuminuria is defined as the presence of more than 30 mg of albumin in a 24-hour urine sample or more than 30 mg/g of albumin in a spot urine sample adjusted for urinary creatinine.⁶

Prolonged use of non-steroidal anti-inflammatory drugs (NSAIDs), autoimmune diseases, polycystic kidney disease, Alport syndrome, hypertension (HT), diabetes, chronic glomerulonephritis, chronic pyelonephritis, prolonged periods of acute kidney injury, and congenital abnormalities are some of the common causes of chronic kidney disease (CKD).¹

Renal Replacement Therapy

Renal replacement therapy (RRT) provides crucial support for patients experiencing acute or chronic renal failure and can be administered intermittently or continuously through extracorporeal methods such as hemodialysis (HD) or para-corporeal methods like peritoneal dialysis. The selection of RRT modalities depends on individual patient needs, the severity of renal failure, and other medical considerations. By providing timely and appropriate RRT, healthcare providers aim to mitigate the impact of renal failure on patients' overall health and quality of life.⁷

Hemodialysis

HD has revolutionized patient care by enabling survival for more than a million individuals worldwide suffering from end-stage renal disease (ESRD), where kidney function is severely impaired or absent. Its evolution from a short-term treatment to a long-term RRT has significantly impacted nephrology and led to the emergence of a distinct field within medical science, often referred to as the physiology of the artificial kidney.⁸

Dialysis Mechanism and Goals

Dialysis involves the diffusion of molecules across a semi-permeable membrane driven by variances in concentration and electrical charge. In HD, the primary

goal is to restore the equilibrium of fluids between the intra and extracellular compartments, mimicking the natural function of the kidneys. This is accomplished by transferring substances such as urea from the blood into the dialysate and bicarbonate from the dialysate into the blood. The rate of diffusion is chiefly influenced by the concentration and size of solute particles. Ultrafiltration, on the other hand, primarily aims to remove excess total body water without affecting solute concentrations^(9,10)

Prevalence of Hemodialysis in Iraq

In 2011, a study by Al-Saedy et al. reported the prevalence of HD in Baghdad as 64 patients per million population (pmp). The study attributed the low number of patients on HD to a shortage of HD machines and the need for more educational programs for the public and the medical staff.¹¹

In January 2012, Majeed et al. reported the prevalence of patients with ESRD on regular HD in Iraq to be 2,445 (74 patients/million), with the highest number of patients in Baghdad being 24.25%. This was higher than that of the previous years, suggesting that the introduction of more dialysis stations led to an increase in the number of patients receiving HD in Iraq.¹²

The prevalence of ESRD in Sulaimani was reported as 0.01% (155.7 pmp), with the majority of patients being older than 50 years. Diabetes was identified as the commonest cause.¹³

Since 2012, extensive literature reviews have assessed the nutritional status and the prevalence of hepatitis and human immune deficiency virus among patients with ESRD on HD.¹⁴⁻¹⁷ However, none of these were directed to assess the overall prevalence of HD in Iraq.

Dialysis Complications

Mortality rates are notably elevated among patients undergoing dialysis, particularly in the first three months after starting HD treatment. In high-income countries (HICs), approximately one-quarter of patients on HD die within a year of beginning therapy, with even higher rates observed in low- and middle-income countries (LMICs). Despite advancements in treatment, mortality remains alarmingly high among dialysis patients, primarily due to cardiovascular events and infections.

Depression is also prevalent among this population, exacerbated by factors, such as high pill burden, the necessity of traveling to dialysis sessions, and the discomfort associated with vascular access puncture.^{18,19}

Compared to the overall population, dialysis patients experience significantly higher rates of hospitalization, unemployment, and less independent lifestyles.^{20,21}

While there have been modest improvements in mortality rates for dialysis patients over time, their health-related quality of life has remained unchanged in the past two decades and is notably lower than that of the general population. This is largely due to the considerable burden of symptoms experienced by dialysis patients.^{22,23}

MATERIALS AND METHODS

Study Design

A cross-sectional study was conducted in all cities of Iraq from January 1 to December 31, 2023.

Study Population

The study population included all patients who underwent HD in Iraq during the specified period.

Inclusion Criteria

All adult patients with ESRD who underwent HD in all cities of Iraq.

Exclusion Criteria

Patients who underwent peritoneal dialysis or continuous renal replacement therapy (CRRT) were excluded from this study.

