



Evaluation of Iranian Patients with Chronic Renal Failure and End-Stage Renal Disease Admitted to Medical Centers in Mecca and Medina during Hajj in 2012 and 2013: Causes and Outcomes

Seyed Mansour Gatmiri^{1,2}, Najme Shamspour^{1,3,*}, Farzaneh Sadat Minoo^{1,2}, Mahboob Lessan-Pezeshki^{1,2}, Navvab Shamspour⁴ and Aminreza Tabatabaei⁴

¹ Nephrology Research Center, Tehran University of Medical Sciences, Tehran, Iran

² Center of Excellence in Nephrology, Tehran University of Medical Sciences, Tehran, Iran

³ Kerman University of Medical Sciences, Kerman, Iran

⁴ Research Center For Emergency and Disaster Resilience, Red Crescent Society of Islamic Republic of Iran, Tehran, Iran

* **Corresponding author:** Najme Shamspour, Departments of Nephrology, Urology and Renal Transplantation, Kerman University of Medical Sciences, Kerman, Iran. Tel: 03431217243; Email: n.shamspour@kmu.ac.ir

Received 2020 August 22; Revised 2020 September 01; Accepted 2020 September 18.

Abstract

Background: Chronic renal failure (CRF) and end-stage renal disease (ESRD) are among the underlying reasons for the hospitalization of expeditious pilgrims to Mecca.

Objectives: This study aimed to evaluate the reasons and consequences of sending the patients with CRF and ESRD to Mecca to perform rites of pilgrimage.

Methods: This retrospective cross-sectional study assessed the profiles of all pilgrims in 2012 and 2013. The independent variables were awareness and unawareness of the patients with CRF and patients on dialysis; moreover, the dependent variables were reasons for referral and hospitalization in hospital, probable death rate, and indications of dialysis in an emergency.

Results: Out of all Pilgrims, 2416 (1.76% of the total pilgrims' population) cases had CRF, out of whom 1.15%, 10.47%, and 88.36% of the patients were on dialysis, aware, and unaware of their disease, respectively. Furthermore, 93 (3.9%) patients with CRF were hospitalized during Hajj. Cardiovascular disease (41%) and respiratory diseases (20%) were the most common reasons for patients' hospitalization.

Conclusion: It is suggested that the glomerular filtration rate of the pilgrims be calculated before sending them to Hajj; moreover, the patients with CRF should be screened accurately. Proper vaccination and cardio check-up are necessary before the Hajj expedition. Considering low-salt diet and adequate fluid intake in patients with CRF during Hajj can minimize patients' referral to hospitals.

Keywords: Chronic renal failure (CRF), End-stage renal disease (ESRD), Hajj

1. Background

Hajj rite is a universal event in which millions of Muslims gather in Mecca from all over the world. About two million Muslims in the world participate in this religious ritual annually (1). Approximately, 100,000 pilgrims go to Mecca from Iran (2). The 35-45-day course of Hajj has its specific complexities and features regarding health aspects (3). Health problems in days of the Hajj can generally be divided into two groups. The first group of complications includes infectious diseases, trauma, heat exhaustion, as well as digestive and respiratory problems that involve pilgrims during Hajj. Following that the second group consists of the worsening of underlying diseases, such as cardiovascular, respiratory, psychiatric, and renal diseases due to changes in lifestyle and living conditions (4-7).

One of the most important chronic failures affecting a percentage of pilgrims is chronic renal failure (CRF) (8). The CRF is a health problem all over the world, and the prevalence of end-stage renal disease (ESRD) is incrementally high (9). On the other hand, CRF is very prevalent in elders (10) who account for the majority of those going on a

pilgrimage to Mecca. This fact highlights the importance of attention to CRF as much again in the days of Hajj (8).

Many patients on dialysis would like to participate in Hajj spiritual rituals. Since these patients are in a specific disease group, special policies should be considered for them. These patients are more exposed to the risk of infections, nutritional problems, side effects of medications, hospitalization, morbidity, and mortality due to different diseases for their vulnerable situation and weaker immune system (11). On the other hand, cardiovascular diseases in this group of patients are the first reason for death and hospitalization in ordinary conditions (12) that may be the main reason these days for specific conditions of Hajj (1).

According to the specific conditions of these individuals, patients with CRF had been prevented from going to Hajj every few years following the Health Ministry's advice. However, this restriction imposes a heavy mental load on these patients.

2. Objectives

This study aimed to evaluate this issue regarding

the attainment of necessary protocols and recommendations to reduce the probability of hospitalization and complications of CRF and ESRD problems during Hajj.

3. Methods

The study population of this retrospective cross-sectional study included all patients with renal failure who suffered from CRF and ESRD and participated in the Hajj ritual in 2012 and 2013. The medical files of these people were available in the archives of the Iranian Medical Center for Hajj Pilgrims. The samples were selected using a census method.

Electronic profiles were explored in this study before sending all Iranian pilgrims to Hajj in 2012 and 2013. Before being sent to Hajj, evidence of heart disease and testing before dispatching and medications were available for pilgrims. The ESRD on dialysis and CRF patients were identified before embarking by exploring their documents. Subsequently, the glomerular filtration rate (GFR) was calculated according to creatinine, age, and weight recorded in their documents using the Cockcroft-Gault formula. People with GFR less than 60cc/min for 1.73 m² body surface area (BSA) were identified as patients with CRF who were not aware of their illness (unaware).

The ESRD patients on hemodialysis were identified by an introduction form given by Iran Kidney Foundation to introduce them to the dialysis center in Hajj, which was in their document before the expedition. A nephrologist who was a member of the research team evaluated the electronic and non-electronic documents archived in Mecca and Medina hospitals and recorded all the data in the prepared checklists. The data included physical examinations, medical history, findings, analysis of documents, reasons for referral, referral outcome, rate and cause of admissions, need for emergency dialysis, as well as the cause of death and morbidity rates during the Hajj.

The accuracy of the recorded data in the checklist was rechecked by another physician committed to Hajj and Pilgrimage Hospital. The two independent variables were awareness and unawareness of the patients on hemodialysis about CRF and ESRD; moreover, the dependent variables were reasons for referral and hospitalization, admission outcome, causes of mortality and emergency dialysis, and frequency of emergency dialysis.

