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Epidemiology of End-Stage Renal Disease in Fayoum governorate (Egypt)

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Abstract

Introduction: Chronic kidney disease represents a common health burden in Egypt and worldwide. Hemodialysis remains the main renal replacement modality in spite of the advent of kidney transplantation. Identification of the risk factors is the first line to control disease spread and decrease its prevalence.

Aim of the work: To evaluate the main causes and risk factors for end-stage renal disease (ESRD) among the Egyptian population

Subjects and Methods: This cross-sectional study was held on 1000 HD after the exclusion of patients below 18 or above 60 and residents outside the Fayoum governorate. Patients were recruited from Fayoum governmental hospitals and Fayoum university hospital, Egypt. Data were collected from patient medical records, and missed data were collected from the patients or their relatives.

Results: Mean age of the included patients was 49±10.1 years. Most patients in the current study were males (68.5%) and nonsmokers. ESRD was caused by hypertension (HTN) (46.1%), Kidney stones (25.4%), unknown causes (10.3%), and a combination of HTN and diabetes mellitus (DM) (6.8%). There were statistically significant differences between males and females regarding the frequency of some original kidney diseases. There were no statistically significant effects of working on the frequency of different kidney diseases.

Conclusion: HTN, followed by Kidney stones, was the commonest cause of ESRD among HD patients in Fayoum. Future epidemiological studies should be conducted to investigate the unknown causes of ESRD.

Keywords: End-stage renal disease; HD; Epidemiological studies.

1. Introduction

End-Stage Renal Disease (ESRD) is an increasingly major health problem worldwide. It is associated with considerable co-morbidity and mortality. Despite the widespread use of peritoneal dialysis and renal transplantation, hemodialysis (HD) remains the main renal replacement therapy in most countries worldwide. Chronic kidney disease (CKD) is one of the primary causes of premature death and economic cost to both the public and private sectors [1].

Chronic kidney disease is devastating due to poverty and lack of awareness among individuals with a family history of diabetes mellitus (DM), hypertension (HTN), or kidney disease [2].

Identified risk factors for CKD are HTN, DM, cardiovascular diseases (CVDs),

chronic glomerulonephritis (GN), smoking, autoimmune disease, family history of kidney disease, nephrotoxic drugs, poor education level, and infectious disease next to poor sanitation, poor clean and safe water supply [3].

CKD is associated with age-related renal function decline accelerated in HTN, DM, obesity, and primary renal disorders. However, CKD of unknown etiology (CKDu) is also prevalent and rapidly progressing in some regions of the world notably in Africa, Central America, and Asia [4].

In spite of the presence of various epidemiological studies evaluating the risk factors for chronic kidney diseases, this type of study is still deficient in Egypt. With the advent of renal biopsy, identification of original kidney disease became more feasible, while better results from epidemiological studies might be obtained.

The current study aimed to evaluate the main causes and risk factors for ESRD among the Egyptian population in the Fayoum governorate.

2. Subjects and methods

2.1. Subjects

The material of the current Cross-sectional study included 1000 HD patients who were recruited from Fayoum governmental hospitals and Fayoum university hospital, Egypt.

The sample size was calculated using the G-power program with α. Error = 0.05 and power 80% depending on the prevalence of HD in Egypt in previous studies and it was equal to a minimum of 1000 patients.

Informed consent was obtained from all participants and approval was obtained from institutional review board (IRB) No. M341 in Faculty of Medicine, Fayoum University, Fayoum, Egypt.

Inclusion criteria

The patients who fulfilled the following criteria were included in the study: maintained on HD; age range from 18 to 60 years; Fayoum governorate resident.

Exclusion criteria

Any patients who had one or more of the following criteria were excluded from the study: age below 18 or above 60 years; resident outside Fayoum governorate.

2.2. Methods

Patient data were collected for the medical records of the included patients including:

a) Demographics and associated medical disorders: age, sex, body weight, height, occupation, residency, and special habits (smoker).
b) Medical conditions included HTN, DM, Familial Mediterranean Fever (FMF), CVDs, Kidney stones, urinary tract infections (UTI), and immunological diseases.
c) Laboratory investigations included creatinine, urea, calcium, phosphorus, uric acid, iPTH, sodium, and potassium. The prevalence of each original kidney disease in relation to age, sex, residency, and occupation was assessed.

