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Research Article

Social Determinants of Health for Cardiovascular-Kidney-Metabolic Syndrome Among Patients With Diabetes

Kibret Enyew Belay,[1] Yeweyenhareg Feleke,[1] Theodros Aberra Alemneh,[1] Asteway Mulat Haile,[2] and Dawit Girma Abebe[3]

[1]Department of Internal Medicine, Endocrinology and Metabolism Unit, Addis Ababa University, Addis Ababa 1000, Ethiopia
[2]Department of Internal Medicine, Addis Ababa University, Addis Ababa 1000, Ethiopia
[3]Department of Internal Medicine, Alert Specialized Hospital, Addis Ababa 1000, Ethiopia

Correspondence: Kibret Enyew Belay, MD, Department of Internal Medicine, Endocrinology and Metabolism Unit, Addis Ababa University, Yared St 1000, Addis Ababa 1000, Ethiopia. Email: kibret.enyew@aau.edu.et.

Abstract

Context: *Cardiovascular-kidney-metabolic (CKM)* syndrome is a recently introduced term that is a complex disease consisting of cardiovascular disease, renal disease, obesity, and diabetes. The association of social determinants of health (SDOH) with CKM syndrome is not fully known.

Objective: We aimed to assess SDOH affecting CKM syndrome among adult patients with diabetes at follow-up at a tertiary hospital in Ethiopia.

Methods: A cross-sectional hospital-based study was used. Data were collected using a Kobo toolbox and entered into SPSS version 29 for further analysis.

Results: A total of 422 adult patients with diabetes were included in this study. The mean ± SD age of the patients was 54.14 ± 13.74 years. Fifty-two percent of the patients were male. In this study, 52.4% had cardiovascular kidney metabolic syndrome. Male patients (AOR: 1.73; 95% CI, 1.01-2.94), lost to follow-up for more than a year due to lack of money (AOR: 2.69; 95% CI, 1.01-7.22), missed an appointment due to lack of transportation in the past 1 year (AOR: 2.98; 95% CI, 1.21-7.33), were patients with disability (AOR: 1.97; 95% CI, 1.12-3.48), had hypertension (AOR: 3.12; 95% CI, 1.85-5.28), had obesity (AOR: 2.27, 95% CI, 1.17, 4.40), and were in retirement (AOR: 2.12; 95% CI, 1.04-4.30) these being more significantly associated with CKM syndrome.

Conclusion: More than half of patients had CKM syndrome. More attention should be given to SDOH, including male sex, financial constraints, transportation issues, disability, and retirement.

Key Words: cardiovascular kidney metabolic syndrome, diabetes, social determinants of health, Ethiopia

Abbreviations: ARIC, Atherosclerosis Risk in Communities; BMI, body mass index; CKD, chronic kidney disease; CKM, cardiovascular-kidney-metabolic; CVD, cardiovascular disease; RAAS, renin-angiotensin-aldosterone system; SDOH, social determinants of health; TASH, Tikur Anbessa Specialized Hospital.

The presence of a combination of cardiovascular, metabolic, and renal disorders in a complex patient with diabetes is known as cardiovascular-kidney-metabolic (CKM) syndrome, which was coined by the American Heart Association in 2023 [1, 2]. In 2018, among 530 747 individuals with type 2 diabetes in the United States, only 6.4% were free of CKM conditions, while 51% had 3 or more [3]. The Atherosclerosis Risk in Communities (ARIC) study found that renal function was independently and significantly associated with sudden cardiac mortality in the general population, underscoring the importance of addressing CKM syndrome [4]. In 2021, diabetes or its complications were estimated to take the lives of approximately 6.7 million adults aged 20 to 79 years, accounting for 12.2% of all deaths globally [5]. Renal hypoperfusion caused by renin-angiotensin-aldosterone system (RAAS) and sympathetic nervous system activation leads to volume overload, cardiac hypertrophy, and fibrosis, as well as poor tubuloglomerular feedback, resulting in renal hypoxia and injury [6]. CKM management includes lifestyle measures, RAAS inhibitors, sodium-glucose cotransporter-2 inhibitors (CREDENCE, DAPA-CKD, EMPA-KIDNEY trials, a meta-analysis of those studies), glucagon-like peptide-1 receptor agonists (FLOW trial), nonsteroidal mineralocorticoid receptor antagonists (FINE-HEART study), and simvastatin and ezetimibe (SHARP trial) [7-16].

Despite those advancements in the management of CKM syndrome, the prevalence of the disease and its severity have increased [2]. Social determinants of health (SDOH), which is described as the economic, environmental, political, and social conditions under which individuals live, may affect these disease conditions [17]. A study from the United States showed that unemployment, low family income, food insecurity, lack of home ownership, and unpartnered status were associated with a significantly higher risk for cardiovascular disease (CVD) death [18]. In the Kidney Early Evaluation Program (KEEP) study, patients without insurance were 82% more likely than those who have insurance to die and 72% more likely to develop end-stage renal disease [19].

