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Original Article

Epidemiological Characteristics and Causes of End-stage Renal Disease in Hemodialysis Patients

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Abstract

Background and aims: Hemodialysis (HD) is considered as the main method of renal replacement therapy (RRT) for end-stage renal disease (ESRD) patients in many countries including Iran. Given the limited number of epidemiological studies in this regard at the provincial level across the country, the present study aimed to describe the demographic and clinical characteristics of ESRD patients and determine the most important causes of ESRD in Hamadan Province.

Methods: This cross-sectional study was conducted on 508 HD patients in Hamadan province in January 2017. The checklist used to gather information comprised of the patient's demographic and clinical information. The analysis was carried out using descriptive analysis including frequency tables and charts and the chi-square statistic test was used to compare the groups using Stata software, version 12.

Results: The prevalence rate of HD treatment was 288.9 per million population (PMP). Further, most under HD patients were married, illiterate, and urban residents. The mean age of patients at the diagnosis was 47.64 ± 15.17 years. Hypertension (37.4%), diabetes (28.74%), and glomerulonephritis (10.63%) were the common causes of ESRD. Eventually, there was a significant difference between ESRD causes according to gender and residency ($P<0.05$).

Conclusion: In general, the prevalence rate of HD in Hamadan was relatively similar to that of developing countries although it was lower than the national average. Furthermore, hypertension and diabetes were the common causes of ESRD in Hamadan Province. Therefore, preventive strategies should be taken to modify their risk factors.

Keywords: Kidney failure, Hemodialysis, Prevalence, Diabetes, Hypertension, Hamadan province

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Introduction

Nowadays, chronic kidney disease is considered a serious challenge for health systems worldwide[1] so that a large proportion of health care finance is allocated to this problem, which also imposes depression, anxiety, disability, and other problems to affected patients.[2,3] The growing trend of non-communicable diseases such as diabetes and hypertension among societies causing end-stage renal disease (ESRD) globally continues to grow higher compared to the yearly growth rate of the world population.[4]

Hemodialysis (HD) is usually represented as the main way of renal replacement therapy (RRT) for ESRD patients in many countries including Iran.[5,6] The Iranian Ministry of Health (MOH) provides free of charge HD for ESRD patients.

The prevalence of ESRD is projected to nearly double in the next decade around the world. Moreover, its prevalence varies among countries. For example, it is 320 per million population (PMP),[7] 600 PMP,[4] and 312 PMP in Yemen, Saudi Arabia, and Turkey, respectively.[8] The incidence of HD in Iran follows an upward trend. More precisely, the prevalence rates of ESRD in Iran reached from 13.8 and 137 PMP in 1997 to 63.8 and 357 PMP in 2006, respectively.[9,10]

Most studies showed that diabetes and hypertension are two common causes of ESRD,[11,12] and elderly people are far more involved.[13,14] The analysis data regarding the national registry of the ESRD of Iran during 1997-2006 provided through MOH revealed that the mean age of newly registered males and females increased from 47.0 and 49.0 years to 52.5 and 53.0 years, respectively, with a

male to female ratio of 1.3.[9]

Generally, epidemiological studies in this regard are rare across the country at the provincial level. The aim of this study was to describe the demographic and clinical characteristics of ESRD patients and determine the most important causes of ESRD in Hamadan province.

Materials and Methods

This cross-sectional study was conducted on 508 HD patients in Hamadan province in western Iran during January-April 2017. Data were gathered by a checklist on the hospital records of all ESRD patients. The applied checklist comprised patient's demographic information including gender, location, marital status, education, smoking, addiction, and body mass index (BMI), as well as clinical information encompassing hemoglobin, blood urea nitrogen (BUN), creatinine before dialysis, sodium, potassium, phosphor, calcium, and albumin levels, diabetes, hypertension, diabetes+ hypertension, urologic and obstructive diseases, along with polycystic kidney and glomerulonephritis. Hamadan province with an area of 19 493 km² in extent is located in western Iran. According to the national census held by the Statistical Center of Iran (https://www.amar.org.ir/english), this province had a population of 1 758 268 people in 2011.

Eight hospitals in the province have dialysis units, including Alimoradian, Vali Asr, Ghaem, Imam Hossein, Imam Reza, Besat, and Shahid Beheshti (Figure 1). Missing data due to incomplete hospital records resulted in the exclusion of some variables from the analyses in this study although some of these data were completed by phone calls with patients.