2.3. Statistical analysis

All data were tabulated in SPSS sheet V. 21. Categorical data were expressed in number and percent and were tested using a Chi-square test while continuous data were expressed as mean and standard deviation and were tested using student t-test when comparing between 2 groups or Kruskal Wallis test when comparing more than two groups.

3. Results

The study included 1000 patients with a mean age of 49±10.1 years and male predominance (68.5%). The mean body weight was 72.8±13.9 Kg and the mean body mass index (BMI) was 27.2±4.8 Kg/m^2. Most of the included patients were non-smokers (68.8%). About 42.3% were not working while the remaining patients were working (worker (47.7%); employers (8.4%); professionals (1.6%)). They had different distribution over Fayoum governorate and most of them were Fayoum city dwellers (33.6%) while 16.2% were from Senoris, 11.3% were from Yousif Elsedik, 8.8% were from Ibsheway, 13.8% were from Etsa, and 16.3% from Tamiyya. Only 1.7% of the included patients had a positive family history of renal disease. The included patients have maintained on dialysis for 7.1±3.8 years and about 35.2% of them were positive for hepatitis C serology (Table 1).

Table 1: Demographics and baseline characteristics of the study participants.

Parameters		Frequency (n=1000)
Gender	Male	685 (68.5%)
	Female	315 (31.5%)
Smoking	Smoker	248 (24.8%)
	Ex-smoker	64 (6.4%)
	Non-smoker	688 (68.8%)
Occupation	Unemployed	423 (42.3%)
	Worker	477 (47.7%)
	Employer	8 (0.8%)
	Professional	16 (1.6%)
Residence	Fayoum	336 (33.6%)
	Senoris	162 (16.2%)
	Yousif Elsedik	113 (11.3%)
	Ibshway	88 (8.8%)
	Etsa	138 (13.8%)
	Tamiyya	163 (16.3%)
Family History of CKD	Positive	17 (1.7%)
	Negative	983 (98.3%)
HCV serology	Positive	68 (6.8%)
	Negative	352 (35.2%)

Table 2 showed that 46.1% of cases had end renal disease caused by HTN, followed by 25.4% because of Kidney stones, and 10.3% of them because of unknown causes, and 6.8% driven by a combination of HTN and DM, and the lowest percentage was for uric acid and non-steroidal anti-inflammatory drugs (NSAIDs) 0.1%. The distribution of different diseases of the highest frequency was shown in Figure 1.

Table 2: Frequency of different causes of ESRD in the total cohort.

Parameters	Frequency (n=1000)
Unknown	103 (10.3%)
HTN	461 (46.1%)
Kidney stones	254 (25.4%)
DM	26 (2.6%)
HTN and DM	68 (6.8%)
Bladder cancer	5 (0.5%)
CVDs	8 (0.8%)
NSAIDs	18 (1.8%)
HTN and NSAIDs	9 (0.9%)
Uric acid and NSAIDs	1 (0.1%)
Glomerulonephritis (GN)	20 (2%)
UTI	9 (0.9%)
UTI and NSAIDs	7 (0.7%)
Amyloidosis	4 (0.4%)
FMF	2 (0.2%)
Hemorrhage	3 (0.3%)
Systemic lupus erythromatosis (SLE)	2 (0.2%)

