

End-stage Renal Disease in the Middle East: A Systematic Review and Meta-analysis

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Introduction. End-stage renal disease (ESRD) results in unpleasant consequences for patients, their families, and also society. Annually, each country expends a huge amount for ESRD treatment. In addition, its prevalence is dramatically growing, though it can be prevented. Many countries do not have accurate epidemiologic data about this disease. We conducted this study to measure a pooled prevalence of ESRD in the Middle East.

Materials and Methods. Included articles were prospective and retrospective cross-sectional and editorial studies from January 1990 till January 2015 from the Middle East area that reported the prevalence of ESRD and renal replacement therapy. To measure pooled prevalence of ESRD we used a random effect model. For evaluating publication bias and heterogeneity, we used the Egger test and *I* squared test, respectively.

Results. After excluding duplicates and irrelevant studies, 18 articles remained in our study. The prevalence reported in these studies varied from 55 pmp to 818 pmp. The pooled prevalence of ESRD was 360 pmp (95% confidence interval, 290 pmp to 430 pmp; $I^2 = 100\%$; $P < .001$).

Conclusions. Most of the countries in the Middle East are categorized as developing countries. We believe that the prevalence in this region is much higher than what we measured. They lack a data registry system for most of diseases like ESRD, while it is needed for better prevention and treatment of these diseases.

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INTRODUCTION

Chronic kidney disease (CKD), defined as a kidney damage or glomerular filtration rate (GFR) less than 60 mL/min/1.73 m² for at least 3 months, can lead to end-stage renal disease (ESRD), the last stage of CKD when renal replacement therapy (RRT) is essential.¹⁻³ It is estimated that over 500 million people suffer from CKD worldwide that are susceptible to develop ESRD if no action is done to diagnose and treat them in early stages. Indeed, ESRD represents the tip of the iceberg and the actual number of patients with CKD is

a lot more (as much as 20 to 50 times greater).^{2,4} It is estimated that the annual cost for CKD and ESRD is \$48 billion and \$32.9 billion.⁵⁻⁷ On the other hand, the prevalence of CKD and ESRD continuously grows.^{1, 2} Due to dramatic growth in the prevalence of 2 leading causes of ESRD, diabetes mellitus (DM), and hypertension. As a result, ESRD becomes a global concern.⁸⁻¹¹

Most of the developing countries lack a patient registry system. As a result, the exact number of patients with CKD and ESRD is unknown.^{3,4,12} The Middle East is a transcontinental region located

in western Asia consists of mostly developing countries where 5% of worldwide population lives. The reported ESRD prevalence in this area ranges between 52 per million population (pmp) in Iraq and 818 pmp in Lebanon with the mean prevalence of 430 pmp in the whole Middle East.^{13,14}

To our knowledge, in spite of the rapid growth in the prevalence of ESRD and a danger of reaching an outbreak in the next decade, there is no recent systematic review on the ESRD prevalence in the Middle East.¹ Therefore, we performed a systematic review and meta-analysis to determine the prevalence of ESRD in the Middle East by reviewing the articles of the countries in this region in the past 25 years.

MATERIALS AND METHODS

Search Strategy

A systematic review and meta-analysis was conducted based on the preferred reporting items for systematic review and meta-analysis protocols 2015 statement,¹⁵ by searching the PubMed, Scopus, and Google scholar databases by 3 different investigators, to collect all the potentially relevant English articles from January 1990 till January 2015 in the Middle East area. The keywords used were “CKD,” “ESRD,” “chronic renal insufficiency,” “dialysis,” “transplant,” and “renal replacement therapy,” combined with “prevalence” and its alternatives (“frequency,” “epidemiology,” and “incidence”), and the Middle Eastern countries. The Ethics Committee of Shiraz University of Medical Sciences approved the study protocol (94-01-18-9952).

Study Design and Participants

All relevant prospective and retrospective cross-sectional studies on human and editorials published without restriction to specific age or sex, were included in this study. Case series and reviews were excluded. Each article was briefly assessed by 2 researchers to include all the epidemiologic studies that mentioned prevalence or calculable prevalence of ESRD, estimated GFRs less than 15 mL/min/1.73 m² (stage 5), and RRT in patients. Duplicate and irrelevant studies were eliminated in this step. Furthermore, the reference lists of all articles were reviewed to detect other relevant papers that were missed in searching process. An expert statistician at the end reviewed the data

and excluded studies that did not mention the sample size.

Data Extraction

The primary objective of this study was to calculate prevalence of ESRD in the Middle East. Assessing the incidence ranges, the most common RRT modality, the leading cause of ESRD, and the predominant sex with ESRD were the other goals. To achieve these goals, 2 investigators read the articles completely and collected the year of study, name of country, age ranges and mean age, sex ratio, prevalence and incidence of ESRD, the most common RRT modality, and the main cause leading to ESRD. For the second time all papers fully reviewed independently by 2 researchers and the mentioned data were recorded. We excluded studies that lacked the information that we needed or the ones conducted on different target groups (pregnant patients, hospitalized patients, and children; Figure 1).