Data Collection and Questionnaire

Data were collected using a semi-structured, pre-prepared questionnaire designed by the authors after an extensive literature review based on previously published studies. The questionnaire underwent further analysis, revision, and editing based on feedback from a consultant specialist.

The data were filled in using the reported information to the governorate centers in each city of Iraq.

The collected information included:

1. Age
2. Gender
3. Marital status
4. HD sessions/week
5. Anthropometric measures
6. Etiology of the disease
7. Biochemical parameters.

Statistical Analysis

Before entry, data were cleaned and checked for any missing values. The data were entered into a Microsoft Excel sheet and exported to SPSS version 26 statistical software for analysis. Descriptive analysis was done to process the data, including frequency distribution and

percentages for qualitative data, and means and standard deviations (SDs) for quantitative data. Categorical variables were analyzed using chi-square tests, while continuous variables were analyzed using t-tests when needed. A p-value of < 0.05 was accepted as statistically significant in all tests.

RESULTS

Descriptive Analysis

Prevalence of Hemodialysis in 2023, Iraq

Table 1 presents a comprehensive breakdown of the demographic and geographical data for patients who underwent HD in 2023 across various regions of Iraq. The total number of patients who underwent HD in all cities of Iraq that year was 10,721. There were 4,725 (44.1%) female patients and 5,996 (55.9%) male patients, resulting in a male-to-female ratio of approximately 1.27:1. The mean age for all participants was (52.27 ± 12.9) years. Male patients had a slightly lower mean age of (50.43 ± 12.4) years, while female patients had a slightly higher mean age of (54.12 ± 13.4) years. Participants were distributed across various regions of Iraq, with the largest patient population that underwent HD in Baghdad (2,900 patients, 27.0%), followed by Basra (1,125 patients, 10.5%) and Karbala (866 patients, 8.1%). Conversely, Sulaymaniyah had the smallest number of patients undergoing HD (190, 1.8%). Other regions, such as Erbil (690 patients, 6.4%), Dohuk (339 patients), Salah-al-din (218 patients, 2.0%), Anbar (475 patients, 4.4%), Diyala (479 patients, 4.5%), Wasit (387 patients, 3.6%), Najaf (300 patients, 2.8%), Maysan (340 patients, 3.2%), Al-Muthanna (244 patients, 2.3%), Nasiriyah (421 patients, 3.9%), Ninawa (660 patients, 6.2%), Kerkuk (403 patients, 3.8%), Babil (444 patients, 4.1%), and Diwaniyah (240 patients, 2.2%) showed varying patient numbers.

Regarding marital status, 7,918 (73.9%) were married. Of these, 4,234 (39.49%) were males and 3,684 (34.36%) were females. Meanwhile, 2,803 patients (26.1%) were single. Of these, 1,762 (16.44%) were males and 1,041 (9.71%) were females as shown in the Figure 1.

Hemodialysis Sessions/Week

Concerning the number of HD sessions per week, 3,317 (30.94%) of the participants were males and 4,378 (40.84%) were females. A total of 7,695 (71.8%) participants had two sessions each week.

Meanwhile, 3,026 (28.2%) had three sessions per week. Of these, 1,618 (15.09%) were males and 1,408 (13.13%) were females as shown in Figure 2

Etiology of ESRD among the Patients

Assessment of the etiological factors leading to renal disease among male and female patients undergoing HD showed that a total of 3,467 (32.3%) patients were diagnosed with diabetes mellitus (DM). Of these, 1,834 (17.1%) were males and 1,633 (15.2%) were females. Meanwhile, patients with hypertension (primary HT) comprised 4,317 (40.3%) individuals. Of these, 2,389 (22.3%) were males and 1,928 (18%) were females. Patients with polycystic kidney disease were 271 (2.6%)

in number, comprising 125 (1.2%) males and 146 (1.4%) females. Glomerulonephritis was identified in 164 (1.5%) of patients, comprising 88 (0.8%) males and 76 (0.7%) females. Patients with other etiological factors contributing to kidney disease were 2,502 (23.3%), comprising 1,560 (14.6%) males and 942 (8.8%) females.

Inferential Analysis

The association between the number of sessions per week and gender were statistically significant, with a p-value of 0.001, as shown in Table 3 below. Likewise, the association between gender with marital status showed a statistically significant difference, with a p-value of 0.001, as shown in Table 5.

