European Review for Medical and Pharmacological Sciences 2022; 26: 6259-6264

Prevalence of stroke and myocardial infarction among patients with deteriorated GFR

S.H. ALHARBI

Department of Medicine, Alimam Muhammad Ibn Saud Islamic University, Riyadh, Saudi Arabia

Abstract. – OBJECTIVE: Serval modifiable risk factors have been linked to stroke and myocardial infarction, including chronic Kendy disease. This study aimed to assess the prevalence of stroke and myocardial infarction among patients with deteriorated GFR (GFR < 60 mL/min).

PATIENTS AND METHODS: A total of 1185 Saudi participants were enrolled during a cross-sectional survey conducted in Hai'l region, Northern Saudi Arabia. Volunteers were enrolled based on their GFR estimation. Only those with Stage III, Stage IV, or Stage V CKD were included.

RESULTS: The overall prevalence of stroke was 2.4%. The risk of stroke associated with deteriorated GFR, the relative risk (RR) and the 95% confidence interval (95% CI), RR (95% CI) = 2.1371 (0.9804-4.6584), *p* = 0.0561. The prevalence rates of males and females were 3.7% and 1.2%, respectively. The overall prevalence of myocardial infarctions was 3.2% (4.7% in males and 2% in females).

CONCLUSIONS: Deteriorated GFR <60 mL/min is significantly associated with stroke and myocardial infarction. Stroke and MI are more prevalent among men than women. Stroke and MI are more prevalent in middle-aged adults and older individuals.

Key Words:
Stroke, Myocardial infarction, Chronic kidney disease, GFR, Saudi Arabia.

Introduction

Low glomerular infiltration rates (GFR) are usually associated with chronic kidney disease (CKD), which affects about 10 to 13% of the general population. CKD is an irreversible, progressive disease associated with the development of several conditions, including cardiovascular diseases (CVD). Many individuals with CKD remain asymptomatic till more advanced stages of kidney dysfunction[1,2]. Early detection of CKD with the application of conservative treatment can slow the disease's progression and its development into end-stage kidney disease. This, besides preventing CVD, lengthens patient survival[3].

CKD can cause a long-standing risk of cardiovascular consequences in the general population[4]. Individuals with CKD have a higher prevalence of atheromatous and/or atheromatous CVD resulting from the array of CKD-related risk factors, such as uremic toxins. Uremic toxins play a significant part in developing various CVDs, the foremost cause of death in patients with end-stage kidney disease[5]. Heart attack[6] and stroke[7] associated with CKD were previously reported. CKD is prevalent in Saudi Arabia due to its widespread modifiable risk factors such as hypertension, diabetes, and obesity[8].

Patients and Methods

A total of 1185 Saudi participants were enrolled during a cross-sectional survey conducted in Hai'l region, Northern Saudi Arabia. Volunteers were enrolled based on their GFR estimation. Only those with Stage III, Stage IV, or Stage V CKD were included. CKD stage was determined according to GFR estimation using creatinine level, age, and sex. GFR was categorized into:

Stage III CKD (GFR = <60-30 mL/min).
Stage IV (GFR = <30-15 mL/min).
Stage V (GFR = <15 mL/min).

Stroke and myocardial infarctions conditions were determined based on evidence provided by the participant that he/she was treated due to a former well-proved stroke or myocardial infarctions (MI) diagnosis.

Ethical Committee Approval and Informed Consent

This study was approved by the Ethical Committee Research Board at the College of Med-

Corresponding Author: Saleh Hadi Alharbi, MD; e-mail: dr.shharbi@gmail.com

icine, University of Hai'l, Hai'l, Saudi Arabia. Each participant signed a written informed consented to participate at this study.

Statistical Analysis

Data were entered into SPSS software (version 26; IBM, Armonk, NY, USA) and analyzed to obtain frequencies, cross-tabulations, relative risk (RR), and Pearson Chi-square test for statistical significance (p-value). Statistically significant was considered when p-value <0.05 considering a 95% confidence interval (CI).

Results

This study investigated 1185 volunteers aged 18 to 100 with a mean age of 44. About 535 (45%) were males, and 650 (55%) were females. In this study subjects, the overall prevalence of stroke was 2.4%. Most cases of stroke cases were seen with GFR (60-31 mL/min) followed by 30-15 and <15, representing 19/970 (2%), 6/189 (3.2%), and 3/26 (11.5%), respectively, with reverse proportions, as indicated in Table I, Figure 1. The risk of stroke associated with deteriorated GFR, the relative risk (RR) and the 95% confidence interval (95% CI), RR (95% CI) = 2.1371 (0.9804-4.6584), $p = 0.0561$. The prevalence rates of males and females were 3.7% and 1.2%, respectively.