Definitions

Chronic kidney disease was defined as a kidney damage or an estimated GFR less than 60 mL/min/1.73 m² for at least 3 months and was classified into 5 stages. A GFR less than 15 mL/min/1.73 m² was defined as ESRD.^{2,5}

The Middle East is a geographical area located in southwestern of Asia that contains some Asian and African countries. Its importance is due to the geopolitical situation. As a result of the geopolitical and socioeconomic issues, the exact countries placed in this area are controversial. There is controversy on definite countries that mentioned as the Middle East, though 17 countries are common in most references, which were included in this study: Iran, Turkey, Saudi Arabia, Jordan, Qatar, Syria, Kuwait, Yemen, Oman, Lebanon, UAE, Israel, Egypt, Bahrain, Cyprus, Iraq, and Palestine. Some references have included Azerbaijan, Armenia, Georgia, Libya, Tunisia, and Algeria in the Middle East.¹³⁻¹⁴

Statistical Analysis

We entered our data in an Excel spreadsheet and analyzed the data using the Stata (version 14.0, StataCorp LP, College Station, TX, USA). To combine prevalence rates, we used a random effect model. For evaluating publication bias and heterogeneity we used the Egger test and the *I* squared, respectively.

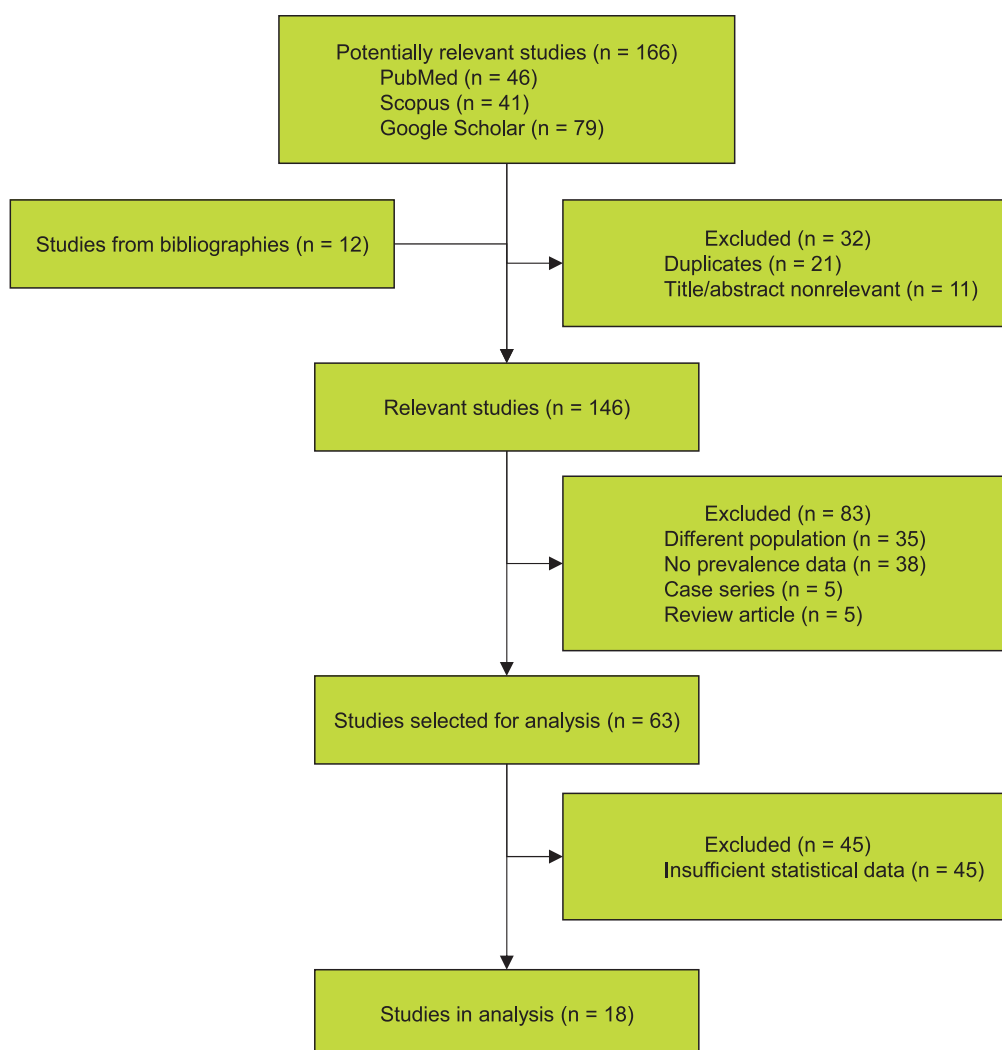


Figure 1. Search strategy.