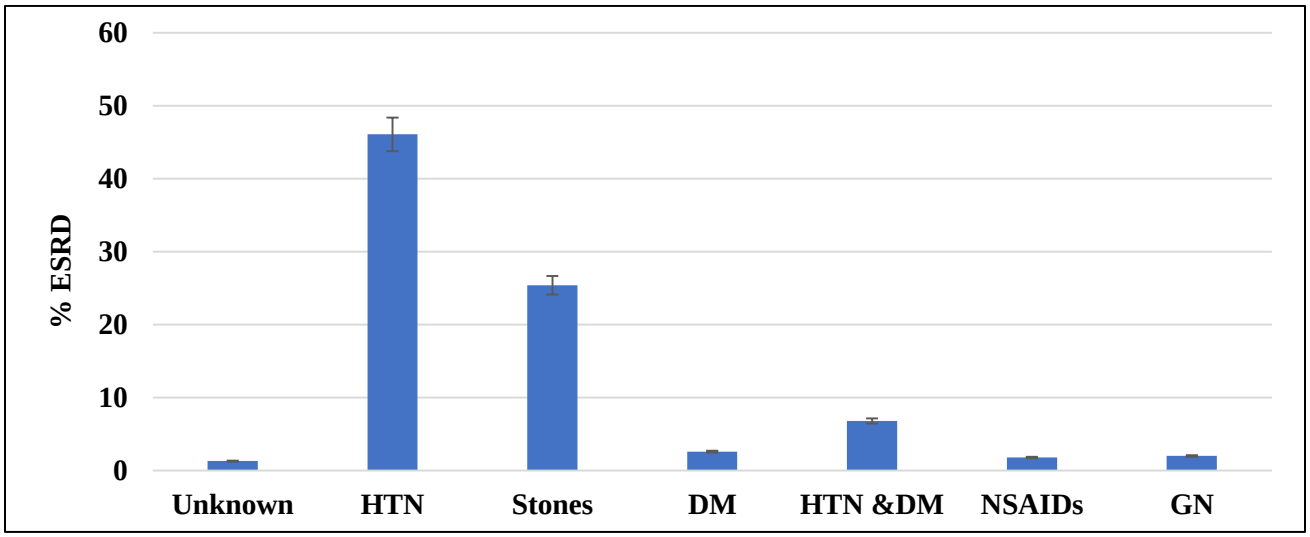

Figure 1: Distribution of different kidney diseases of the highest frequencies in the study populations.

Table 3 showed a statistical significance of the main causes of ESRD (*P<0.001*) with highest mean age among patients with bladder cancer, and hemorrhage, while the lowest mean among patients had Systemic lupus erythematosus (SLE), and FMF.

Table 3: Comparison of mean ages in relation to different causes of ESRD.

Parameters	Frequency (Mean± SD)	*P-value*
Unknown	51.2±9.5	<0.001
HTN	47.3±10.1	
Kidney stones	50.2±9.3	
DM	52.6±7.2	
HTN & DM	55.4±5.6	
Bladder cancer	57.6±3.4	
CVD	56±7.4	
NSAIDS	43.2±11.9	
HTN & NSAIDS	48.7±13.5	
Uric acid & NSAIDS	56±0	
GN	43.8±11.9	
UTI	48.1±9.5	
UTI& NSAIDS	42.6±13.1	
Amyloidosis	35.8±6.7	
FMF	23.5±2.1	
Hemorrhage	57.7±2.5	
SLE	21.5±0.7	

Furthermore, a statistical significance (*P<0.001*) was found between males and females regarding the different causes of ESRD. The highest percentage of NSAIDs, HTN/NSAIDs, and SLE were noticed among females. Unknown ESRD causes, HTN, Kidney stones, DM, HTN& /DM, bladder cancer, CVD, NSAIDs/uric acid, NSAIDs/UTI, GN, UTI, Amyloidosis, FMF, and Hemorrhage were noticed among males. Similar comparisons were shown in Tables 5 and 6 for occupation and residences parameters, respectively. It worths mentioning that the higher percentage of HTN, and UTI, and /NSAIDS were reported in Tamiyya, while other ESRD were reported in Fayoum cities (Figure 2).

Table 4: Comparison of gender in relation to different causes of ESRD.

Parameters	No.	Male	Female	*P-value*
Unknown	103	85 (82.5%)	18 (17.5%)	<0.001
HTN	461	283 (61.4%)	178 (38.6%)	
Kidney stones	254	200 (78.7%)	54 (21.3%)	
DM	26	18 (69.2%)	8 (30.8%)	
HTN & DM	68	40 (58.8%)	28 (41.2%)	
Bladder cancer	5	5 (100%)	0 (0%)	
CVD	8	7 (87.5%)	1 (12.5%)	
NSAIDS	18	7 (39.9%)	11 (60.1%)	
HTN & NSAIDS	9	4 (44.4%)	5 (55.6%)	
Uric acid & NSAIDS	1	1 (100%)	0 (0%)	
GN	20	14 (70%)	6 (30%)	

UTI	9	5 (55.6%)	4 (44.4%)	
UTI& NSAIDS	7	7 (100%)	0 (0%)	
Amyloidosis	4	4 (100%)	0 (0%)	
FMF	2	2 (100%)	0 (0%)	
Hemorrhage	3	3 (100%)	0 (0%)	
SLE	2	0 (0%)	2 (100%)	

Table 5: Comparison of occupation in relation to different causes of ESRD.