Table 1: Demographic and regional composition of the patients who underwent hemodialysis (HD) in 2023 across various regions of Iraq.

			Gender		Total
			Male	Female	
Age	Mean ± SD		50.43 ± 12.4	54.12 ± 13.4	52.27 ± 12.9
Iraqi Governorate	Baghdad	Fr	1,769	1,131	2,900
		%	16.5%	10.5%	27.0%
	Erbil	Fr	379	311	690
		%	3.5%	2.9%	6.4%
	Sulaymaniyah	Fr	89	101	190
		%	0.8%	0.9%	1.8%
	Dohuk	Fr	198	141	339
		%	1.8%	1.3%	3.2%
	Salah-al-din	Fr	111	107	218
		%	1.0%	1.0%	2.0%
	Anbar	Fr	294	181	475
		%	2.7%	1.7%	4.4%
	Diyala	Fr	192	287	479
		%	1.8%	2.7%	4.5%
	Wasit	Fr	221	166	387
		%	2.1%	1.5%	3.6%
	Najaf	Fr	183	117	300
		%	1.7%	1.1%	2.8%
	Karbala	Fr	454	412	866
		%	4.2%	3.8%	8.1%
	Maysan	Fr	208	132	340
		%	1.9%	1.2%	3.2%
	Al-Muthanna	Fr	143	101	244
		%	1.3%	0.9%	2.3%
	Nasiriyah	Fr	259	162	421
		%	2.4%	1.5%	3.9%
	Basra	Fr	642	483	1,125
		%	6.0%	4.5%	10.5%
	Ninawa	Fr	322	338	660
		%	3.0%	3.2%	6.2%
Kerkuk	Fr	211	192	403	
	%	2.0%	1.8%	3.8%	
Babil	Fr	198	246	444	
	%	1.8%	2.3%	4.1%	
Diwaniyah	Fr	123	117	240	
	%	1.1%	1.1%	2.2%	
Total	Fr	5,996	4,725	10,721	
	%	55.9%	44.1%	100%	

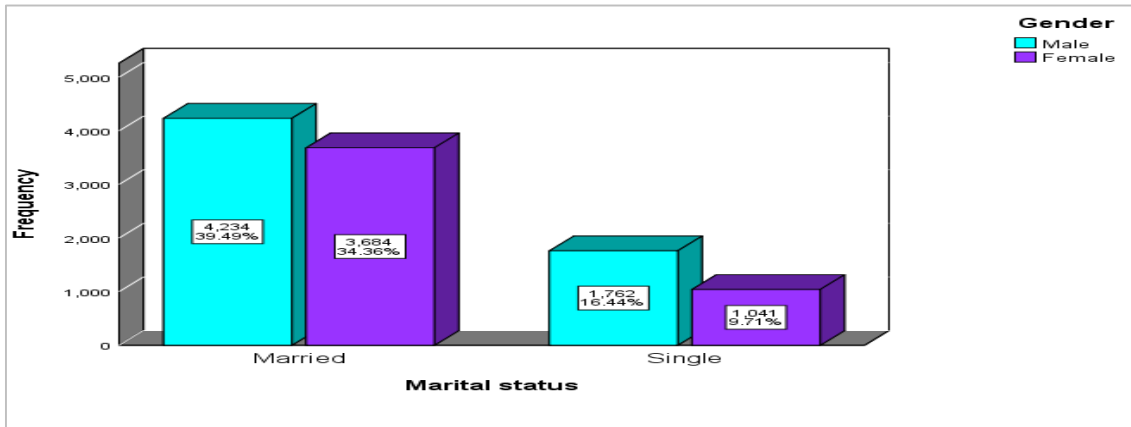


Figure 1: Marital status for patients undergoing HD in Iraq.