Furthermore, hospitalization outcomes as full recovery, more advance previous CRF, or death were determined in the checklists. In this study, the questionnaires were initially collected and coded, and the data were entered into SPSS software (version 20) to analyze and test the hypotheses through descriptive and inferential statistics. The inclusion criteria were: 1) diagnosis of the patients with CRF according to the descriptions in the document before

the expedition, 2) GFR less than 60cc/min for 1.73 m² of BSA, and 3) ESRD patients on hemodialysis or peritoneal dialysis before the expedition to Hajj.

On the other hand, the patients with CRF or ESRD on dialysis who referred to the clinic or hospital in the center of Hajj pilgrimage due to accidents, such as trauma and problems unrelated to their underlying disease in the days of Hajj, as well as those With normal renal function before and during the Hajj who were admitted due to acute renal failure and required emergency dialysis were excluded from the study. Informed consent was obtained from all people who went to Hajj regarding the use of their hospitalization documents for research activities; moreover, they were assured of the confidentiality of their information.

4. Results

4.1. Data related to total pilgrims who participated in Hajj during 2012 and 2013

All participated populations in Hajj were 75067 and 61525 cases in 2012 and 2013, respectively (n=136592). Moreover, the mean±SD ages of the participants in 2012 and 2013 were 53±25 and 54±21years, respectively. The results of the t-test showed no significant difference among the participants in this regard during 2012 and 2013 (P=0.231). Furthermore, 29456 (48%) males and 32023 (52%) females, as well as 37564 (50.04%) males and 37503 (49.96%) females participated in Hajj during 2013 and 2012, respectively (P=0.456).

The screening was performed before the participants embarked on Hajj in 2012 and 2013, and the frequency percentages of the chronic diseases in the general population were 38.07% (n=28580) and 26.17% (n=16104) in 2012 and 2013, respectively.

The Chi-square test showed no significant difference between 2012 and 2013 regarding the frequency of patients (P=0.231). In addition, the comparison of patients with a history of renal disease between 2012 and 2013 revealed no significant differences between them in this regard (P>0.05).

According to [Table 1](#), hypertension (HTN) (17.2%), diabetes mellitus (DM) (10.9%), and coronary artery disease (3.5%) were the most common diseases among Iranian pilgrims in descending order. On the other hand, cirrhosis obtained the lowest prevalence rate among diseases. According to the screening data of pilgrims, the frequency percentages of the CRF recorded based on history and ESRD patients on dialysis were estimated at 0.18% and 0.02%, respectively.

According to [Table 1](#), HTN and DM are the most prevalent underlying diseases among Iranian pilgrims in descending order.

4.2. Data related to patients with CRF

Regarding GFR, 2416 (1.7%) pilgrims had GFR

lower than 60cc/min. In total, 0.18% and 1.56% of these populations were aware and unaware of their disease, respectively, before embarking according to their accessible medical documents in the pilgrimage center. In addition, 28 pilgrims (1.65% of the total patients and 0.02% of the total pilgrims) were on dialysis. Totally, among 2416 cases with renal disease, 1512 (63%) individuals were male. Moreover, 4.5% and 32.4% of the females were aware and unaware, respectively. In addition, 0.4% of them were on dialysis.

The mean±SD age of the patients with CRF was 62.51±10.86, and no significant difference was observed between two age groups regarding awareness, unawareness, and dialysis (P>0.05). In the aware group, 190 (75%), 60 (23.7%), and 3 (1.185%) of the patients had 30=<GFR<60, 15=<GFR<30, and GFR<15, respectively. On the other hand, in the unaware group, 1988 (93.1%) and 147 (6.8%) cases had 30=<GFR<60 and 15=<GFR<30, respectively (Table 2).

4.3. Reasons for the hospitalization of the patients with CRF

Totally, 93 (3.9%) patients with CRF were hospitalized in the pilgrimage medical center of Mecca and Medina in 2012 and 2013. Furthermore, 2044 cases of referral and hospitalization were recorded in Mecca and Medina during these 2 years, among which 96 cases (4.5%) were due to CRF, and three cases were removed from the study due to hospitalization by trauma.

Cardiovascular disease (1.6% of the total CRF and 41% of the 93 hospitalized patients with CRF), respiratory diseases (0.8% of the total CRF and 20% of the 93 hospitalized patients with CRF), and renal diseases (0.53% of the total CRF and 13% of the 93 hospitalized patients with CRF) were the leading causes of hospitalization of patients with CRF in Mecca and Medina in 2012 and 2013 (Table 3).

The frequency proportion of hospitalization in the dialysis group was 10 in 93 (10.75% of the hospitalized renal patients), which is equal to 0.48 of

Table 1. Investigation of the disease prevalence in 2012 and 2013

Row	Disease	Frequency		2013	Percent	Significant
		2012	Percent			
1	Hypertension	12328	16%	11176	18%	0.12
2	Diabetes Mellitus	7488	9.9%	7403	12%	0.12
3	Coronary Artery Disease	2780	3.7%	2074	3.3%	0.14
4	Anemia	1965	2.6%	1836	2.9%	0.12
5	COPD	264	0.35%	242	0.39%	0.012
6	Heart Failure	210	0.28%	204	0.33%	0.124
7	History of MI	354	0.47%	325	0.53%	0.231
8	Cardiac Arrhythmia	223	0.29%	212	0.34%	0.234
9	Renal Failure	125	0.166%	128	0.21%	0.125
10	History of Stroke	123	0.163%	113	0.183%	0.123

COPD: Chronic obstructive pulmonary disease
MI: Myocardial infarction

Table 2. Characteristics of patients with chronic renal failure in 2012 and 2013

Chronic Renal Failure	Frequency	Percentage of each group in total patients with renal failure	Percentage of each group of pilgrims	Percentage of male in each group	<GFR <60	15<GFR <30	GFR <15
Aware	253	10.47%	0.18%	5.8%	75%	23.7%	1.18%
Unaware	2135	88.37%	1.56%	56%	93.1%	6.8%	0
Dialysis	28	1.15%	0.02%	0.7%	0	0	100%
Total	2416	100	1.76%	62.5%	-	-	-

Table 3. Main causes of hospitalization of patients with chronic renal failure in Mecca and Medina