RESULTS

Literature Search

The process of literature identification and selection is summarized in Figure 1. Of the 166 publications identified by searching databases, 144 were selected during the initial screening. After reading full manuscripts, 82 articles were excluded due to different populations, inappropriate article type, and lack of prevalence reporting. After statistical evaluation, 18 studies that reported the prevalence of ESRD in 9 countries of the Middle East were selected for meta-analysis.^{13,16-29}

Study Characteristics

Five studies reported prevalence in Iran,¹⁶⁻²⁰ 3 studies were from Egypt,²¹⁻²³ and 2 studies mentioned the prevalence for the whole Middle

East.^{13,24} Two studies reported the prevalence in Turkey.²⁵⁻²⁶ Tunisia,²⁷ Yemen,²⁸ Syria,²⁹ Qatar,³⁰ Lebanon,¹³ and Iraq,¹³ were represented in 1 study each. Twelve studies were cross-sectional and 4 were editorial studies (Table 1).

Description of Studies

Afifi and colleagues on their work on leading causes of ESRD mentioned the ESRD prevalence in Egypt based on the Sixth annual report of the Egyptian Society of Nephrology,³¹ which was 375 pmp.²¹ El-Minshawy conducted a cross-sectional study on both sexes in 2006 at Governorate State, one of the 28 Egypt's governorate with the population of 4.4 million with the estimated prevalence of 308 pmp.²² In the other cross-sectional study accomplished on both sexes in Menoufia, another

Table 1. Characteristics of Reviewed Studies

Study	Type of Study	Year of Publication
Egypt		
Affifi et al ²²	Cross-sectional	2004
El-Minshawy ²³	Cross-sectional	2011
Abd et al ²³	Cross-sectional	2015
Middle East		
Moeller et al ²⁴	Comment	2001
Najafi ¹³	Editorial	2009
Iran		
Haghighi et al ¹⁶	Cross-sectional	2002
Nafar et al ¹⁷	Cross-sectional	2008
Aghigh et al ¹⁸	Cross-sectional	2009
Monfared et al ¹⁹	Cross-sectional	2009
Khajehdehi et al ²⁰	Cross-sectional	2014
Turkey		
Erek et al ²⁵	Editorial	2002
Suleymanlar et al ²⁶	Cross-sectional	2011
Tunisia		
Maiz et al ²⁷	Cross-sectional	2002
Yemen		
Al-Rohani et al ²⁸	Cross-sectional	2007
Syria		
Saeed et al ²⁹	Cross-sectional	2007
Qatar		
Fituri et al ³⁰	Cross-sectional	2009
Lebanon		
Najafi ¹³	Editorial	2009
Iraq		
Najafi ¹³	Editorial	2009

Egypt's governorate with the population of 2.2 million, the prevalence of ESRD was reported 330 pmp.²³ Moeller and coworkers who sent survey forms to 120 countries in 2001 calculated the prevalence of ESRD in the Middle East would be 150 pmp.²⁴ Also, Najafi, in his editorial article, mentioned the prevalence of ESRD in the Middle East to be 430 pmp.¹³ Haghighi and colleagues and Nafar and colleagues reported the prevalence of 238 pmp in 2000 and 274 pmp in 2004, respectively.^{16,17} Agahighi and colleagues collected data from the Dialysis and Organ Transplantation Center of Ministry of Health in Iran during 10 years. They reported that the prevalence in Iran increased from 137 pmp in 1997 to 357 pmp in 2006.¹⁸ Monfared and coworkers and Khajehdehi and colleagues conducted a cross-sectional study in Guilan and Fars provinces of Iran and reported a prevalence rate of ESRD as 309.7 pmp and 531.7 pmp in these two provinces.^{19,20} Based on the Turkish Registry of Nephrology, Dialysis and Transplantation in

2000, Erek and colleagues reported the prevalence of ESRD in as 358 pmp, while Suleymanlar and coworkers calculated the point prevalence in 2008 to be 756 pmp.^{25,26} Maiz and coworkers in their study on hemodialysis patients reported the prevalence of ESRD based on the Tunisian Annual Report of Renal Replacement Therapy in 1999, which was 430 pmp.²⁷ Fituri and colleagues, who accomplished a cross-sectional study in Qatar from 2001 till 2006, reported the prevalence as 624 pmp.²⁸ Saeed and colleagues reported the prevalence of ESRD in Syria in 2005 as 143 pmp based on the annual report of the Renal Replacement Therapy in Syria.²⁹ Najafi mentioned the prevalence of ESRD in Lebanon and Iraq to be 818 pmp and 55 pmp, respectively.¹³

Primary Objective

The highest prevalence rate of ESRD belonged to Lebanon, which was 818 pmp in 2008,¹³ followed by the prevalence in Turkey²⁶ and Qatar³⁰ in 2008 and 2006, which were 756 pmp and 624 pmp, respectively. Iraq reported the lowest prevalence in 2008, which was 55 pmp.¹³ The overall prevalence of ESRD reported in the Middle East in 2001²⁴ and 2008¹³ were 150 pmp and 430 pmp, respectively.