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Except for individual social factors that address specific disease components of CKM, several evidence gaps exist about screening for comprehensive social needs among patients with CKM syndrome. It is also important to identify social needs to improve CKM health that are effective in resource-limited settings. There has been no published research focused on SDOH and CKM syndrome in Africa.

As a result, the main aim of this study was to identify SDOH that influence CKM syndrome in low-income settings. This study aims to provide critical data regarding SDOH associated with CKM syndrome among patients with diabetes. This study aims to narrow the information gap regarding patients with diabetes and CKM complications. The results of this study will also help develop a module and guideline for assessing SDOH for people with diabetes locally and in similar low- and middle-income countries and develop a strategy to address SDOH.

Materials and Methods

Study Area and Study Design

A hospital-based, cross-sectional study was conducted among patients with diabetes who visited diabetic clinics at Tikur Anbessa Specialized Hospital (TASH), Ethiopia. The hospital is the largest tertiary hospital with clinics practicing at the subspecialty level in each unit. The endocrinology and metabolism unit in the hospital had 4 clinic visits scheduled every week. The average number of patients with diabetes attending the clinic monthly ranges from 800 to 1000. This study was conducted from May 1, 2024, to June 30, 2024.

Population

The source population consisted of all adult patients with diabetes of TASH visiting the endocrinology and metabolism clinic with a diagnosis of diabetes. The study population includes selected adult patients with diabetes of TASH visiting the endocrinology and metabolism clinic with a diagnosis of diabetes and who had an appointment during the study period.

Sample Size and Sampling Technique

There has been no published paper with a similar study focused on SDOH and CKM disease conducted in Ethiopia and low-income countries. Therefore, the sample size for the study was determined using a single population proportion formula from a prevalence of 50%, a statistical significance level of 5% ($\alpha = .05$), $Z\ \alpha/2 = 1.96$, and a margin of error of 5% ($d = 0.05$). The total sample size was determined by the following formula:

$$n = \frac{(Z\alpha/2)^2(P)(1-p)}{d^2}$$

$$n_1 = \frac{(1.96)^2 \times 0.5(1-0.5)}{0.0025} = 384$$

Adding a 10% nonresponders rate, the total sample size was 422. Every consecutive eligible patient was involved in the study until we had an adequate sample size.

Data Collection Procedure

All methods were conducted in compliance with the Declaration of Helsinki guidelines. An ethical clearance letter was obtained from the department of internal medicine institutional review board. Informed verbal consent was obtained from each study participant before data collection. All participants included in this study were also informed that their data would be used as part of publications in anonymized form, to which they gave consent.

Using a pretested, structured questionnaire developed from the recent World Health Organization operational framework of SDOH, these were directly collected from patients by data collectors at the diabetic clinic during the study period. CKM disease, comorbid conditions, glycemic control, and type of diabetes were collected from electronic data using a medical record number. Data collectors had a day orientation by the principal investigator on how to collect data from patients and electronic data. All adult patients with diabetes at follow-up (new or existing, type 1 and type 2) in the diabetic follow-up clinic were included. Pregnant patients and patients with incomplete medical records were excluded.

CKM syndrome was defined as the presence of CVD and/or diabetic nephropathy in a patient with diabetes [20]. CVD includes the presence of heart failure, coronary heart disease, cerebrovascular disease, arrhythmia, cardiomyopathy, or peripheral artery disease [21]. Diabetic nephropathy is defined as a persistent elevation of urinary albumin excretion (urine albumin to creatinine ratio >30 mg/g or 24-hour urine protein >150 mg), low estimated glomerular filtration rate (<60 mL/min/1.73 m^2), or other manifestations of kidney damage more for more than 3 months [22]. The inability to afford healthy foods was defined based on the ability to consistently afford meals meeting the plate method recommended by the American Diabetes Association. The plate method is composed of 50% vegetables (preferably nonstarchy vegetables), 25% carbohydrates (whole grains or other nutrient-dense options), and 25% protein (lean protein sources) [23].

Data Quality Control

Three medical students and one physician as supervisor were involved in collecting the data after undergoing 1 day of training by the principal investigator. A pretest was conducted on 5% of the sample size to check the consistency and the data completeness in the records. A few minor changes to the questionnaire were made based on the pretest results. The tool used in this study also underwent face validation by expert endocrinologists and public health specialists to ensure its appropriateness for our population and research objectives. The supervisor and principal investigator checked the information collected daily to ensure completeness and consistency.