Disease	Frequency	Patients with chronic renal failure (Percent) (n=2416)	Admitted patients (n=93) (Percent)
Cardiac Diseases (ACS, CHF, Arrhythmia)	39	1.6	41
Respiratory (Asthma, COPD, Bacterial and Viral Pneumonia)	19	0.8	20
GI (GI Bleeding and Gastroenteritis)	5	0.2	5
Infection (Cellulitis, Sepsis, Peritonitis)	6	0.2	6
Renal (AKI on CKD, Electrolyte Disorders, UTI, Non-Functioning AVF, Kidney Stones)	13	0.53	13
Endocrine (Hypoglycemia and Hypoglycemia)	2	0.01	2
Hematology (Anemia)	1	0.05	1
Ophthalmology (Conjunctivitis)	1	0.05	1
Urology (BPH)	1	0.05	1
Surgery (Appendicitis)	2	0.1	2
Neurology (CVA and Convulsion)	4	0.2	4
Total among 2413 people	93	3.9	100

GI: Gastrointestinal, AKI: Acute Kidney Injury, CKD: Chronic Kidney Disease, AVF: Arteriovenous fistula

Table 4. Problems while hospitalization among patients with chronic renal failure in Mecca and Medina

Disease	Frequency	Percent
Cardiac Diseases	11	0.4
Infectious Diseases	2	0.1
Renal Causes	34	1.4
Endocrine	3	0.1
Hematologic Diseases	17	0.7
Urologic Diseases	1	0.05
Total	68	2.8

the total hospitalizations among all pilgrims. The number of patients on dialysis who participated in Hajj was 28 cases, 35.7% of whom were hospitalized in these days. Hyperkalemia (3 out of 10 patients) and cardiovascular disease (3 out of 10 patients) were the most important reasons for hospitalization in 2012 and 2013, respectively. Therefore, 10.7% of the patients on dialysis were hospitalized due to hyperkalemia and the same number (10.7%) due to cardiovascular disease.

The frequency of hospitalization in the aware group was 10 out of 93 cases (10.75% of the hospitalized patients due to renal failure), which is equal to 0.48% of all hospitalization among all pilgrims. In the aware group, four patients underwent a kidney transplant before, and all of them (100%) were admitted to participate in Hajj. Bacterial pneumonia was the leading cause of hospitalization in aware patients with CRF (3 out of 10 admitted patients and 2 out of the 3 cases with kidney transplant patients).

Out of 93 patients in the unaware group, 73 (78.5%) cases were hospitalized. Moreover, acute coronary syndromes (17 cases out of 73 patients) and bacterial pneumonia (17 cases out of 73 patients) were the major causes of hospitalization among unaware patients.

Other complications during hospitalization are regarded as problems that consist of other reasons for hospitalization. According to Table 4, the majority

of complications during hospitalization among patients with CRF were due to renal failure including hyperkalemia as the most common (n=18), acute kidney injury (AKI) (n=14), and hypernatremia (n=1). Following that, the second group of complications included hematologic disorders, such as anemia (n=17, 0.7%) during hospitalization.

In total, 11 patients required emergency dialysis, including ESRD patients on dialysis (n=9), aware patients with CRF (n=1), and unaware patients with CRF (n=1). Hyperkalemia (4 cases out of 9 patients, 44.4%) was the most common cause of emergency dialysis in ESRD patients on dialysis. Emergency dialysis in these patients was determined just outside the dialysis program routine that required a referral to Iran's hospitals.

Regarding the outcome of hospitalized patients, a 15.9% increase was observed in creatinine (Cr), and renal failure was noted among unaware patients with CRF (Table 5). Considering the hospitalization time of patients, this study indicated that 52.7%, 9.26%, and 20.4% of the hospitalizations were before, after, and during Tashrigh days, respectively (on the 5th day of Dhu al-Hijjah when pilgrims should go to Arafat and Mina). No significant relationship was seen between hospitalization time and reason (P>0.05).

With respect to the heaping up of hospitalization time in different times of the Hajj ritual, the results of this study show that hospitalization times were 10.4%, 4.8%, and 20.4% before, after, and during Tashrigh days, respectively.

During 2012 and 2013, no deaths occurred among patients on dialysis and aware patients with CRF. However, two cases in the unaware group of patients with CRF died in these days. It is worth mentioning that both died at the hotel due to cardiac arrest, which was recorded on their death certificate. One of them was a 53-year-old woman with Cr=1.7, and the other one was a 71-year-old man with Cr=1.5 before embarking to Hajj.

Table 5. Consequences by hospitalization in patients with chronic renal failure

Outcome of hospitalization	Aware (Percent)	Unaware (Percent)	Dialysis (Percent)	Total
Recovery	5 (5.3)	50 (54.3)	4 (4.3)	59 (63.7)
Progression of Stage CKD	5 (5.3)	15 (15.9)	0	20 (21.3)
Transferred to Iran	0	1 (1.1)	0	1 (1.1)
Referral to Saudi Arabia Hospital	0	7 (7.4)	6 (6.4)	13 (13.8)
Total	10 (10.75)	73 (78.6)	10 (10.75)	93 (100)

5. Discussion

In our study, 2135 patients (88.35% of the patients with CRF and 1.56% of the total pilgrims) were unaware of their CRF. Furthermore, HTN (17.2%) and DM (10.9%) were the most frequent underlying diseases among pilgrims during these years. In a study conducted on 89,000 people aged 15-64 years in Iran during 2005, the prevalence of DM and HTN were 7.7% and 25.2%, respectively

(13). According to a study performed on Iranian pilgrims (2009), HTN (20%) and DM (10.8%) were the most prevalent underlying diseases (2).

Similarly, Tabatabaei et al. (2011) estimated the prevalence of CRF based on history before embarking at 10,000 (0.18%) cases among Iranian pilgrims (14). Evidence showed that the amount of CRF was estimated less than the real prevalence rate. National Health and Nutrition Examination Survey III showed a lower awareness level of Americans about renal

diseases (15). This fact that 88.5% of the patients with CRF in our study were unaware of their CRF shows that this unawareness is so high in Iran and highlights the necessity of intelligent planning to execute screening plans and promoting public awareness.

Overall, aware and unaware patients with CRF, as well as ESRD patients on dialysis constitute 2416 of the patients (1.76% of the total pilgrims). According to the recently published statistics by the National Kidney Foundation in the US in late 2011, 26,000,000 adult patients affected by CKD lived in the US (16). In a study conducted in Korea, 26.7% and 8.6% of the subjects with diabetes suffered from microalbuminuria and CKD, respectively (17).