Pooled prevalence of ESRD calculated in the current study was 360 pmp (95% confidence interval, 290 pmp to 430 pmp; $Z = 10.53$, $P < .001$). Significant heterogeneity existed between the studies ($I^2 = 100\%$, $P < .001$; Figure 2). The Egger test showed that there was no significant publication bias ($P = .07$). Figure 2 is a forest plot of studies we reviewed and showed the prevalence reported in each study with their confidence interval (showed by a horizontal line). The study by Khajehdehi and colleagues showed wide confidence interval that can be due to small number of its sample size.²⁰

Secondary Objective

The reported incidence varied from 49.9 pmp in Iran in 2000,^{16,17} to 202 pmp in Qatar in 2006 (Table 2).³⁰ As shown in Table 3, approximately all studies reported hemodialysis as the most common RRT.^{13,16,17,19, 22,23,25-28,30}

Although DM was the main cause that led to ESRD in most of studies we reviewed, hypertension was mentioned as the main leading cause by Abd and colleagues in Egypt, Monfared and colleagues in Iran and Suleymanlar and coworkers in Turkey.^{18,23,26} Also, 2 studies in Egypt and Yemen

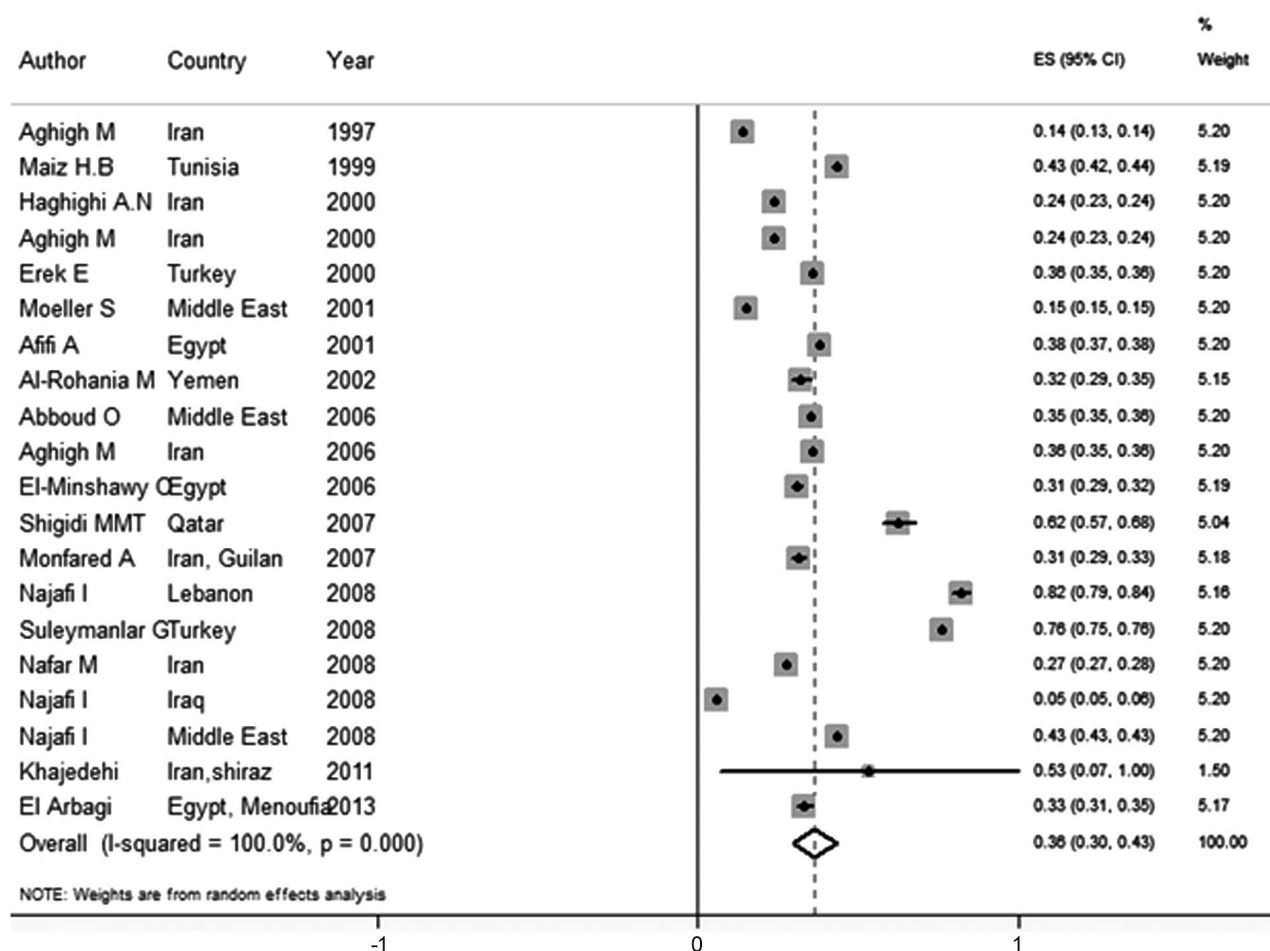


Figure 2. Forest plot of reviewed studies.

reported unknown causes as the most common cause.^{22,26} A study by Aghighi and colleagues reported unknown cause as the leading cause of ESRD in 1997 and 2000, while in the same study they reported DM as the leading cause in 2006.¹⁸ Glomerulonephritis was reported as the main leading cause in 1 study conducted in Turkey.²⁵

In most of the reports, men were the predominant sex, though the male-female ratio varied from 0.6 to 2.1.^{20,28}

DISCUSSION

Chronic kidney disease and its last stage, ESRD, are going to be a global disaster. Not only they are rapidly growing, but also they impose huge cost on health system of countries.⁹ End-stage renal disease increases mortality and morbidity. It increases the risk of cardiovascular events.^{2,9,32} Although the first and most important step to prevent ESRD and its consequences is to have the

accurate information about epidemiology of the disease,³³⁻³⁴ still developing countries lack a data registry system.⁴ The Middle East is an important political area placed in North Africa and Southwest Asia, consists of countries that mostly categorized as developing country.¹³ We performed this study to have an overview of studies done on ESRD prevalence in this area.