Data Analysis

After data were checked manually for completeness and consistency, these were exported into SPSS version 29 software for further cleaning and analysis. Frequencies, percentages, and mean scores were computed in the descriptive statistics. Using bivariate analysis, independent variables were assessed for the association with CKM syndrome. The result is presented using tables, graphs, and text. Those independent variables with P values less than .2 were analyzed using multivariable logistic regression. The association was expressed as odds ratio with 95% CI and a P value of less than .05 was used as a statistically significant level for associations between dependent and independent variables.

Results

Demographic Information and Background Diabetes History

A total of 422 adult patients with diabetes were included in this study. The mean age of participants was 54.14 years. Most of the participants (95.02%) were from urban areas, 52.84% were male, 83.2% had type 2 diabetes or other specific causes, and almost two-thirds of the patients had hypertension (Table 1). The study participants are homogeneous, consisting of individuals of Black race. There is no relatively significant cultural variations among them as well.

Physical Environment and Economic Instability

Most of the patients (84.4%) have lived in their current house for more than 5 years. However, half (50.9%) of them have a high economic burden of a housing price-to-income of above 40%. Most of the patients (91.2%) have regular access to electricity and (74.9%) have a comfortable space for physical activity A significant number (41.9%) of patients could not afford to eat healthy food (Table 2).

Educational Status and Health Behaviors

Most of the patients (94.5%) have attended at least primary school and above. They can self-manage to take their medication (90.8%) and 95.5% can remember their hospital appointments. However, 70.6% of patients eat vegetables less than or equal to 3 days a week and 40% perform less than 150 minutes of moderate physical activity. The mean body mass index (BMI) of the patients was 26.47 (Table 3).

Table 1. Demographic information and background diabetes history of patients with diabetes on follow-up at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia

Variables		Frequency	Percentage
Sociodemographic characteristics			
Age of participants	Mean ± SD = 54.14 ± 13.74 min = 18 and max = 90		
Age groups, y	≤45	115	27.3%
	46-55	96	22.7%
	56-65	117	27.7%
	≥66	94	22.3%
Sex of participants	Male	223	52.84%
	Female	199	47.16%
Marital status	Single	48	11.4%
	Married	337	79.9%
	Divorced or Widowed	37	8.8%
Residence	Rural	21	4.98%
	Urban	401	95.02%
Birth order	First	131	31.0%
	Middle	226	53.6%
	Last	65	15.4%
Diabetes history			
Type of diabetes	Type 1 diabetes	71	16.8%
	Type 2 diabetes or other specific causes	351	83.2%
Duration of diabetes, y	<5	105	24.9%
	5-9	76	18.0%
	10-20	138	32.7%
	>20	103	24.4%
Recent hemoglobin A_{1c} level measured within past 3 mo	≤7	124	29.4%
	7-10	203	48.1%
	>10	95	22.5%
FBS control status	Good FBS control	179	42.4%
	Poor FBS control	243	57.6%
Hypertension	Yes	264	62.6%
	No	158	37.4%
Dyslipidemia	Yes	143	33.9%
	No	279	66.1%
Other comorbidities	Yes	16	3.8%
	No	406	96.2%

Abbreviations: FBS, fasting blood sugar; max, maximum; min, minimum.

Table 2. Physical environment and economic instability of patients with diabetes on follow-up at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia

Variables		Frequency	Percentage
Physical environment			
Housing status	Own	291	69.0%
	Rent	115	27.3%
	Other or homeless	16	3.8%
Housing stability, y	<5	66	15.6%
	≥5	356	84.4%
Housing price-to-income ratio >40%	Yes	207	49.1%
	No	215	50.9%
Access to electricity?	Yes	385	91.2%
	No	37	8.8%
Natural or human-made disasters in past 1 y	Yes	33	7.8%
	No	389	92.2%
Comfortable space for physical activity	Yes	316	74.9%
	No	106	25.1%
Economic characteristics			
Monthly income, ETB	<2000	105	24.9%
	2001-5000	145	34.4%
	5001-9000	71	16.8%
	>9000	101	23.9%
Skipped medication due to lack of money in past 1 y	Yes	100	23.40
	No	322	76.30
Lost to follow-up due to lack of money for >1 y	Yes	35	8.3%
	No	387	91.7%
Skipped renal, eye, or dental screening due to cost in past 1 y	Yes	67	15.9%
	No	355	84.1%
Could not afford to eat healthy food	Yes	177	41.9%
	No	245	58.1%
Employment status	Employed	157	37.2%
	Unemployed	116	27.5%
	Retired	117	27.7%
	Others	32	7.6%
Disabilities (extremity, vision or cognitive)	Yes	93	22.0%
	No	329	78.0%
Age <18 y children in family	Yes	196	46.4%
	No	226	53.6%
Family members with disabilities	Yes	35	8.3%
	No	387	91.7%
Older family members who are unable to work	Yes	113	26.8%
	No	387	91.7%

Abbreviation: ETB, Ethiopian birr.