Based on the kidney disease outcomes quality initiative (KDOQI), the rate of CRF in Norway was reported about 10.2%, which is the same in the US (18). The recent data obtained from the US show that out of 7 people, 1 case is afflicted with CKD, which shows a 30% increase, compared to the previous decade. In a study conducted by Framingham on the incidence of CKD for 18.5, the prevalence rate of this disease was determined at 7.9% (18). Moreover, the number of afflicted patients to ESRD worldwide was estimated at 3,346,000 cases at the end of 2014. According to the annual growth of this group of patients in the world (5-6%, compared to 1.1% of the population growth), this problem was regarded as one of the most important obstacles in all countries. At the end of 2014, 2,358,000 and 304,000 cases were on hemodialysis and peritoneal dialysis, respectively; moreover, about 684,000 individuals had a kidney transplant (19, 20). At the end of 2014, the number of Iranian ESRD patients on renal replacement therapy (RRT) was determined at 53,000 people (20). By comparison to the 6% annual growth of ESRD in Iran (20) and country population growth (1.3%) (20, 21), it can be estimated that this population is going to deal with a great social level that will be a critical challenge in all aspects of medical care, economy, country macroplanning, and organizations, such as Hajj and Pilgrimage Organization (20).

At the end of 2014 in Iran, 25,934 people were on hemodialysis (20), 1523 cases were on peritoneal dialysis, and about 25,500 patients had a kidney transplant (20). Moreover, 44% and 63% of the patients with ESRD were older than 60 and 50 years, respectively (22). A study on patients on dialysis in Tehran province, Iran, showed that 56.3% of the patients with advanced ESRD initiated their hemodialysis with temporary catheters, which denotes delays in diagnosis and referral to a nephrologist. A study conducted by Mahdavi-Mazdeh et al. on the increasing rate of prevalence and incidence of advanced ESRD dependent on RRT showed an increase from 238 and 49.9 cases in 2000 to 357 and 63.8 individuals in 2006 Chronic renal

failure (CRF) and end-stage renal disease (ESRD) are among the underlying reasons for the hospitalization of expeditionary pilgrims to Mecca. This study aimed to evaluate the reasons and consequences of sending the patients with CRF and ESRD to Mecca to perform rites of pilgrimage (23). In a published study in Tehran, Iran, the rate of CRF based on GFR less than 60 cc/min/1.73 m² was determined at 18% (24).

In the same vein, in a study conducted by Kalaleh, the prevalence of CRF with GFR less than 60 cc/min/1.73 m² was estimated at 15% (25). In another study conducted in Shahreza, Iran, the CRF was determined at 18%. Studies on societies across the world show a prevalence rate between 10% and 12% (26). In a study conducted by Safarnejad on 17,000 people in 2002-2005, the prevalence of CRF (GFR<60 cc/min/1.73 m²) was observed among 8.3% of the people. In this study, the prevalence rate was a little more in males, compared to females.

In addition to age, CRF shows a direct relationship with obesity and blood pressure; moreover, CRF in diabetics is 10 times more than that in non-diabetics. Furthermore, there is a negative relationship between CRF prevalence and education. Other dangerous factors are family history, as well as the low-socioeconomic status of the people (27).

In a study in Tehran, Iran, on 32000 taxi driver in 2007, CRF (GFR <60 cc/min/1.73 m²) was reported 6.5% (28). Hosseinpanah et al. in a cohort study that was conducted on 100 volunteers older than 20 years of age reported CRF of 18.9% (29). Noori et al. in another 7-year-follow-up on 3107 patients older than 20 years of age reported CRF of 13.5% (30).

According to the older age-range of the studied population, a higher level of CRF was expected; however, it happened may be due to other reasons. Since the majority of the pilgrims were elderlies and despite low GFR in elders, the Cr level may not be so significantly increased because muscular mass reduces by age and this fact can lead to false high GFR.

Secondly, people who are preparing for pilgrimage are in better health conditions than their peers. Therefore, in order to overcome problems in the primary design, a prospective study seems necessary to assess the true prevalence of CRF in pilgrims using precise methods and formulas.

In our study, 67.5% of the known population with CRF were male, and the number of males was more than females in all three aware, unaware, and dialysis groups. However, in total pilgrims, no significant difference was observed among males and females. In a study conducted by Safarnejad et al. in 2002-2005 on 17000 people, the rate of CRF in males was a little more than that in females (27); moreover, in a study performed by Tabatabaei (2011), 62.3% of the patients with CRF were male (14).

In our study, the mean±SD age of the patients with CRF was 62.51±10.86 years, which showed no

significant difference among aware, unaware, and dialysis groups ($P>0.05$). On the other hand, the mean±SD ages of the pilgrims were 53 ± 25 and 54 ± 21 in 2012 and 2013, respectively.

Improvement of socioeconomic conditions and health standards increase life in elderlies on a global scale (31, 32) who account for a high percentage of pilgrims (8). The prevalence of CRF was increased significantly by age; moreover, it was related to obesity, DM, and renal diseases. According to the United States Renal Data System statistics from 1995 to 2005, the increased rates of advanced CRF (ESRD) during 10 years were about 51% and 72% in the age range of 65-74 and over 75 years, respectively (31, 32).

Various diseases can involve kidneys in elderlies, and no disease can be related to a specific age range. However, some of these disorders have more prevalence in geriatrics, such as renal disease due to DM and HTN, as well as amyloidosis (33). By measuring inulin clearance and iothalamate in elderlies, it is proved that GFR will decrease incrementally with increasing age. The Cr clearance in elderlies shows 0.8 ml/min/1.73 m² of BSA annually.

This amount reduces 1 mm/min /1.73 m² BSA annually using the iothalamate clearance method. A few complications, such as HTN, glucose intolerance, DM, systemic renal atherosclerosis, and dyslipidemia reduce GFR in elderlies significantly (33, 34). The underlying diseases, such as HTN and DM, were common in our study.

A significant difference was observed between unaware (1.64 mg/dl) and aware (1.86 mg/dl) groups regarding the mean Cr ($P>0.001$), and the aware group had higher Cr, compared to the unaware group. In addition, in the aware group, 190 (75%), 60 (23.7%), and 3 (1.18%) patients had $30\leq\text{GFR}<60$, $15\leq\text{GFR}<30$, and $\text{GFR}<15$, respectively.

On the other hand, in the unaware group, 1988 (93.1%) and 147 (6.8%) patients were in the $30\leq\text{GFR}<60$ and $15\leq\text{GFR}<30$ groups, respectively. It should be noted that no one in the unaware group was in the $\text{GFR}<15$ group.

According to the mentioned observations, the unaware group was in the CRF group. This can be promising that proper screening should be considered for those who are going to be sent to Hajj to identify the initial steps of this disease and prevent moving toward advanced ESRD.