Parameters	No.	Unemployed	Worker	Employer	Professional	*P-value*
Unknown	103	40 (38.8%)	9 (47.6%)	11 (10.7%)	3 (2.9%)	0.6
HTN	461	196 (42.5%)	213 (46.2%)	44 (9.5%)	8 (1.7%)	
Kidney stones	254	109 (42.9%)	125 (49.2%)	18 (7.1%)	2 (0.8%)	
DM	26	11 (42.3%)	15 (57.7%)	0 (0%)	0 (0%)	
HTN & DM	68	31 (5.6%)	30 (44.1%)	5 (7.4%)	2 (2.9%)	
Bladder cancer	5	2 (40%)	2 (40%)	1 (20%)	0 (0%)	
CVD	8	1 (12.5%)	6 (75%)	1 (12.5%)	0 (0%)	
NSAIDS	18	7 (38.9%)	8 (44.4%)	2 (11.1%)	1 (5.6%)	
HTN & NSAIDS	9	6 (66.7%)	3 (33.3%)	0 (0%)	0 (0%)	
Uric acid & NSAIDS	1	0 (0%)	0 (0%)	1 (100%)	0 (0%)	
GN	20	6 (30%)	13 (65%)	1 (5%)	0 (0%)	
UTI	9	2 (22.2%)	7 (77.8%)	0 (0%)	0 (0%)	
UTI& NSAIDS	7	5 (71.4%)	2 (28.6%)	0 (0%)	0 (0%)	
Amyloidosis	4	3 (75%)	1 (25%)	0 (0%)	0 (0%)	
FMF	2	1 (50%)	1 (50%)	0 (0%)	0 (0%)	
Hemorrhage	3	3 (100%)	0 (0%)	0 (0%)	0 (0%)	
SLE	2	0 (0%)	2 (100%)	0 (0%)	0 (0%)	

Table 6: Comparison of residence location in relation to different causes of ESRD.

Parameters	No.	Fayoum	Senoris	Yousif Elsedik	Ibshway	Etsa	Tamiyya	*P-value*
Unknown	103	38 (36.9%)	15 (14.6%)	10 (9.7%)	17 (16.5%)	3 (2.9%)	20 (19.4%)	0.01
HTN	461	160 (3.7%)	66 (14.3%)	50 (10.8%)	34 (7.4%)	74 (16.1%)	77 (16.7%)	
Kidney stones	254	69 (27.2%)	40 (15.7%)	27 (10.6%)	24 (9.4%)	54 (21.3%)	40 (15.7%)	
DM	26	10 (38.5%)	5 (19.2%)	4 (15.4%)	2 (7.7%)	1 (3.8%)	4 (15.4%)	
HTN & DM	68	19 (27.9%)	18 (26.5%)	10 (14.7%)	5 (7.4%)	5 (7.4%)	11 (16.2%)	
Bladder cancer	5	4 (80%)	1 (20%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
CVD	8	4 (50%)	1 (12.5%)	1 (12.5%)	1 (12.5%)	1 (12.5%)	0 (0%)	
NSAIDS	18	8 (44.4%)	4 (22.2%)	3 (16.7%)	1 (5.6%)	0 (0%)	2 (11.1%)	

HTN & NSAIDS	9	3 (33.3%)	3 (33.3%)	2 (22.2%)	1 (11.1%)	0 (0%)	0 (0%)	
Uric acid & NSAIDS	1	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
GN	20	9 (45%)	7 (35%)	2 (10%)	1 (5%)	0 (0%)	1 (5%)	
UTI	9	4 (44.4%)	0 (0%)	3 (33.3%)	1 (11.1%)	0 (0%)	1 (11.1%)	
UTI& NSAIDS	7	3 (42.9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (57.1%)	
Amyloidosis	4	3 (75%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (25%)	
FMF	2	0 (0%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	
Hemorrhage	3	1 (33.3%)	1 (33.3%)	0 (0%)	0 (0%)	0 (0%)	1 (33.3%)	
SLE	2	0 (0%)	0 (0%)	0 (0%)	1 (50%)	0 (0%)	1 (50%)	