There is a global increasing trend in the prevalence and incidence of CKD and ESRD. Previous reports believed that 90% of patients with ESRD are from rich countries.⁴ Although the mentioned reports related this situation to better accessible of RRT in rich countries and as a result improve in survival,⁴ this also can be due to the absence of data registry in most of low-income countries that results in incomplete epidemiological information.¹² As mentioned by United States Renal Data System in 2015, the prevalence of patients with ESRD increased 68% since 2000 and 3.5% since 2012 in

Table 2. Prevalence and Incidence of End-stage Renal Disease in the Middle Eastern Countries*

Study	Prevalence, pmp	Incidence, pmp	Sample size
Egypt			
Afifi et al ²²	375	...	68,000,000
El-Minshawy ²³	308	...	4,400,000
Abd et al ²³	330	...	2,287,266
Middle East			
Moeller et al ²⁴	150	...	271,000,000
Najafi ¹³	430	...	261,000,000
Iran			
Aghigh et al ¹⁸	137	13.82	70,000,000
Haghighi et al ¹⁶	238	49.9	63,600,000
Aghigh et al ¹⁸	238	49.9	70,000,000
Nafar et al ¹⁷	274	95	70,000,000
Aghigh et al ¹⁸	357	63.8	70,000,000
Monfared et al ¹⁹	309.7	110.66	2417
Khajehdehi et al ²⁰	531.7	...	9,404
Turkey			
Erek et al ²⁵	358	276	64,337,000
Suleymanlar et al ²⁶	756	188	70,000,000
Tunisia			
Maiz et al ²⁷	430	110	9,456,000
Yemen			
Al-Rohani et al ²⁸	320	64	1,250,000
Syria			
Saeed et al ²⁹	143	100	18,130,000
Qatar			
Fituri et al ³⁰	624	202	640,000
Lebanon			
Najafi ¹³	818	120	4,400,000
Iraq			
Najafi ¹³	55	...	29,000,000

*Ellipses indicate data not provided in the publication.

the United States. Also, previous survey based studies on global prevalence of ESRD reported that since 2001 till 2004 the ESRD prevalence increased from 240 pmp to 280 pmp.²⁴⁻³⁴ The highest ESRD prevalence rate was reported in Japan, which was 2045 pmp, while Asia (excluding Japan) and Africa were reported to have the lowest rates, which were about 70 pmp.³⁴

The prevalence and incidence in the Middle East countries varied from 818 pmp in Lebanon to 55 pmp in Iraq and 49.9 pmp in Iran to 276 pmp in Turkey, respectively.^{13,16-17,25} Previous reports from the Middle East announced the prevalence of ESRD in this area as 150 pmp in 2001 and 430 pmp in 2009.^{13,24} While based on studies we reviewed, the prevalence we measured for the Middle East was 393 pmp. Compared to other countries, it seems that the prevalence of ESRD in this area is moderate. As Barsoum mentioned, due to lack of

accurate statistics, we believe that the actual ESRD prevalence for the Middle East countries are a lot more than what we calculated based on studies.^{9,12}