Out of 2044 (927 cases in 2013 and 1117 cases in 2012) admissions and referrals to emergency departments of the pilgrimage medical hospitals, 96 cases (4.6% of all hospitalizations) were related to CRF. Among 96 cases, 3 cases were removed from the study due to trauma. Totally, 93 people equivalent to 3.9% of renal diseases were hospitalized in pilgrimage medical hospitals.

Cardiovascular diseases (1.6% of the total

patients with CRF and 41% in 93 admissions), respiratory diseases (0.8% of the patients with CRF and 20% in 93 admissions), and renal disease (0.53% of the patients with CRF and 13% in 93 admissions) were the main reasons for the admission of patients with CRF to the hospitals in Mecca and Medina.

According to several studies, cardiovascular problems are responsible for more than 50% of the death and admissions in renal disease (12). Increasing cardiovascular problems followed by death starts in the era of $\text{GFR}<50-60$ ml/min (35). Evidence shows that clinical presentations and pathology of cardiovascular disease are different in the presence of CRF, and CRF is an independent risk factor for cardiovascular diseases (36). According to studies, the incidence and severity of coronary artery disease increase with a decrease in GFR (37). The prevalence of congestive heart failure in patients with CRF is higher than that in others, and its prevalence increase with decreasing GFR (38).

Ghaanei et al. (1998) in a study showed that the majority of the afflicted patients with CRF were sent each year with a high probability of intensifying complications, which can be an important risk for cardiovascular patients. The prevalence of ischemic heart disease among Iranian pilgrims was estimated at 491.2 per 10,000 people (39). Another study was conducted in 2011 on 111 patients with a mean age of 62 years. According to the results, 34% of the cases had cardiovascular diseases, and 20% of the cases were referred with HTN; moreover, cardiac attacks were recorded in 17% of the patients (40).

In our study, about 40% of the admissions of patients with CRF was due to cardiac problems, which was regarded as the main reason for the admission of patients on dialysis (3 cases out of 10 patients). The second reason for the admission of patients with CRF was respiratory disease and mainly pneumonia (20%). Furthermore, the most common reason for pneumonia in Hajjis was a viral infection, especially influenza, and bacterial infection, especially mycoplasma pneumonia (41).

In our study, among patients on dialysis, only one case of bacterial pneumonia was admitted at first with viral pneumonia leading to sepsis and hypotension. In the aware group with renal history, there were three admissions, of whom two cases had a kidney transplant, and other cases of admissions were due to pneumonia in the unaware patients. In unaware patients, bacterial pneumonia (17 cases out of 73 patients) (23.2%) was the second main reason for admission.

Probably, the reason for a small number of admissions in the first two groups (dialysis and aware patients), compared to the total population with pneumonia was the vaccination of all patients on dialysis and with CRF against influenza according to the pilgrimage protocol. This vaccination is obliged for this group; however, it was not obliged for all

Hajis in the unaware groups. It was observed in the studies on patients with CRF that the influenza vaccine reduced hospitalization rate and mortality risk in this population (42). Therefore, these findings recommend screening for CRF and vaccination in all GFR younger than 60 years old.

Another issue is the effectiveness of the influenza vaccine in the kidney transplantation group, compared to healthy ones, as well as a decrease in the effect of the vaccine by mycophenolate mofetil (43). In our study, both the transplant patients who were admitted for pneumonia were taking mycophenolate mofetil. An important point about patients with a kidney transplant is the necessity of attention to sending these patients to Hajj, especially in the fall and winter when influenza is epidemic and this infection can be associated with rejection and even death.

This issue is of critical importance despite the few numbers of transplant cases among pilgrims in our study, which is not valuable statistically. The third main reason for the admission of the patients with CRF was renal causes that accounts for 0.53% of the hospitalization.

In total, 1.4% of the cases had hyperkalemia (18 males), and 14 males suffered from AKI, followed by one case of hypernatremia. Another study investigated the causes of admission of Hajjis during Mina and Arafat in 2003. In this study, 1487 patients were admitted, and 2.4% of them were due to renal diseases (44). This study had no focus on whether the renal disease was acute or chronic. In our study, renal disease percentage was less (0.53% vs. 2.4%) than that in the aforementioned study. Although in patients with CRF, a higher percentage of admission is naturally expected, this difference may be related to a different time of the study since our study was conducted in the first and second months of the fall. The repetition of the study in warm months of the year will increase the probability of dehydration, heatstroke, rhabdomyolysis, and nephrolithiasis as the causes of admission in patients with CRF.

Therefore, studies on CRF in warm months, compared to other months can help regulate comprehensive protocol to guide pilgrims regarding less dangerous pilgrimage. Among renal causes of admission, hypokalemia was significantly noted in all three groups, especially in dialysis patients. One of the main causes of hyperkalemia during Hajj is the intake of food with more potassium due to lack of obeying diet and constipation in these days. Therefore, dialysis patients are recommended to consume a low potassium and high fiber diet along with a laxative (kayexalate powder) during Hajj (45).

The admission frequency of patients on hemodialysis was 10 out of 93 admissions (10.75%), which was equal to 0.48% of the total admissions among pilgrims. Since the participator dialysis patients were 28, 35.7% of them were admitted to

participate in Hajj medical hospitals. The frequency of admission in the aware group was 10 out of 93 admissions (10.75%), which was equal to 0.48% of the total admissions among Hajjis. Since all were 253 cases, it means that 3.9% were admitted during Hajj. In total, four patients with renal transplant were among the aware group and all (100%) of them were admitted to participate in Hajj. The frequency of admission in the unaware group was 73 cases out of 93 admissions (78.5%), which was equal to 3.5% of the total admissions among Hajjis. Since all were 2135, it means that 3.4% of them were admitted during these days.

Regarding the admission proportion to the initial population of each group, four patients were with renal transplant (100%) and 10 (35.70%) cases out of 28 patients on dialysis were admitted during Hajj, which was more than that, compared to two other groups.

Since the number of renal transplants was low in our study, it was not valuable statistically; however, it indicates that the transplant patients should be sent with more cautious, especially in months with more risks of epidemic infectious diseases. According to the main causes of admission of patients on dialysis, including hyperkalemia (3 cases out of 10 patients) and cardiovascular diseases (3 cases out of 10 patients), screening for cardiovascular disease, nutritional considerations, and prescription of kayexalate, as well as laxatives, should be considered. If necessary, emphasis on three-time weekly dialysis can prevent complications of dialysis patients and hospitalization during Hajj.