The overall prevalence of myocardial infarctions was 3.2% (4.7% in males and 2% in females). Most cases of MI cases were seen with GFR (60-31 mL/min) followed by 30-15 and <15, representing 21/972 (2.2%), 14/188 (7.4%), and 3/25 (12%), respectively, with reverse proportions, as indicated in Table I, Figure 1. RR (95% CI) = 3.0857 (1.5955 -5.9679), $p = 0.0008$.

Table II and Figure 2 shows the distribution of the sex by stroke and MI in different GFR levels. Stroke was observed in 20/535 (3.7%) males and 8/650 (1.2%) females. The risk of stroke in males with deteriorated GFR was RR (95% CI) =3.0374 (1.3486 to 6.8408), $p = 0.0073$.

MI was observed in 25/535 (4.7%) males and 13/650 (2%) females. The risk of MI in males with deteriorated GFR was RR (95% CI) =14.3357 (8.2675 to 24.8578), $p < 0.0001$, z statistic =9.482. Most cases of stroke were seen in the age range 56-70 years, followed by 41-55 and 70+ years, constituting 13/28 (46.4%), 7/28 (25%), and 7/28 (25%) in that order. Most patients with MI were observed in the age group 56-70 years 17/38 (44.7%), followed by 70+ years, representing 14/38 (37%), as shown in Table III, Figure 3. Increased age is significantly associated with deteriorated GFR and risk of stroke and MI ($p < 0.05$).

Discussion

The present study's findings show that the overall prevalence of CKD is higher among females

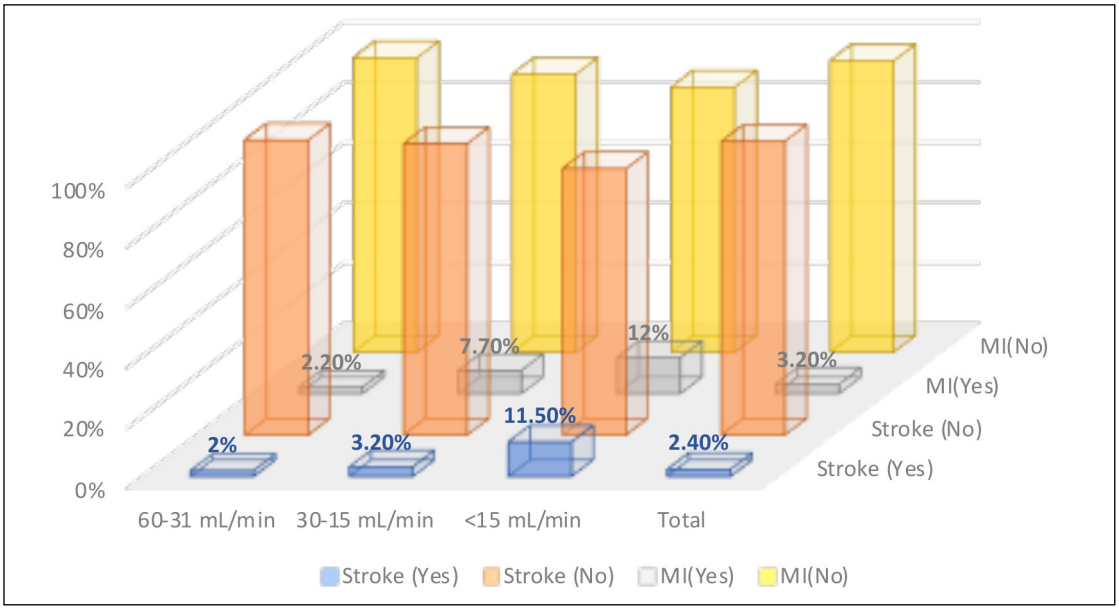

Figure 1. Description of Stroke and MI by proportions of GFR levels.

Table I. Distribution of GFR by stroke and MI.

Variable	GFR (mL/min) 60-31 mL/min	30-15	<15	Total
Stroke				
Yes	19	6	3	28
No	951	183	23	1157
Total	970	189	26	1185
Myocardial Infarction				
Yes	21	14	3	38
No	951	174	22	1147
Total	972	188	25	1185

than males. However, some previous studies have reported reverse results[9,10].