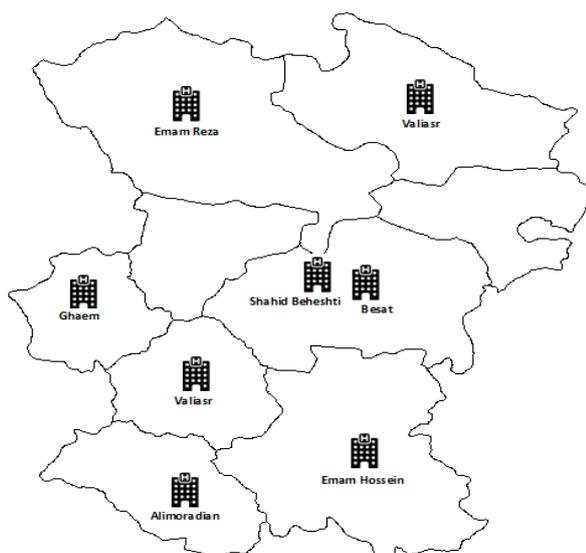Data were gathered by a checklist on the hospital records of all ESRD patients in the province. Patients with acute renal failure receiving transient HD and non-native patients were excluded from the study. The applied checklist included patient's demographic information (i.e., age, gender, marital status, BMI, residence area, educational level, the history of tobacco use, or substance abuse) and clinical information (i.e., hemoglobin, BUN, creatinine, sodium, calcium, phosphor, potassium, and albumin levels, along with ESRD cause). Descriptive analysis was used, including frequency tables and charts in order to describe and summarize data and then the chi-square test and student t test were used to compare different groups. A level of 0.05 was considered significant for all statistical tests. Stata software (StataCorp, College Station, TX, USA), version 12 was used to perform all analytical operations.

Results

In January 2017, 508 patients underwent HD in the dialysis wards of public hospitals in Hamadan Province (the prevalence rate was equal to 288.9 PMP). In addition, the demographic characteristics of HD patients are shown in Table 1. Further, 279 (54.95%) of patients were males and 320 (62.99%) of them lived in urban areas. About 40% of them were illiterate and 76.97% of HD patients were married. The history of smoking and addiction among subjects was 82 (16.14%) and 57 (11.22%), respectively. Furthermore, 324 (63.78%) of HD patients had a normal range of BMI and only 34 (6.69%) of them were obese.

The mean age at the diagnosis of patients was 47.64 ± 15.17 years. As shown in Figure 2, age distribution at the diagnosis of HD patients was approximately normal and mostly concentrated between 20 and 50 years in males, as well as 50 and 70 years in females.
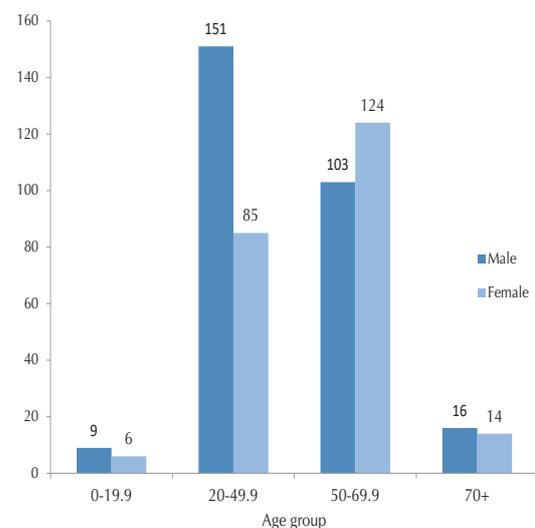
Mean hemoglobin, BUN before dialysis, BUN after

Figure 1. The Hospitals With a Dialysis unit in Hamadan Province.

Figure 2. Age Distribution of Hemodialysis Patients in Hamadan Province in 2017 by Gender.