Although DM is considered as the most common cause of ESRD followed by hypertension in most of developed and developing countries,^{8,16-18,25} still some reports mentioned infection as the most common cause in some developing countries such as Egypt.^{8,9,22} Infections can lead to chronic glomerulonephritis and interstitial nephritis and finally result in ESRD.^{4,21} As reported by Aghighi and colleagues, the most common cause in Iran before 2002 was unknown and since that time DM had taken its place.¹⁷ By looking through all causes of ESRD, we can easily find out that approximately all causes of ESRD are preventable.^{4,8} As a result, a global coherent and systematic program can prevent this unpleasant disease.

As long as the rate of ESRD patients rapidly

Table 3. Treatment Modality, Cause of End-stage renal Disease (ESRD), Sex, and Maximum Age Group*

Study	Year of study	Main Renal Replacement Therapy	Cause of ESRD	Male-Female Ratio	Maximum Age, y
Egypt					
Afifi et al ²²	1996 to 2001	...	Diabetes mellitus	1.4	46.3
El-Minshawy ²³	2006	Hemodialysis	Unknown	1.9	46
Abd et al ²³	2013	Hemodialysis	Hypertension	1.1	52.45
Middle East					
Moeller et al ²⁴	2001	Hemodialysis	...	...	...
Najafi ¹³	2008	Hemodialysis	Diabetes mellitus	0.7	40 to 60
Iran					
Aghigh et al ¹⁸	1997	Hemodialysis	Unknown	1.3	47.8
Haghighi et al ¹⁶	2000	Hemodialysis	Diabetes mellitus	1.2	45 to 64
Aghigh et al ¹⁸	2000	Hemodialysis	Unknown	1.3	52.7
Nafar et al ¹⁷	2004	Hemodialysis	Diabetes mellitus	0.7	...
Aghigh et al ¹⁸	2006	...	Diabetes mellitus Hypertension	1.3	52.7
Monfared et al ¹⁹	2005 to 2007	Hemodialysis	Diabetes mellitus	1.3	56.3
Khajehdehi et al ²⁰	2009 to 2011	...	...	0.6	45.6
Turkey					
Erek et al ²⁵	2000	Hemodialysis	Glomerulonephritis	...	...
Suleymanlar et al ²⁶	1996 to 2008	Hemodialysis	Hypertension	...	...
Tunisia					
Maiz et al ²⁷	2000	Hemodialysis	...	1	48.8
Yemen					
Al-Rohani et al ²⁸	1998 to 2002	...	Unknown	2.1	...
Qatar					
Fituri et al ³⁰	2002 to 2006	Hemodialysis	Diabetes mellitus	1	65 to 74

*Ellipses indicate data not provided in the publication.

grows, the rate of all RRTs is growing too.^{4,36} Although hemodialysis is the most common treatment in most of developing and developed countries, transplantation is the best and certain way of treatment.^{36,37} It improves patients' quality of life and reduces the expenses.^{36,37} As reported in 2004, the prevalence of dialysis and transplant were 215 pmp and 65 pmp globally, while the prevalence reported for dialysis and transplant in the Middle East was 140 pmp and 55 pmp, respectively.³⁴ About 8.5% of ESRD patients were on peritoneal dialysis worldwide.²³ The number of patients on peritoneal dialysis is higher than transplanted patients in Turkey and Kuwait.¹³ The first kidney transplant was operated in the late 1960s in Iran. Still Iran is the leader of kidney transplant in the Middle East since it is the only country without kidney transplant waiting list due to living unrelated organ donor transplant program.^{13,38} The highest and lowest rates of kidney transplant were reported in Kuwait and Sudan, which were 29.8 pmp and 0.05pmp.³⁹ The Middle East Society of Organ Transplantation

was established in 1987 in Turkey with the aim of improving transplantation in this region. Now, it consists of more than 29 countries with more than 650 million population.⁴⁰

In United States, the ESRD prevalence was the highest in patients with the age of 65 to 74 years.³⁵ Hassanien and colleagues reported that the mean age varied between 33 and 61.9 years in their systematic review on Gulf Cooperation Council countries (mainly in Middle East).⁴¹ In the studies we reviewed the mean age ranged from 45.6 to 56.3 years.^{19,20} Also, 40 to 60 years was reported as the most prevalent age group in most studies.^{17-19,21,26,30} Comparing the age ranges reveals that the age of ESRD patients in developing countries is less than developed countries as mentioned by previous studies.^{24,34} This difference in age can be due to younger general population of developing countries,^{24,34} as well as different study populations (some studies included children),⁴¹ in addition to the better accessibility to RRTS in developed countries that cause longer life duration.⁴