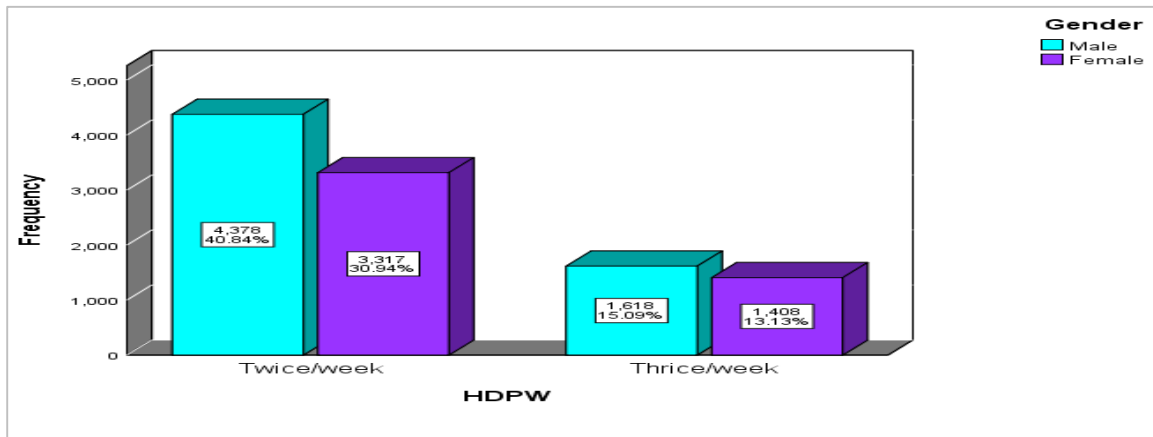


Figure 2: Number of hemodialysis sessions/week for patients who underwent HD in 2023, Iraq.

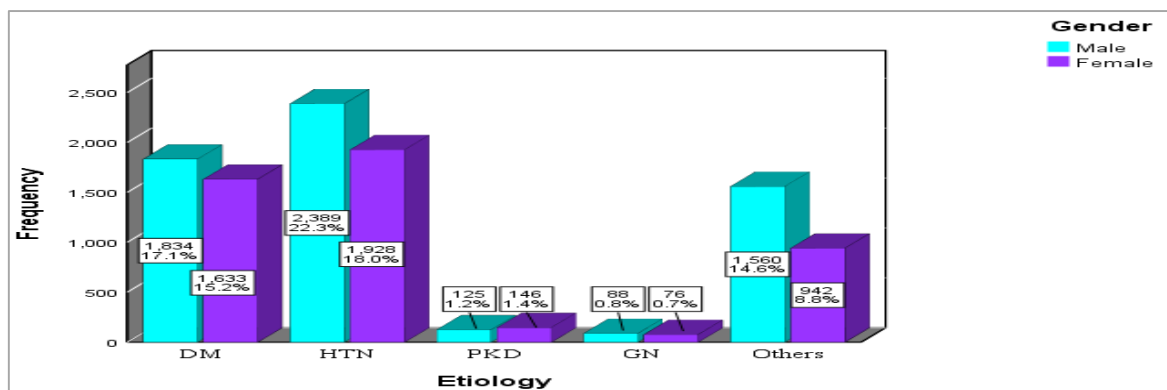


Figure 3: Etiology of ESRD for patients who underwent HD in 2023, Iraq.

Table 2: The association of gender with the etiology of kidney disease among patients who underwent HD in 2023, Iraq.

			Gender		Total	Pearson chi-square	P-value
			Male	Female			
Etiology	Diabetes mellitus	Fr	1,834	1,633	3,467	66.28	0.001
		%	17.1%	15.2%	32.3%		
	Hypertension (Primary HT)	Fr	2,389	1,928	4,317		
		%	22.3%	18.0%	40.3%		
	Polycystic kidney disease	Fr	125	146	271		
		%	1.2%	1.4%	2.5%		
	Glomerulonephritis	Fr	88	76	164		
		%	0.8%	0.7%	1.5%		
	Others	Fr	1560	942	2,502		
		%	14.6%	8.8%	23.3%		
	Total	Fr	5,996	4,725	10,721		
		%	55.9%	44.1%	100.0%		

Table 3: The association of the number of HD sessions/week with gender for patients who underwent HD in 2023, Iraq.

			Gender		Total	Pearson Chi-square	P-value	Odds Ratio
			Male	Female				
HDPW	Twice/Week	Fr	4,378	3,317	7,695	10.331	0.001	1.25
		%	40.8%	30.9%	71.8%			
	Thrice/Week	Fr	1618	1,408	3,026			
		%	15.1%	13.1%	28.2%			
	Total	Fr	5,996	4,725	10,721			
		%	55.9%	44.1%	100.0%			

Table 4: The association of gender with biochemical parameters of patients who underwent HD in 2023, Iraq.