Table 1. Demographic Characteristics of HD Patients in Hamadan Province in 2017

Variable		Number	Percent
Gender	Male	279	54.95
	Female	229	45.08
Location	Urban	320	62.99
	Rural	188	37.01
Marital status	Single	97	19.10
	Married	391	76.97
	Bigamy	13	2.56
	Divorce	7	1.38
Education	Illiterate	203	39.96
	Primary & guidance school	177	34.84
	High school & diploma	106	20.87
	University	22	4.33
Smoking	Yes	82	16.14
	No	426	83.86
Addiction	Yes	57	11.22
	No	451	88.78
BMI	Under weight	58	11.42
	Normal	324	63.78
	Over weight	92	18.11
	Obese	34	6.69

Note. HD: Hemodialysis; BMI: Body mass index.

dialysis, creatinine before dialysis, sodium, potassium, phosphor, calcium, and the albumin serum of HD patients were 10.26, 114.4, 40.24, 7.5, 138.72, 4.98, 5.11, 8.72, and 3.86, respectively (Table 2).

ESRD cause in HD patients in Hamadan province in 2017 is shown in Table 3. In total, hypertension, diabetes, and glomerulonephritis with 37.4% (27.36 plus 10.04), 28.74% (18.7 plus 10.04), and 10.63% were the common causes of ESRD. Diabetes was a more common cause of ESRD among females (35.8% vs. 22.94%) while urologic and obstructive diseases (13.62 vs. 4.37) and glomerulonephritis (15.41 vs. 4.8) were more common among males ($P < 0.001$). Compared with rural areas, diabetes caused a higher proportion of ESRD cases (33.13 vs. 21.27) in urban areas while glomerulonephritis was more common in rural areas (14.36 vs. 8.44, $P = 0.035$).

Discussion

This cross-sectional study was performed on 508 HD patients regarding the epidemiologic characteristics and causes of ESRD in Hamadan province. In 2017, the prevalence rate was 288.9 PMP in the province. More than half of the patients (54.95%) were males and about 63% lived in urban areas. Furthermore, 40% and 76.97% of them were illiterate and married, respectively. More than 16 and 11% of patients had a history of smoking and addiction, respectively. The mean age at the diagnosis

of patients was 47.64 ± 15.17 years, and hypertension, diabetes, and glomerulonephritis were the common causes of ESRD.

The prevalence rate of HD in Hamadan province was relatively similar to the global estimation of maintenance dialysis (284 PMP) in 2010,[15] which was substantially less than those in developed countries such as the United State, the European Union, and Japan.[4] In Isfahan, this rate was 300 PMP in 2013.[16] A report by the consortium dialysis of Iran revealed that Hamadan is among the provinces with lower rates of HD in Iran. It should be noted that these differences may be due to disparity in economic status and demographic distribution among these countries, including a higher percentage of older people in developed countries. Additionally, this high prevalence is largely due to the longer survival made possible by rapid response teams, which thus relies on healthcare expenditures and economic strength, resulting in more patients living on dialysis in industrialized countries. Similarly, a part of the difference can be attributed to the widely varying situations regarding RRT for different countries. Improved health conditions

Table 2. Biochemical Indicators of HD Patients in Hamadan Province in 2017 by Gender

Biochemical Indicators	Males Mean ± SD	Females Mean ± SD	Total Mean ± SD	P Value
Hemoglobin	10.19+1.8	10.3+1.7	10.26±1.7	0.27
BUN before dialysis	112.94+41.66	116.2+46.29	114.4±43.8	0.41
BUN after	39.86+19.01	40.73+21.12	40.24±19.94	0.65
Creatinine before dialysis	7.74+3.12	7.35+2.93	7.5±3.04	0.15
Sodium	138.73+3.95	138.71+4.29	138.72±4.1	0.96
Potassium	4.97+0.74	5.0+0.8	4.98±0.77	0.69
Phosphor	5.13+1.32	5.11+1.36	5.11±1.34	0.85
Calcium	8.62+0.89	8.85+0.85	8.72±0.9	**0.004**
Albumin	3.87+0.62	3.86+0.61	3.86±0.62	0.87

Note. HD: Hemodialysis; BUN: Blood urea nitrogen; SD: Standard deviation.