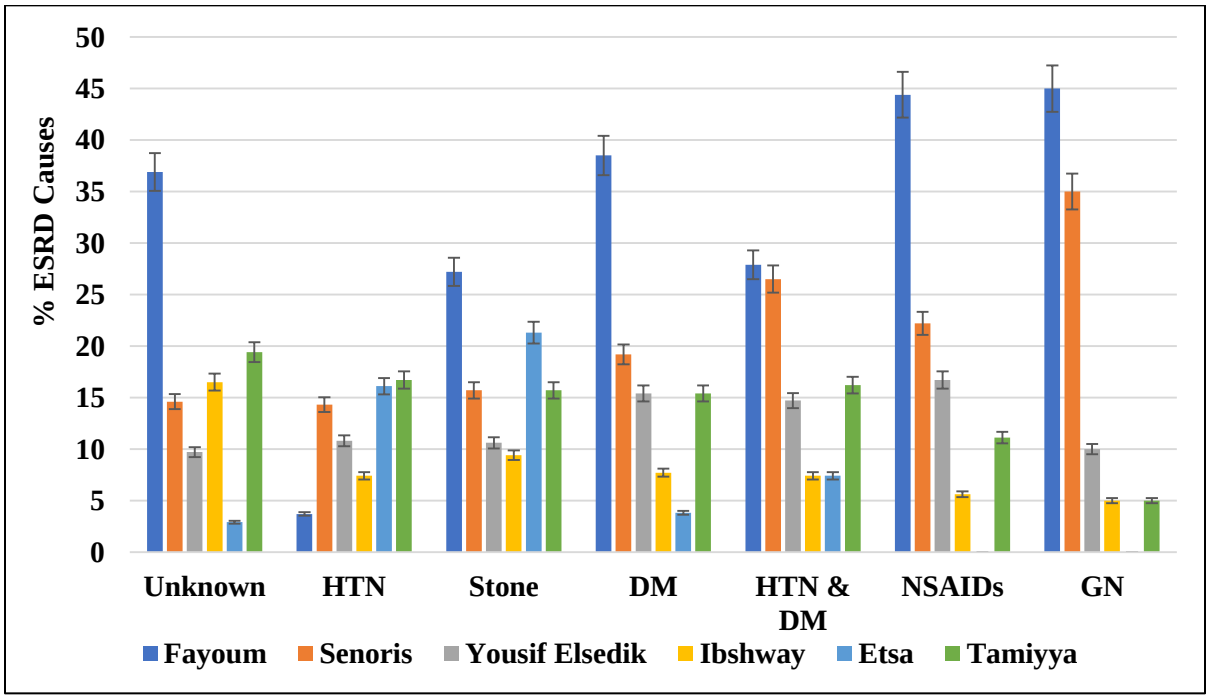

Figure 2: Distribution of Different ESRD causes of the highest frequencies among different cities of the Fayoum Governorate.

4. Discussion

Chronic kidney disease (CKD) arises from many heterogeneous disease pathways that alter the function and structure of the kidney irreversibly over months or years. The diagnosis of CKD rests on establishing a chronic reduction in kidney function and structural kidney damage [5].

Most cases of CKD result from kidney damage or other health problems, which might be caused by GN, DM, HTN, autoimmune, or genetic diseases [6].

Effective identification and management are necessary to prevent CKD progression and cardiovascular events, reduce the risks associated with acute kidney injury (AKI), and improve patient safety and medication management [7].

The current study aimed to detect the principal causes and risk factors of ESRD patients in the Fayoum governorate, Egypt. One thousand patients on regular HD were included in that cross-retrospective real-life study in Fayoum governmental and Fayoum university hospitals, Egypt. Data were collected from the patients, their relatives, and from their medical records and with age groups between 18-60 years. We excluded patients who did not live in Fayoum governorate, had congenital anomalies, or were aged behind the range of 18-60 years.

The mean age was 49±10.1 years for all participants. A similar age range was reported by El-Ballat *et al.,* 2019, equal to 52.80±13.82 years [8]. Also, Mukakarangwa *et al.,* 2018, reported the mean age was 52.27 ± 12.91 years [9]. Also, Ragab *et al.,* 2021, reported that the mean age in Egypt increased from 45.6 years in 1996 to 49.8 years in 2008, which supported the current findings [10].