	Gender	Mean	Std. deviation	Std. error mean	T-test	P-value
Cholesterol level	Male	195.3	18.245	.23563	24.8	0.001
	Female	210.7	39.557	.57547		
Albumin level	Male	3.32	.435	.00562	11.7	0.001
	Female	3.49	.918	.01336		
S. Creatinin	Male	8.88	2.579	.03331	34.02	0.001
	Female	7.20	2.513	.03657		
Pre-dialysis B. urea	Male	182.83	42.672	.55108	0.71	0.476
	Female	182.13	55.768	.81132		
S. Ca level	Male	7.27	2.104	.02718	116.41	0.001
	Female	7.09	1.892	.02753		
HCT level	Male	27.18	5.071	.06550	7.37	0.001
	Female	27.99	6.083	.08850		

Table 5: The association of gender with marital status for patients who underwent HD in 2023, Iraq.

			Gender		Total	Pearson chi-square	P-value
			Male	Female			
Marital status	Married	Fr	4,234	3684	7,918	74.02	0.001
		%	39.5%	34.4%	73.9%		
	Single	Fr	1762	1041	2803		
		%	16.4%	9.7%	26.1%		
Total		Fr	5,996	4,725	10721		
		%	55.9%	44.1%	100.0%		

DISCUSSION

This study sheds light on the burden of ESRD in Iraq, emphasizing the critical need for access to RRTs in the country. Notably, this is a nationwide study that evaluates the prevalence of HD and ESRD in this area for the first time.

In 2023, Iraq recorded a total of 10,721 patients undergoing HD, with an estimated population of 45.5 million, resulting in a prevalence rate of 235.6 pmp.

Iraq's prevalence rate of ESRD is notably lower compared to its neighboring countries. For instance, Jordan reported a prevalence rate of 709 pmp in 2021,²³ while Saudi Arabia in 2017 and Kuwait in 2021 showed rates of 802 pmp and 474 pmp, respectively.^{24,25}

One factor contributing to the lower rate of HD in Iraq is not the cost, as it is free of charge in our country, but the rate of access to unrelated kidney transplants is high compared to surrounding countries.

Lebanon exhibited a higher prevalence of 875 pmp in 2021 in a study that involved all its cities,²⁶ while Egypt reported a rate of 710 pmp in Alexandria.²⁷ In Iran, Hamadan province reported a prevalence rate of 284.²⁸

The global prevalence of HD varies significantly across different regions, depending on the prevalence of ESRD, which reflects differences in the incidence and prevalence of DM, HT, and other ESRD causes, healthcare infrastructure, access to treatment, and disease management practices.

In the Philippines, the reported prevalence of ESRD stands at 230 pmp.²⁹ Europe has also experienced an increase in the prevalence of ESRD, with the latest data from the ISN-GKHA (Global Kidney Health Atlas) showing a prevalence of 873.5 pmp in 2023.^{30,31}

This suggests a growing burden of kidney disease in the region, possibly due to factors, such as aging populations, changes in lifestyle habits, and improved detection and diagnosis of kidney-related conditions.

Countries like Taiwan, Japan, and the USA report some of the highest incidences of treated end-stage kidney disease (ESKD), with incidences ranging from 2,196 to 3392 pmp/year.^{29,32,33} These nations typically have well-established healthcare systems and robust infrastructure for managing chronic conditions like ESRD, leading to higher rates of treatment utilization. In contrast, South Africa, Belarus, Bangladesh, Russia, Peru, Colombia, Albania, and Estonia reported the lowest treated ESRD occurrences, ranging from 22 to 85 pmp/year.³⁴

The lower prevalence of HD among Iraqi patients could be attributed to limited healthcare infrastructure and

resources dedicated to managing chronic diseases like ESRD. This may result in fewer facilities equipped to provide HD services and lower access to specialized care for kidney patients. Additionally, lower awareness about kidney disease and limited screening programs for early detection in Iraq may contribute to this issue. Without adequate awareness and screening, many individuals with kidney disease may remain undiagnosed until they reach advanced stages, reducing the reported prevalence. Economic challenges in Iraq could also impact access to healthcare services, including HD. Financial barriers may prevent individuals from seeking regular dialysis treatment or accessing necessary medications and follow-up care, leading to underreporting of HD cases. Discrepancies in data collection and reporting methodologies between countries could influence the reported prevalence rates of HD. Variations in healthcare systems, data collection practices, and reporting standards may result in differences in the accuracy and completeness of ESRD data.