In the present study, the overall prevalence of stroke in this series of patients was 2.4%, and the results showed a statistically significant association between CKD and stroke. Such findings were previously reported, showing that CKD is a risk for stroke, associated with impaired platelet reactivity[11]. In patients with CKD, the risk of stroke increases with some risk factors such as older age, hypertension, and diabetes. The risk may be worsened with younger persons and women younger than 40 years with end-stage CKD. This increased risk is due to uremia, cerebral blood flows dysfunction, vascular calcification, arterial stiffness, and chronic inflammation[12,13].

The current study results show that the prevalence rate of stroke is higher among males (3.7%) than females (1.2%). A recent study has reported elevated stroke epidemiology in males compared to females[14]. However, stroke has a more enormous consequence on females than males since females have more events and are less likely to recover. As the age-specific stroke rate is higher in males (longer life expectancy) and considerably higher incidence at older ages, females have more stroke consequences than males[15]. Sex differences in stroke contribute to overall stroke management. There are considerable differences in clinical presentation, response to treatment, and outcomes[16].

In the present study, the overall prevalence of myocardial infarctions was 3.2%, including 4.7% in males and 2% in females. The risk of MI is statistically significant among CKD patients. Several studies have indicated that CKD is a greater risk for developing myocardial infarctions events[17]. It

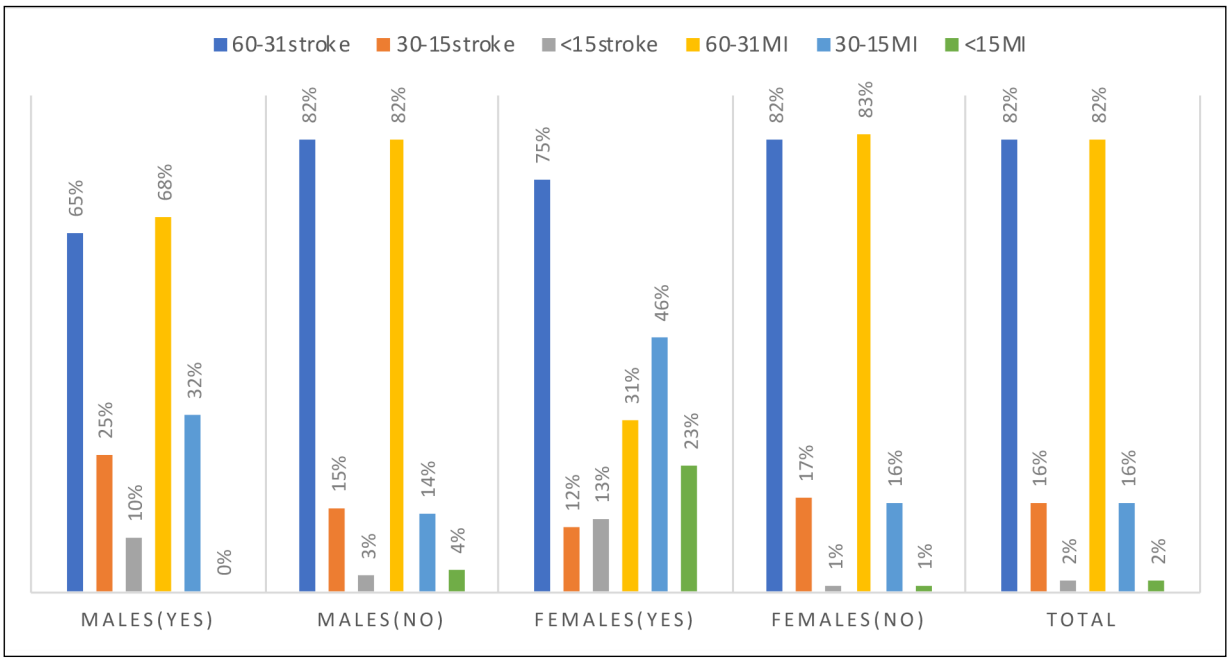

Figure 2. Description of Stroke and MI by proportions sex.

Table II. Distribution of the sex by stroke and MI in different GFR levels.

Variable	Males		Females		Total
GFR-Stroke	Yes	No	Yes	No	
60-31	13	421	6	530	970
30-15	5	76	1	107	189
<15	2	18	1	5	26
Total	20	515	8	642	1185
GFR-MI					
60-31	17	417	4	532	970
30-15	8	73	6	102	189
<15	0	20	3	3	26
Total	25	510	13	637	1185

Table III. Distribution of study population by age and, stroke & MI.