Most patients in the current study were males (68.5%). Similarly, Yu *et al.,* 2010, reported that males develop ESRD more than females [11]. The results of Mukakarangwa *et al.,* 2018, showed that the prevalence of treated ESRD in males was almost twice that of females (60.7% versus 39.3%), which matched our study results [9]. Yet for the study conducted by Duong *et al.,* 2015, the males represented 47% [12].

The mean body weight of the included patients was 72.8±13.9 Kg, and the mean BMI was 27.2±4.8 Kg/m2. Baramania *et al.,* 2021, reported similar body weight and BMI [13]. Also, Megahed *et al.,* 2020, reported the mean body weight for HD patients as 72.3581± 7.035 KG [14]. Lower body weight and BMI were reported in another study by Megahed *et al.,* 2021, who reported a mean weight of 59.81±12.8 Kg [15]. Another previous study reported the average BMI was lower (22.4 ± 3.7 kg/m2) for HD patients [16].

Most patients in the current study were non-smokers, where 24.8% were smokers. Megahed *et al.,* 2021, reported smoking in only 2% of the included patients; however, it was conducted on a smaller sample size [15]. A prospective study by Xia *et al.,* 2017, reported that smoking is positively associated with the progression of CKD, which also supported our study results [17].

Yacoub *et al.,* 2010, in their study, concluded that smoking, or particularly heavy smoking (> 30 packs/year), was a massive risk factor for the development of CKD [18].

In the current study, workers and unemployed patients had almost equal percentages. Contrary to the current study, Bramania *et al.,* 2021, reported that only 15% of patients were still workers, while the remaining were retired or stopped working due to HD [13]. Anees *et al.,* 2014, reported that 34% of patients were workers [19].

About 35.5% of the included patients were positive for HCV serology, while Megahed *et al.,* 2021, reported that over 70% of ESRD patients were HCV positive [15]. The study conducted by Bramani *et al.,* 2021, reported that 10% of ESRD patients had positive HCV serology [13]. Jin *et al.,* 2018, reported HCV antibody positivity was 4% among HD patients [16]. The high prevalence of HCV in Fayoum governorate might be attributed to the high prevalence of HCV in the general population and the high rate of blood transfusion in dialysis units to treat anemia instead of provision of iron therapy and erythropoietin, which is expensive; thus, there is a need to increase the provision of iron therapy and erythropoietin among dialysis patients instead of blood transfusion.

Positive family history of ESRD was reported in only 1.7% of patients. Ghonemy *et al.*, 2016, reported that 1.1% of patients had a history of ESRD in their family members, which matched our study results [20].

In the current study, 46.1% of cases had ESRD caused by HTN, 25.4% because of kidney stones, 10.3% because of unknown causes, and 6.8% caused by the combination of HTN and DM. In the study by Ghonemy *et al.*, 2016, the distributions of the leading causes of ESRD were the following: HTN (31.8%), DM (15.5%), UTI (8.8%), kidney stones (8.4%), Unknown causes (17.7%), primary GN (3.7%), and drug/toxin (3.5%) [20]. In some Egyptian governorates like Cairo, the principal cause of ESRD was HTN (29.7%), followed by DM (12.5%). In Canal governorates, HTN was the principal cause of ESRD, with an incidence of 27.3%, followed by DM (10.7%) [21]. In the Minya governorate, the principal ESRD cause was also HTN (20%) and DM (8%) [21]. Similarly, In the Menoufia governorate, HTN and DM represented 34.8% and 16.6%, respectively, as the principal causes of ESRD [22]. In Assiut, El-Arbagy *et al.*, 2016, found that ESRD resulted from unknown reasons and was prevalent in 25% of patients (the highest proportion) [23]. That might be because of an environmental factor(s), for example, physical (harmful rays), chemical (heavy metals, dyes, and hydrocarbons), biological (viral infection), genetic (chromosomal abnormality), and nutritional factors, such as deficiency of one or more vitamins or minerals, undiagnosed chronic HTN or inefficient control, and lack of awareness among the treating physicians of the proper time frame for a referral [23]. The second cause of ESRD was HTN (21.4%), followed by DM (14.9%), prevalent in 13.5% of patients [23].