Out of 93 admissions of patients on dialysis and with CRF, there were 67.7% recovery and 21.3% increase in the stage of CKD; moreover, 1.1% and 13.8% were transferred to hospitals in Iran and Saudi Arabia, respectively. All four kidney transplant patients experienced an increase in the stage of CKD. Making transplant patients aware of this issue can be effective in their decision to go or not to go to this travel.

In a study conducted on the reasons for sending pilgrims back to Iran in 2011, the majority of the reasons were psychiatric problems (65%), followed by neurologic problems (23%), respiratory problems (12%), and renal problems (1%) (44). In our study, just one person was sent to Iran due to cellulitis, osteomyelitis, and the need for amputation after Tashrigh days. The majority of the causes of referring the pilgrims to the hospitals in Saudi Arabia were a need for dialysis since Iran Medical Center in Mecca and Medina was not equipped with this facility.

One case in the unaware group experienced emergency dialysis due to gastroenteritis and rising of Cr from 3.4mg /dl (before being sent) to 6 mg /dl, nausea, vomiting, and confusion. Another one in the aware group also had Cr=4 mg/dl and was sent to hospitals during Tashrigh days and in these days. He

experienced a rising in Cr level to 8mg/dl, as well as vomiting and K=7 meq/L. The second patient suffered from ESRD followed by regular chronic dialysis. Dehydration prevention and provision of sufficient drinking should be recommended to the patients with CRF in Hajj, especially during Tashrigh days.

The main cause of emergency dialysis in patients with CRF (4 out of 9 cases) was hyperkalemia. A study was performed on 213 hemodialysis patients who referred to the dialysis center in Medina from 1st January to 30th December 1996. The main cause of the emergency dialysis (16.9%) was hyperkalemia (potassium>6.5 meq/L), which was consistent with the result in this study (46). Therefore, attention to diet and prescription of laxatives (kayexalate powder) seem necessary in Tashrigh days.

In our study, out of 64 deaths in 2012 and 2013, two cases were unaware of CRF and died at the hotel due to cardiac arrest that was recorded in their death certificate. One patient was a 53-year-old woman with Cr=1.7 mg/dl (GFR=37.45) and another one was a 71-year-old man with Cr=1.5 mg/dl (GFR=40.83). Among patients on dialysis and with CRF in the aware group, there was no recorded death during these two years. It seems necessary to evaluate the morbidity and mortality rate of patients with CRF who died at least three months after Hajj.

6. Conclusion

It is suggested that the glomerular filtration rate of the pilgrims be calculated before sending them to Hajj; moreover, the patients with CRF should be screened accurately. Proper vaccination and cardio check-up are necessary before the Hajj expedition. Considering low-salt diet and adequate fluid intake in patients with CRF during Hajj can minimize patients' referral to hospitals.

Acknowledgements

The authors would like to thank the intimate supports of the Zyarat Organization of the Islamic Republic of Iran for their contribution to collecting the data.

Footnotes

Authors' Contribution: Conceived and designed the analysis; Seyed Mansour Gatmiri, Najme Shamspour.

Collected the data; Seyed Mansour Gatmiri, Najme Shamspour, Navvab Shamspour, Aminreza Tabatabaei

Contributed data or analysis tools; Seyed Mansour Gatmiri, Najme Shamspour, Farzaneh Sadat Minoo, Mahboob Lessan-Pezeshki

Performed the analysis: Seyed Mansour Gatmiri, Najme Shamspour, Navvab Shamspour, Aminreza Tabatabaei

Wrote the paper: Seyed Mansour Gatmiri, Najme Shamspour

Ethical Approval: Ethical approval was obtained from the Tehran University of Medical Sciences, Tehran, Iran.

Funding/Support: This study was a proposal (grant No: 93-02-146-26193) and a thesis (No: 92114 02006) supported by Tehran University of Medical Sciences, Tehran, Iran.