Worldwide, not only some studies reported

males as the predominant sex in ESRD,^{35,41} but also they reported higher mortality among men as long as they were at higher risk for developing cardiovascular diseases.⁴² Most of studies that we reviewed also revealed male as the predominant sex.^{16,18,19,21-23,28} On the other hand, Najafi and colleagues mentioned that after age adjustment, women were at a higher risk to develop impaired kidney function.⁴³

There are some limitation to the interpretation of results from the present study; first some most of studies did not report separate prevalence rates for men and women, so we could not report the separate prevalence for each. In studies like our study that evaluate epidemiology due to a large sample size data showed a high dispersion as shown in our forest plot. Furthermore, although there were lots of studies that reported prevalence in the Middle Eastern countries, studies with high quality that follow the standard methods and possess sufficient sample size were low.

CONCLUSIONS

End-stage renal disease can make a global disaster if no action is taken. Although most of causes of ESRD are preventable, their prevalence is increasing, leading to an increase in ESRD prevalence. We measured the pooled ESRD prevalence in the Middle East to be 360 pmp. Comparing to other regions, it is not a high prevalence though we believe that the prevalence in this region is much higher. The first step in prevention of one problem is to have a perfect overview of the problem. Knowing about all epidemiological aspects of disease can give us that overview. This can be achieved only by having a good data registry system. Registry systems for chronic diseases such as CKD must become a priority of Health Ministries.

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CONFLICT OF INTEREST

None declared.

REFERENCES

1. Warady BA, Chadha V. Chronic kidney disease in children: the global perspective. *Pediatr Nephrol*. 2007;22:1999-2009.

2. Süleymanlar G, Utaş C, Arinsoy T, et al. A population-based survey of Chronic REnal Disease In Turkey—the CREDIT study. *Nephrol Dial Transplant*. 2010;26:1862-71.
3. White SL, Chadban SJ, Jan S, Chapman JR, Cass A. How can we achieve global equity in provision of renal replacement therapy? *Bull World Health Organ*. 2008;86:229-37.
4. Mahdavi-Mazdeh M, Heidary Rouchi A, Norouzi S, Aghighi M, Rajolani H, Ahrabi S. Renal replacement therapy in Iran. *Urol J*. 2007;4:66-70.
5. Davids MR. Chronic kidney disease—the silent epidemic. *Cont Med Edu*. 2007;25:378.
6. Hoerger TJ, Simpson SA, Yarnoff BO, et al. The future burden of CKD in the United States: a simulation model for the CDC CKD Initiative. *Am J Kidney Dis*. 2015;65:403-11.
7. 2015 USRDS Annual Data Report. Volume 1. CKD in the United States, Chapter 2: Identification and Care of Patients with CKD. *USRDS*;2015; p. 25-34.
8. Perico N, Remuzzi G. Chronic kidney disease: a research and public health priority. *Nephrol Dial Transplant*. 2012;27:iii19-26.
9. Barsoum RS. Chronic kidney disease in the developing world. *New Engl J Med*. 2006;354:997.
10. Malekmakan L, Malekmakan A, Daneshian A, Pakfetrat M, Roosbeh J. Hypertension and diabetes remain the main causes of chronic renal failure in Fars Province, Iran 2013. *Saudi J Kidney Dis Transpl*. 2016;27:423.
11. Ayodele OE, Alebiosu CO. Burden of chronic kidney disease: an international perspective. *Adv Chronic Kidney Dis*. 2010;17:215-24.
12. Barsoum RS. End-Stage Renal Disease in the Developing World. *Artif Organs*. 2002;26:735-6.
13. Najafi I. Peritoneal dialysis in Iran and the Middle East. *Perit Dial Int*. 2009;29:S217-21.
14. Beaumont P, Blake G, Wagstaff JM. *The Middle East: A Geographical Study*. 2nd. Routledge; 2016. p. 13.
15. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Sys Rev*. 2015;4:1.
16. Haghighi AN, Broumand B, D'amico M, Locatelli F, Ritz E. The epidemiology of end-stage renal disease in Iran in an international perspective. *Nephrol Dial Transplant*. 2002;17:28-32.
17. Nafar M, Mousavi SM, Mahdavi M, et al. Burden of chronic kidney disease in Iran. *Iran J Kidney Dis*. 2008;2:183-92.
18. Aghighi M, Mahdavi-Mazdeh M, Zamyadi M, Heidary Rouchi A, Rajolani H, Nourozi S. Changing epidemiology of end-stage renal disease in last 10 years in Iran. *Iran J Kidney Dis*. 2009;3:192-6.
19. Monfared A, Safaei A, Panahandeh Z, Nemati L. Incidence of end-stage renal disease in Guilan Province, Iran, 2005 to 2007. *Iran J Kidney Dis*. 2009;3(4):239-41.
20. Khajehdehi P, Malekmakan L, Pakfetrat M, Roozbeh J, Sayadi M. Prevalence of chronic kidney disease and its contributing risk factors in southern Iran: a cross-sectional adult population-based study. *Iran J Kidney Dis*. 2014;8:109.