In 2023, Baghdad accounted for 27% of all patients undergoing HD, making it the most populous city with an approximate population size of 7 million. The prevalence of HD in Baghdad was 414.29 pmp. The prevalence of HD in Baghdad in 2011 was reported to be 64 pmp according to the Al-Saedy study,¹¹ demonstrating a significant increase in the use of HD services throughout time. Increases in the recognition and prevalence of diseases like diabetes and HT, which can lead to ESRD, as well as other factors, could account for this rise. Al-Saedy et al. (2011) estimated that the population was five million in 2011. This may suggest improvements in healthcare infrastructure, better access to medical facilities, and increased awareness of kidney-related conditions and treatment options among the population.

According to this study,¹² there was a significant increase in the number of HD sessions in Basra from 73 individuals in 2012 to 1,125 patients in 2023. This increase was attributed to the opening of new HD facilities and an increase in confirmed cases requiring HD. It could also be due to improvements in the recording and reporting system for cases undergoing HD since 2012.

There was a considerable discrepancy between different cities in Iraq in reported cases undergoing HD. Variation in prevalence among different cities could be due to higher population densities in some cities, leading to a larger number of individuals with ESRD requiring HD.

Disparities in healthcare infrastructure and resources among cities can impact the availability and accessibility of HD services.

Certain cities may have higher rates of risk factors like obesity, diabetes, and HT that are linked to chronic kidney failure (CKD). Differences in healthcare awareness and education programs across cities can influence the early detection and management of CKD. The gender distribution of patients undergoing HD in Iraq, as observed in this study, reveals a male-to-female ratio of approximately 1.27:1. This result aligns with earlier research by Majeed et al. (2012) (12), which similarly found a male-to-female ratio of 1.28:1 and a slightly greater prevalence of ESRD among males. Moreover, a study conducted in Baghdad by Al-Saedy et al. showed a similar trend, with a male-to-female ratio of 1.7.¹¹

Interestingly, this gender disparity in HD prevalence is not unique to Iraq. Studies conducted in other countries, such as Jordan, Australia, China, and various European countries, have consistently demonstrated that men are more likely than women to require RRT. For instance, in Jordan, men were found to have a higher rate of RRT than women, with a male-to-female ratio of 1.66:1.²³ The observed higher prevalence of HD among males across different regions suggests potential gender-related differences in the risk factors, progression, and management of CKD is recommended. These differences may stem from various factors, including disparities in healthcare access, the prevalence of underlying comorbidities, such as diabetes and HT, lifestyle factors, and genetic predispositions.

The etiological factors contributing to ESRD among patients undergoing HD are complex and varied among different populations. In this study, the assessment of these factors revealed several key findings. Among the patients included in this study, DM and HT were the primary causes of CKD. DM emerged as a predominant etiological factor, affecting 32.3% of patients. HT (primary HT) was another prevalent etiological factor, affecting 40.3% of patients. A significant proportion of patients (27.4%) had other etiological factors contributing to their kidney disease. These findings are consistent with previous studies, which identified HT and diabetes as the most common causes of ESRD, consistent with the majority of patients with CKD worldwide.^{12,35,36,37,38}

The study found a statistically significant association between the number of dialysis sessions per week and gender. This aligns with previous research conducted by Emmett et al.,³⁹ which similarly reported a significant association between gender and the frequency of dialysis sessions. According to these results, patients' gender may impact how frequently they receive dialysis sessions, potentially due to social and cultural factors that influence healthcare-seeking behavior and treatment adherence. Furthermore, variations in the prevalence and severity of underlying health conditions, such as HT or diabetes, between genders could affect the frequency of dialysis sessions needed to manage ESRD effectively.

The study also demonstrated a statistically significant association between gender and various biochemical parameters, including cholesterol, creatinine, calcium, and hematocrit. These results align with earlier research conducted in Iran and Algeria, which also reported statistically significant differences in these parameters based on gender.^{28,40}

Higher cholesterol levels in females compared to males were observed in this study. Considering the mean age of females in the study, which includes a large proportion of post-menopausal females, the reduction in estrogen levels may increase the cholesterol levels, particularly low-density lipoprotein (LDL) cholesterol, due to the inability to lower LDL cholesterol levels and increase high-density lipoprotein (HDL) cholesterol levels.⁴¹ Furthermore, lower serum creatinine levels in females compared to males could be attributed to creatinine, a byproduct of muscle metabolism, with males generally having higher muscle mass than females, resulting in higher serum creatinine levels. It could also be due to males tending to have higher metabolic rates, which can lead to increased creatinine production and higher serum levels.