References

1. Serafi A. Pattern of cardiovascular diseases in pilgrims admitted in Al-Noor hospital Makkah during 1429H. *Pak J Physiol.* 2010; **6**(1):14-7.
2. Tabatabaei A, Mortazavi M. Prevalence of underlying diseases in & Pilgrimage. Medical Congress in & Pilgrimage, Tehran, Iran; 2011. P. 12.
3. Ahmed QA, Arabi YM, Memish ZA. Health risks at the Hajj. *Lancet.* 2006; **367**(9515):1008-15. doi: [10.1016/S0140-6736\(06\)68429-8](https://doi.org/10.1016/S0140-6736(06)68429-8). [PubMed: [16564364](https://pubmed.ncbi.nlm.nih.gov/16564364/)].
4. Al-Ghamdi SM, Akbar HO, Qari YA, Fathaldin OA, Al-Rashed RS. Pattern of admission to hospitals during Muslim pilgrimage (Hajj). *Saudi Med J.* 2003; **24**(10):1073-6. [PMID: 14578971].
5. Madani TA, Ghabrah TM, Albarrak AM, Alhazmi MA, Alazraqi TA, Althaqafi AO, et al. Causes of admission to intensive care units in the season of the Islamic year 1424 (2004). *Ann Saudi Med.* 2006; **27**(2):101-5. doi: [10.5144/0256-4947.2007.101](https://doi.org/10.5144/0256-4947.2007.101). [PubMed: [17356316](https://pubmed.ncbi.nlm.nih.gov/17356316/)].
6. Gautret P, Soula G, Delmont J, Parola P, Brouqui P. Common health hazards in French pilgrims during the of 2007: a prospective cohort study. *J Travel Med.* 2009; **16**(6):377-81. doi: [10.1111/j.1708-8305.2009.00358.x](https://doi.org/10.1111/j.1708-8305.2009.00358.x). [PubMed: [19930376](https://pubmed.ncbi.nlm.nih.gov/19930376/)].
7. Khan NA, Ishag AM, Ahmad MS, El-Sayed FM, Bachal ZA, Abbas TG. Pattern of medical diseases and determinants of prognosis of hospitalization during 2005 Muslim pilgrimage in a tertiary care hospital. A prospective cohort study. *Saudi Med J.* 2006; **27**(9):1373-80. [PubMed: [16951776](https://pubmed.ncbi.nlm.nih.gov/16951776/)].
8. Madani TA, Ghabrah TM, Al-Hedaihy MA, Alhazmi MA, Alazraqi TA, Albarrak AM, et al. Causes of hospitalization of pilgrims during the Hajj period of the Islamic year 1423 (2003). *Ann Saudi Med.* 2006; **26**(5):346-51. doi: [10.5144/0256-4947.2006.346](https://doi.org/10.5144/0256-4947.2006.346). [PubMed: [17019102](https://pubmed.ncbi.nlm.nih.gov/17019102/)].
9. Hassannia T, Farzadfar F, Noori A, Moradi-Lakeh M, Delavari F, Jamshidi HR, et al. National and sub-national prevalence, trend, and burden of end stage renal diseases (ESRD) in Iran 1990-2013; the study protocol. *Arch Iran Med.* 2014; **17**(12):800-3. [PubMed: [25481317](https://pubmed.ncbi.nlm.nih.gov/25481317/)].
10. Vachharajani TJ, Moist LM, Glickman MH, Vazquez MA, Polkinghorne KR, Lok CE, et al. Elderly patients with CKD--dilemmas in dialysis therapy and vascular access. *Nat Rev Nephrol.* 2014; **10**(2):116-22.
11. Hauser AB, Stinghen AE, Kato S, Buchares S, Aita C, Yuzawa Y, et al. Characteristics and causes of immune dysfunction related to uremia and dialysis. *Perit Dial Int.* 2008; **28**(Suppl 3):S183-7. [PubMed: [18552253](https://pubmed.ncbi.nlm.nih.gov/18552253/)].
12. de Jager DJ, Vervloet MG, Dekker FW. Noncardiovascular mortality in CKD: an epidemiological perspective. *Nat Rev Nephrol.* 2014; **10**(4):208-14. doi: [10.1038/nrneph.2014.8](https://doi.org/10.1038/nrneph.2014.8). [PubMed: [24492321](https://pubmed.ncbi.nlm.nih.gov/24492321/)].
13. Noori N, Hosseinpanah F, Nasiri AA, Azizi F. Comparison of overall obesity and abdominal adiposity in predicting chronic kidney disease incidence among adults. *J Ren Nutr.* 2009; **19**(3):228-37. doi: [10.1053/j.jrn.2008.11.005](https://doi.org/10.1053/j.jrn.2008.11.005). [PubMed: [19261489](https://pubmed.ncbi.nlm.nih.gov/19261489/)].
14. Tabatabaei A, Eynolahi B. Prevalence of CKD in & pilgrimage. Medical Congress in & Pilgrimage, Tehran, Iran; 2011. P. 12.
15. Levey AS, Atkins R, Coresh J, Cohen EP, Collins AJ, Eckardt KU, et al. Chronic kidney disease as a global public health problem: approaches and initiatives - a position statement from Kidney Disease Improving Global Outcomes. *Kidney Int.* 2007;