In contrast to our results, the epidemiology of ESKD in countries of the Gulf Cooperation Council found that the leading cause of ESRD was diabetic nephropathy (17%), followed by GN (13%), and hypertensive nephropathy (8%), with a significant increase in the prevalence of diabetic nephropathy (DN) [24].

In China, Yao *et al.*, 2009, reported that the incidence of DN increased from 9.9% in 2000 to 17.2% in 2005 and counts as the second cause of ESRD after GN [25]. In Japan, DN (37.1%) was the most common primary disease among ESRD patients, followed by chronic GN (33.6%) and nephrosclerosis (8.3%) [26].

In European countries, the 2013 European Renal Association −European Dialysis and Transplant Association Registry stated that the most common identifiable cause of ESRD was GN (20.4%), followed by DM (15.6%), unknown causes (14.6%), and HTN (10.7%) [27].

In the USA, DM (37.47%) was the highest cause of ESRD, followed by HTN (25.1%), GN (16.34%), and cystic kidney disease (4.69%). These causes have continued to rise since 1996 [28].

Regarding age differences between different CKDs, only bladder cancer patients had older ages than other causes, which were comparable regarding age. That came in handy with the fact that bladder cancer affected mainly the elderly. Saginala *et al.*, 2020, reported that the age range for bladder cancer was 65-73 years [29]. Similar results were reported in another study [30].

There were statistically significant differences between males and females regarding the frequency of some CKDs. HTN was more frequent among males than females. Similarly, Ramirez *et al.*, 2018, reported that HTN was more frequent among males than females of different ages [31]. On the other hand, Hughson *et al.*, 2014, reported that females were more prone to hypertensive nephrosclerosis than males because females had lower nephron mass than males [32].

Kidney stones disease was also more prevalent among males in the current study. In concordance with the current study, Gillams *et al.*, 2021, reported a higher incidence of stone kidney disease among males [33]. Unlikely, Zahng *et al.*, 2021, reported that Kidney stones appeared in females three times more than in males [34]. Daudon *et al.*, 2018, proved the same results [35].

In the current study, diabetic nephropathy was higher among males than females. Following the current study, Maric *et al.*, 2020, reported that men are at higher risk for diabetic nephropathy than women [36]. Also, Thomas *et al.*, 2019, reported that women were more protected from diabetic nephropathy due to hormonal causes [37].

In that study, females were more prone to NSAID-induced renal failure than males. Likely, in a previous Egyptian study, females had more NSAID-induced nephropathy than males [38]. On the contrary, Swathi *et al.*, 2021, reported that males had a higher risk for NSAID-induced renal failure [39].

Other causes of original kidney diseases had much lower incidence rates, which could affect the analysis of gender differences.

In the current study, there were no statistically significant effects of working on the frequency of different original kidney diseases. However, it was reported in previous studies that the nature of work could affect the cause of ESRD, such as exposure to certain toxins could cause ESRD [40]. Hasson *et al.*, 2020, reported increased incidence among miners and heat-related jobs [41]. Sanoff *et al.*, 2010, reported a Positive association of renal insufficiency with agriculture employment and unregulated alcohol consumption [42].

There is a statistical significance difference with $P<0.001$ as regards residence in different ESRD, with a higher percentage of HTN and UTI/NSAIDs among cases in Tamiyya, while most of the other causes were reported in Fayoum city. The difference in distribution between different cities might be due to the differences in air pollens percentage, water purity, and the presence of genetic or inherited diseases, which run in families.

Conclusion

The most common cause of ESRD among Fayoum governorate residents was HTN, kidney stones, unknown ESRD causes, and DM. Age-related effect on the original kidney disease was reported with bladder cancer only. There were male-to-female differences in the frequency of some CKDs, such as HTN, kidney stones, and DM, which were more frequent among males. NSAID-induced renal disease was more frequent among females. Future epidemiological studies should be conducted to investigate the unknown causes of ESRD.

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Ethical considerations

Informed consent was obtained from all participants and approval was obtained from institutional review board (IRB) No. M341 in Faculty of Medicine, Fayoum University, Fayoum, Egypt.

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Conflicts of Interest: All authors declare no conflict of interest.

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