Lower serum calcium levels in females could be attributed to hormonal differences. As mentioned earlier, post-menopausal females represent a large proportion of females undergoing HD in Iraq. Females generally have lower bone density, and decreased estrogen levels, particularly in the menopausal stage, increase the risk of osteoporosis compared to males. Lower bone density can result in reduced calcium stores in bone tissue, contributing to lower serum calcium levels.⁴²

Serum albumin also showed a statistically significant association with gender, with lower levels among male patients. This finding is inconsistent with the results of Khazaei et al. and Abedi-Samakoosh et al. Differences in the demographic characteristics of the study populations, such as age distribution, comorbidities, and severity of kidney disease, could influence the relationship between gender and serum albumin levels. Variations in sample size may also contribute to discrepancies in findings. Discrepancies in dialysis protocols, including dialysis duration, frequency, and adequacy, may impact nutritional status and serum albumin levels differently among male and female patients, especially knowing that the mean serum albumin is much lower than that reported in previous studies, with a mean ranging between 3.3 to 3.4 mg/dL in males and females. Meanwhile, other studies reported means ranging from 3.8 to 4.2 mg/dL.^{28,43}

This supports the idea that patients in Iraq have lower frequency and hours than adequate levels, which causes all of this.

The association between gender with the etiological factors causing kidney disease was statistically significant, consistent with findings from a study in Iran conducted in 2020.²⁸

CONCLUSIONS

This study highlights the burden of ESRD in Iraq and emphasizes the critical need for access to RRTs. In 2023, Iraq recorded a prevalence rate of 235.6 pmp, which was lower compared to neighboring countries.

The study underscores the regional variations in the prevalence of HD, influenced by disparities in the incidence and prevalence of DM, HT, healthcare infrastructure, and disease management practices.

The capital city, Baghdad, has the largest population undergoing HD, with a notable increase from 2011 to 2023. Potential factors contributing to this rise include population growth, increased disease prevalence, improved healthcare infrastructure, and heightened awareness of kidney-related conditions.

The study reveals a male-to-female ratio of approximately 1.27:1 among patients undergoing HD in Iraq, suggesting potential gender-related differences in CKD risk factors. The main causes of CKD in Iraq in 2023 are DM and HT. The strong correlation between the number of dialysis treatments per week and gender

suggests potential gender-related differences in healthcare-seeking behavior and treatment adherence.

The study identified a statistically significant association between gender and various biochemical parameters, including cholesterol, creatinine, calcium, albumin, and hematocrit.

Additionally, the study found a statistically significant association between gender and the etiological factors causing kidney disease, highlighting the importance of considering gender-related differences in understanding the complexities of CKD and ESRD.

Recommendations

1. Improving the accuracy and reliability of reported cases of HD in Iraq is essential for assessing the burden of ESRD and planning appropriate healthcare interventions. This could be achieved by implementing standardized reporting protocols for collecting data on HD cases nationwide and providing training for healthcare personnel involved in data collection and reporting. Strengthening public health surveillance systems to track trends and patterns of HD prevalence and associated risk factors is also crucial. Inconsistencies and inaccuracies in reporting may undermine the validity of prevalence estimates and hinder efforts to allocate resources effectively.

2. Conducting longitudinal studies to track changes in the prevalence of HD over time and assess the impact of interventions aimed at improving access to healthcare and managing CKD.

3. Given the lower prevalence of HD in Iraq compared to neighboring countries, investment in strengthening the healthcare infrastructure is necessary, including the expansion of HD facilities, training of healthcare professionals, and procurement of essential medical equipment and supplies.

4. Prioritizing preventive care and health promotion initiatives to address modifiable risk factors associated with chronic kidney failure is crucial. Enhancing patient education and empowerment initiatives can improve health literacy, treatment adherence, and self-management skills among individuals with kidney disease.

Limitations of the Study

The study may have suffered from underreporting of HD cases due to limitations in the reporting system. Inaccuracies and inconsistencies in data collection and

recording could lead to incomplete datasets, resulting in an underestimation of the true prevalence of HD in Iraq. The study may have encountered variability in reporting practices across different healthcare facilities and regions in Iraq. Variations in data collection methods, documentation standards, and reporting protocols could introduce bias and discrepancies in the reported prevalence rates of HD, compromising the reliability of the findings.

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