- 72(3):247-59. doi: [10.1038/sj.ki.5002343](https://doi.org/10.1038/sj.ki.5002343). [PubMed: 17568785].
16. Levey AS, de Jong PE, Coresh J, El Nahas M, Astor BC, Matsushita K, et al. The definition, classification, and prognosis of chronic kidney disease: a KDIGO Controversies Conference report. *Kidney Int.* 2011;**80**(1):17-28. doi: [10.1038/ki.2010.483](https://doi.org/10.1038/ki.2010.483). [PubMed: 21150873].
 17. Ahn JH, Yu JH, Ko SH, Kwon HS, Kim DJ, Kim JH, et al. Prevalence and determinants of diabetic nephropathy in Korea: Korea national health and nutrition examination survey. *Diabetes Metab J.* 2014;**38**(2):109-19. doi: [10.4093/dmj.2014.38.2.109](https://doi.org/10.4093/dmj.2014.38.2.109). [PubMed: 24851205].
 18. Eckardt KU, Berns JS, Rocco MV, Kasiske BL. Definition and classification of CKD: the debate should be about patient prognosis--a position statement from KDOQI and KDIGO. *Am J Kidney Dis.* 2009;**53**(6):915-20 .doi: [10.1053/j.ajkd.2009.04.001](https://doi.org/10.1053/j.ajkd.2009.04.001). [PubMed: 19406541].
 19. Anand S, Khanam MA, Finkelstein FO. Global perspective of kidney disease. Nutrition in kidney disease 2014. Totowa, NJ: Humana Press; 2014. doi: [10.1007/978-1-62703-685-6_2](https://doi.org/10.1007/978-1-62703-685-6_2).
 20. Dialysis Iranian Consortium. A comprehensive report on the status of patients with kidney failure in the world and Iran. Tehran: Dialysis Iranian Consortium; 2014.
 21. Statistical Center of Iran. Available at: URL: <https://www.amar.org.ir/english>; 2014.
 22. Haghghi M, Heydari RA, Zamyadi M, Mahdavi MM, Nourouzi S, Rajolani H, et al. Dialysis in Iran. *Iran J Kidney Dis.* 2008;**2**(1):11-5.
 23. Mahdavi-Mazdeh M, Heidary Rouchi A, Norouzi S, Aghighi M, Rajolani H, Ahrabi S. Renal replacement therapy in Iran. *Urol J.* 2007;**4**(2):66-70. [PubMed: 17701924].
 24. Mahdavi-Mazdeh M, Zamyadi M, Nafar M. Assessment of management and treatment responses in haemodialysis patients from Tehran province, Iran. *Nephrol Dial Transplant.* 2008;**23**(1):288-93. doi: [10.1093/ndt/gfm580](https://doi.org/10.1093/ndt/gfm580). [PubMed: 17965435].
 25. Aghighi M, Mahdavi-Mazdeh M, Zamyadi M, Heidary RA, Rajolani H, Nourozi S. Changing epidemiology of end-stage renal disease in last 10 years in Iran. *Iran J Kidney Dis.* 2009;**3**(4):192-6. [PubMed: 19841521].
 26. Larijani B, Javadi A, Shafae A, Mahmoudi M, Baradar Jalilli R, Hemati P. Screening for microalbuminuria in the early detection of diabetic nephropathy: a cheap and simple method. *Acta Med Iran.* 2002;**40**:65-8.
 27. Safarinejad MR. The epidemiology of adult chronic kidney disease in a population-based study in Iran: prevalence and associated risk factors. *J Nephrol.* 2009;**22**(1):99-108. [PubMed: 19229824].
 28. Mahdavi-Mazdeh M, Saeed Hashemi Nazri S, Hajghasemi E, Nozari B, Zinat Nadia H, Mahdavi A. Screening for decreased renal function in taxi drivers in Tehran, Iran. *Ren Fail.* 2010;**32**(1):62-8. doi: [10.3109/08860220903491190](https://doi.org/10.3109/08860220903491190). [PubMed: 20113268].
 29. Hosseinpanah F, Kasraei F, Nassiri A, Azizi F. High prevalence of chronic kidney disease in Iran: a large population-based study. *BMC Public Health.* 2009 ; **9**:44 doi: [10.1186/1471-2458-9-44](https://doi.org/10.1186/1471-2458-9-44). [PubMed: 19183493].
 30. Noori N, Hosseinpanah F, Nasiri AA, Azizi F. Comparison of overall obesity and abdominal adiposity in predicting chronic kidney disease incidence among adults. *J Ren Nutr.* 2009; **19**(3):228-37. doi: [10.1053/j.jrn.2008.11.005](https://doi.org/10.1053/j.jrn.2008.11.005). [PubMed: 19261489].
 31. Vachharajani TJ, Moist LM, Glickman MH, Vazquez MA, Polkinghorne KR, Lok CE, et al. Elderly patients with CKD--dilemmas in dialysis therapy and vascular access. *Nat Rev Nephrol.* 2014;**10**(2):116-22. doi: [10.1038/nrneph.2013.256](https://doi.org/10.1038/nrneph.2013.256). [PubMed: 24296629].
 32. James MT, Hemmelgarn BR, Tonelli M. Early recognition and prevention of chronic kidney disease. *Lancet.* 2010; **375**(9722):1296-309. doi: [10.1016/S0140-6736\(09\)62004-3](https://doi.org/10.1016/S0140-6736(09)62004-3). [PubMed: 20382326].
 33. Mathew T, Corso O. Review article: early detection of chronic kidney disease in Australia: which way to go? *Nephrology (Carlton).* 2009;**14**(4):367-73. doi: [10.1111/j.1440-1797.2009.01113.x](https://doi.org/10.1111/j.1440-1797.2009.01113.x). [PubMed: 19563377].
 34. Takazakura E, Sawabu N, Handa A, Takada A, Shinoda A, Takeuchi J. Intrarenal vascular changes with age and disease. *Kidney Int.* 1972;**2**(4):224-30. doi: [10.1038/ki.1972.98](https://doi.org/10.1038/ki.1972.98). [PubMed: 4657923].
 35. Locatelli F, Marcelli D, Conte F, D'Amico M, Del Vecchio L, Limido A, et al. Cardiovascular disease in chronic renal failure: the challenge continues. Registro Lombardo Dialisi e Trapianto. *Nephrol Dial Transplant.* 2000;**15**(Suppl 5):69-80. doi: [10.1093/ndt/15.suppl_5.69](https://doi.org/10.1093/ndt/15.suppl_5.69). [PubMed: 11073278].
 36. Fleischmann EH, Bower JD, Salahudeen AK. Are conventional cardiovascular risk factors predictive of two-year mortality in hemodialysis patients? *Clin Nephrol.* 2001;**56**(3):221-30. [PubMed: 11597037].
 37. Herzog CA, Asinger RW, Berger AK, Charytan DM, Díez J, Hart RG, et al. Cardiovascular disease in chronic kidney disease. A clinical update from Kidney Disease: Improving Global Outcomes (KDIGO). *Kidney Int.* 2011;**80**(6):572-86. doi: [10.1038/ki.2011.223](https://doi.org/10.1038/ki.2011.223). [PubMed: 21750584].
 38. Ahmed A, Rich MW, Sanders PW, Perry GJ, Bakris GL, Zile MR, et al. Chronic kidney disease associated mortality in diastolic versus systolic heart failure: a propensity matched study. *Am J Cardiol.* 2007;**99**(3):393-8. doi: [10.1016/j.amjcard.2006.08.042](https://doi.org/10.1016/j.amjcard.2006.08.042). [PubMed: 17261405].
 39. Ghanei H. Cardiovascular disease in the house of God before and after the pilgrims 1994. *J Isfahan Univ Med Sci.* 1995;**3**(4):290-3.
 40. Almalki WH. The prevalence of cardiovascular diseases and role of protective measures among hajj pilgrims 1432 (2011). *Pak J Pharmacol.* 2012;**29**(2):29-34.
 41. Al-Asmary S, Al-Shehri AS, Abou-Zeid A, Abdel-Fattah M, Hifnawy T, El-Said T. Acute respiratory tract infections among medical mission personnel, Saudi Arabia. *Int J Infect Dis.* 2007;**11**(3):268-72. doi: [10.1016/j.ijid.2006.04.008](https://doi.org/10.1016/j.ijid.2006.04.008). [PubMed: 16905350].
 42. Gilbertson DT, Unruh M, McBean AM, Kausz AT, Snyder JJ, Collins AJ. Influenza vaccine delivery and effectiveness in end-stage renal disease. *Kidney Int.* 2003;**63**(2):738-43. doi: [10.1046/j.1523-1755.2003.00787.x](https://doi.org/10.1046/j.1523-1755.2003.00787.x). [PubMed: 12631142].
 43. Danzinger-Isakov L, Kumar D; AST Infectious Diseases Community of Practice. Guidelines for vaccination of solid organ transplant candidates and recipients. *Am J Transplant.* 2009;**9**(Suppl 4):S258-62. . doi: [10.1111/j.1600-6143.2009.02917.x](https://doi.org/10.1111/j.1600-6143.2009.02917.x). [PubMed: 20070687].
 44. Tabatabaei A, Mortazavi SM, Shamspour N, Shushtarizadeh N. Health knowledge, attitude and practice among Iranian pilgrims. *Iran Red Crescent Med J.* 2015;**17**(2):e12863. doi: [10.5812/ircmj.12863](https://doi.org/10.5812/ircmj.12863). [PubMed: 25838929].
 45. Sterns RH, Cox M, Feig PU, Singer I. Internal potassium balance and the control of the plasma potassium concentration. *Medicine.* 1981;**60**(5):339-54. doi: [10.1097/00005792-198109000-00002](https://doi.org/10.1097/00005792-198109000-00002). [PubMed: 6268928].
 46. Mohamed AO, Sirwal IA, Bernieh B, Ahmed M. Patients on hemodialysis visiting madina munawarah: communication between nephrologists. *Saudi J Kidney Dis Transpl.* 2000; **11**(1):31-34. [PubMed: 18209295].