21. Afifi A, El Setouhy M, El Sharkawy M, et al. Diabetic nephropathy as a cause of end-stage renal disease in Egypt: a six-year study. *Eastern Mediterr Health J*. 2004;10:620-6.
22. El Minshawy O. End-stage renal disease in the El-Minia Governorate, upper Egypt: an epidemiological study. *Saudi J Kidney Dis Transpl*. 2011;22:1048.
23. Abd AR, Kora EA, El-Barbary HS, Gabr HM, Selim AA. Prevalence of End Stage Renal Disease in Menoufia Governorate. *AIDS*. 2017;748:97-8.
24. Moeller S, Gioberge S, Brown G. ESRD patients in 2001: global overview of patients, treatment modalities and development trends. *Nephrol Dial Transpl*. 2002;17:2071-6.
25. Ereğ E, Süleymanlar G, Serdengeçti K. Nephrology, dialysis and transplantation in Turkey. *Nephrol Dial Transpl*. 2002;17:2087-93.
26. Süleymanlar G, Serdengeçti K, Altıparmak MR, Jager K, Seyahi N, Ereğ E. Trends in renal replacement therapy in Turkey, 1996-2008. *Am J Kidney Dis*. 2011;57:456-65.
27. Maiz HB, Abderrahim E, Zouaghi K. Anemia and end-stage renal disease in the developing world. *Art Organs*. 2002;26:760-4.
28. Al-Rohani M. Renal failure in Yemen. *Transplant Proc*. 2004;36:1777-9.
29. Saeed B, Derani R, Hajibrahim M, et al. Organ failure in Syria: initiating a national deceased donation program. *Saudi J Kidney Dis Transpl*. 2007;18:270.
30. Fituri OM, Shigidi MM, Ramachandiran G, Rashed AH. Demographic data and hemodialysis population dynamics in Qatar: A five year survey. *Saudi J Kidney Dis Transpl*. 2009;20:493.
31. Afifi A. Sixth annual report of the Egyptian Society of Nephrology. Paper presented at the 22nd Congress of the Egyptian Society of Nephrology, 4–8 February 2003, Sharm El Sheikh, Egypt.
32. Hosseinpanah F, Kasraei F, Nassiri AA, Azizi F. High prevalence of chronic kidney disease in Iran: a large population-based study. *BMC Public Health*. 2009;9:44.
33. Connor TM, Oygur DD, Gale DP, et al. Incidence of end-stage renal disease in the Turkish-Cypriot population of Northern Cyprus: a population based study. *PloS One*. 2013;8:e54394.
34. Grassmann A, Gioberge S, Moeller S, Brown G. ESRD patients in 2004: global overview of patient numbers, treatment modalities and associated trends. *Nephrol Dial Transpl*. 2005;20:2587-93.
35. 2015 USRDS Annual Data Report - CKD in the United States, Chapter 1: Incidence, Prevalence, Patient Characteristics, and Treatment Modalities. *Am J Kidney Dis*. 2015;66:S93-110.
36. Einollahi B, Taheri S. Renal transplantation practice in Iran and the Middle East: report from Iran and a review of the literature. *Ann Transplant*. 2008;13:5-14.
37. Naghibi O, Naghibi M, Nazemian F. Gender disparity in kidney transplantation. *Saudi J Kidney Dis Transpl*. 2008;19:545.
38. Ghods AJ. Organ transplantation in Iran. *Saudi J Kidney Dis Transpl*. 2007;18:648.
39. Shaheen FA, Souqiyeh MZ. Survey of the current status of renal transplantation in the Arab countries. *Saudi J Kidney Dis Transpl*. 1998;9:123.
40. Shaheen FA. Organ donation in the Middle East countries. *Ethn Dis*. 2008;19:S1-16.
41. Hassanien AA, Al-Shaikh F, Vamos EP, Yadegarfar G, Majeed A. Epidemiology of end-stage renal disease in the countries of the Gulf Cooperation Council: a systematic review. *JRSM Short Rep*. 2012;3:1-21.
42. Sarnak MJ. Cardiovascular complications in chronic kidney disease. *Am J Kidney Dis*. 2003;41:11-7.
43. Najafi I, Attari F, Islami F, et al. Renal function and risk factors of moderate to severe chronic kidney disease in Golestan Province, northeast of Iran. *PloS One*. 2010;5:e14216.

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