Table 3. ESRD Cause in HD Patients in Hamadan Province in 2017, by Gender and Residency

ESRD Cause	Gender		Location		Total
	Males	Females	Urban	Rural	
Diabetes	45 (16.13)	50 (21.83)	72 (22.5)	23 (12.23)	95 (18.7)
Hypertension	77 (27.6)	62 (27.07)	87 (27.19)	52 (27.66)	139 (27.36)
Diabetes + Hypertension	19 (6.81)	32 (13.97)	34 (10.63)	17 (9.04)	51 (10.04)
Urologic & obstructive diseases	38 (13.62)	10 (4.37)	27 (8.44)	21 (11.17)	48 (9.45)
Polycystic Kidney	11 (3.94)	10 (4.37)	15 (4.69)	6 (3.19)	21 (4.13)
Glomerulonephritis	43 (15.41)	11 (4.80)	27 (8.44)	27 (14.36)	54 (10.63)
Unknown	45 (16.49)	54 (23.58)	58 (18.13)	42 (22.34)	100 (19.69)
Total	279 (100)	229 (100)	320 (100)	188 (100)	508 (100)
P value	**<0.001**		0.035		-

Note. HD: Hemodialysis; ESRD: End-stage renal disease.

in developing countries, including a decrease in the prevalence of child malnutrition, water purity, sanitation, and progress in the treatment of infectious diseases, have been associated with increased population growth and aging, a change in lifestyle such as physical inactivity, and changes in food habits like the consumption of high-calorie foods in these countries, laying the groundwork for the spread of diabetes and high blood pressure as risk factors for ESRD. In fact, the increasing trend has stopped in developed countries and these countries have a steady situation while this trend is still increasing in developing countries.[17]

In this study, the gender ratio (male/female) was 1.22, which is consistent with the results of the study on dialysis outcomes and practice patterns conducted on 35 964 HD patients in 12 countries between June 1996 and March 2012, indicating that, overall, more men than women were on HD and the male/female ratio was 1.44 in all age groups.[18] They further concluded that fewer females were treated with dialysis for ESRD compared to males. However, this needs further studies as large gender differences in terms of countries and age groups are likely to be explained by factors beyond biology. A high proportion of urban patients in this study can be justified through the 60% urbanization rate of the province.

Unlike European countries[19] where ESRD is more diagnosed in the elderly, most people had been affected in the middle age (mean age at diagnosis: 47.64 years) in our study. In the United States, the average age of initiating dialysis in 2000 was approximately 62 years.[20] In addition, the mean age of HD patients was 55 in a prospective study in Najran, Saudi Arabia.[21] In developing countries, ESRD mostly affects the economically productive age group,[22] which is consistent with our results. However, this may be due to the increase in surveillance on kidney disease at a younger age and the improvement of ESRD management strategies. The population of Iran is relatively young in comparison with developed countries and the age composition of the population in various countries could also affect this disparity.

Similar to developed countries, the main etiology of ESRD in Hamadan province was hypertension and diabetes. Likewise, national studies in Isfahan[16] and Golestan[23] revealed that diabetes and hypertension were the main causes of ESRD. In contrast, in Nigeria and sub-Saharan Africa, glomerulonephritis was the commonest cause of ESRD.[24,25] Glomerulonephritis in this study was responsible for 10.66% of ESRD cases, which is in line with the results of the study in Egypt.[5] However, this effect was very mild in the United State. The higher prevalence of bacterial, viral, and parasitic infections in developing countries compared with the Unites State explains this difference. Overall, differences in lifestyle, nutritional status, and the distribution of communicable and non-communicable diseases among countries can justify disparities in ESRD causes. Finally, no clear cause was found (19.69%) for a significant percentage of patients in this study. Therefore, careful examinations should be performed before patients reach ESRD.

This study has some limitations, including the difference of sensitivity in laboratory exams in different counties of the province and missing data due to incomplete hospital records. However, this study provides epidemiological evidence of HD status in Hamadan province for health planning and a basis for further research.

Conclusion

The prevalence rate of HD in Hamadan was relatively similar to that of developing countries, but it was lower than the national average. In addition, HD patients in Hamadan were usually affected in younger ages compared with similar studies. Although hypertension and diabetes were the common causes of ESRD in Hamadan province, a noticeable portion of patients was affected through glomerulonephritis. Therefore, preventive strategies should be taken to control the risk factors of diabetes and hypertension. Controlling infectious diseases in the youth should be considered as well.

Conflict of Interest Disclosures

The author declare no conflicts of interest.

Ethical Approval

This study was approved by the Ethics Committee of Hamadan University of Medical Sciences on 2020.04.25 (Approval ID: IR.UMSHA.REC.1399.065).

Acknowledgement

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