Variable	<25 years	26-40	41-55	56-70	70+	Total
GFR-Stroke						
60-31	0	1	5	9	4	19
30-15	0	0	1	3	2	6
<15	0	0	1	1	1	3
Total	0	1	7	13	7	28
GFR-MI						
60-31	0	0	5	11	5	21
30-15	0	0	2	6	6	14
<15	0	0	0	0	3	3
Total	0	0	7	17	14	38

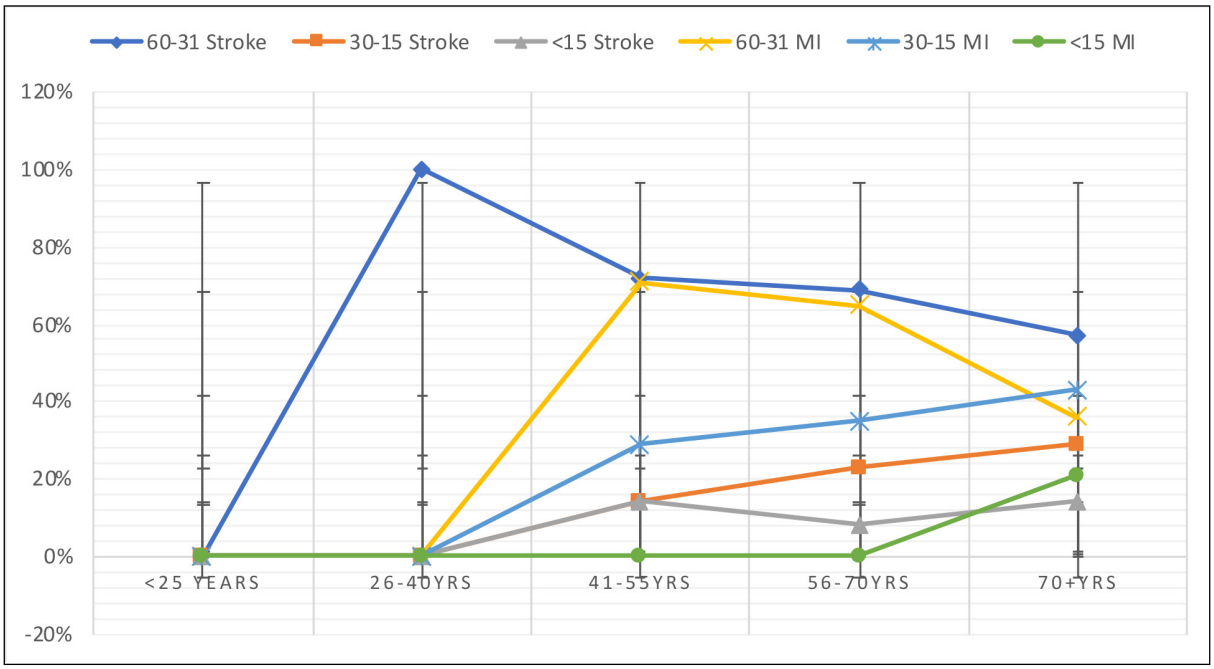

Figure 3. Description of Stroke and MI by proportions age.

was found that early detection of impaired eGFR can reduce cardiovascular events in older patients with acute myocardial infarctions and may prevent poor clinical outcomes[18]. However, there are significant sex differences in the prevalence rates of MI due to multifactorial modifiable risk

factors, such as hypertension, diabetes, depression, and current smoking. For example, a family history of diabetes had a higher risk of AMI in young females, while hypercholesterolemia has a greater stake in young males. Nevertheless, the significant differences in risk factor profiles and their association with sex and MI subtypes can determine the epidemiology of MI in a specific population[19].

The present study's findings revealed that most patients with stroke and MI were in the middle age or older population. It was reported that stroke incidence rises with age and the peak in the oldest. Even though the incidence is higher in males than females over the entire age group, the lifetime risks seemed similar for both[20]. Moreover, it was recently reported that the incidence of MI was lower in those less than 45 years, whereas at least one patient in ten patients with MI <45 years died or underwent a new cardiovascular event during follow-up[21].

Conclusions

Deteriorated GFR <60 mL/min is significantly associated with stroke and myocardial infarctions. Stroke and MI are more prevalent among men than women. Stroke and MI are more prevalent in middle-aged adults and older individuals.

Conflicts of Interest

The authors declares that they have no conflicts of interest.

Acknowledgment

The authors would like to thank staff and students in the College of Medicine, University of Hai'l, for their assistance in data collection.

Informed Consent

Each participant signed informed consent before inclusion in the study.

Availability of Data and Material

The data presented in this study are available on request to the corresponding author.

ORCID ID

S.H. Alharbi: 0000-0002-9635-3307.

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