Table 3. Educational status and health behaviors of patients with diabetes at follow-up at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia

Educational background			
Level of education	No formal education	23	5.5%
	Primary school	87	20.6%
	Secondary school	136	32.2%
	Higher education	176	41.7%
Self-manage to take medications?	Yes	383	90.8%
	No	39	9.2%
Self-manage to remember their hospital appointments	Yes	403	95.5%
	No	19	4.5%
Basic diabetic self-management skills	Yes	358	84.8%
	No	64	15.2%
Health behaviors			
How often do you eat vegetables?	≤3 d/wk	298	70.6%
	>3 d/wk	124	29.4%
Minutes do you practice moderate physical activity	<150 min	169	40.0%
	>150 min	253	60.0%
Type of physical activity do you practice regularly	Aerobics	331	78.4%
	Aerobics and strengthening	20	4.7%
	None	71	16.8%
What is your smoking history?	Yes	61	14.5%
	No	361	85.5%
Alcohol consumption history	Never drinks alcohol	305	72.3%
	<2 or 3 bottles/d for female and male patients, respectively	98	23.2%
	>2 or 3 bottles/d for female and male patients, respectively	19	4.5%
BMI	Mean ± SD = 26.47 ± 4.99, min = 16.07 and max 45.28		
	Normal/underweight (≤24.9)	175	41.5%
	Overweight (25-29.9)	156	37.0%
	Obese (≥30)	91	21.6%
Ever tried herbal or other traditional medication	Yes	58	13.7%
	No	364	86.3%

Abbreviation: BMI, body mass index.

Table 4. Access to health care, social support, and community resources for patients with diabetes at follow-up at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia

Access to health care			
Average out-of-pocket health care expenditure per mo	<10% of your income	228	54.0%
	10%-25% of your income	116	27.5%
	>25% of your income	78	18.5%
Have glucometer	Yes	338	80.1%
	No	84	19.9%
Have health insurance	Yes	370	87.7%
	No	52	12.3%
Missed appointment due to lack of transport in past 1 y	Yes	35	8.3%
	No	387	91.7%
No. of outpatient department follow-up	1	155	36.7%
	≥2 clinics	267	63.3%
Missed follow-up, too busy visiting several clinics in past 1 y	Yes	24	5.7%
	No	398	94.3%
Social support and community resources			
Family support to treat their diabetes	Yes	366	86.7%
	No	56	13.3%
Health professionals in family	Yes	123	29.1%
	No	299	70.9%
Frequent religious places visit	<1/wk	74	17.5%
	1/wk	120	28.4%
	>1/wk	228	54.0%
Social support other than family	Yes	55	13.0%
	No	367	87.0%
Loss of a family member by death in past 1 y	Yes	65	15.4%
	No	357	84.6%

Access to Health Care, Social Support, and Community Resources

Most patients (80.1%) have a glucometer and 87.7% have community-based health insurance. Almost two-thirds (63.3%) of the patients have follow-up in at least 2 departments. Eighty-seven percent of the patients did not have social support other than their family (Table 4).

Prevalence of Cardiovascular-Kidney-Metabolic Syndrome

More than half of patients (52.4%; 95% CI, 47.6%-56.9%) have CKM syndrome. Most of the patients have diabetic nephropathy (Fig. 1).

Social Determinants of Health for Cardiovascular-Kidney-Metabolic Syndrome

In the bivariable binary logistic analysis, sex, skipped medication due to lack of money in the past 1 year, lost to follow-up for more than a year due to lack of money, having a disability, level of education, self-manage to take medication, missed appointment due to lack of money in the past 1 year, family member death, age, hypertension, duration of diabetes, marital status, employment status, vegetable intake, smoking history, BMI, and type of diabetes were candidate variables for multivariable analysis. However, in the multivariable analysis, male sex, lost to follow-up for more than a year due to lack of money, disability, missed appointments due to lack of transportation in the past 1 year, hypertension, employment status, and BMI were significantly associated with CKM syndrome.

Keeping other variables constant, male patients with diabetes were nearly 2-fold (AOR: 1.73; 95% CI, 1.01-2.94) more at risk for CKM compared with their counterparts. Similarly, patients with diabetes who were lost to follow-up for more than a year due to lack of money (AOR: 2.69; 95% CI, 1.01-7.22) and missed appointments due to lack of transportation in the past 1 year (AOR: 2.98; 95% CI, 1.21-7.33) were more than 2 times at risk for CKM compared with the counterparts.

Patients with diabetes who have a disability were nearly 2 times (AOR: 1.97; 95% CI, 1.12-3.48) more at risk for CKM compared with individuals with no disability. Similarly, patients with diabetes having hypertension and obesity were more than 3- (AOR: 3.12; 95% CI, 1.85-5.28) and 2- (AOR: 2.27; 95% CI, 1.17-4.40) fold more at risk for CKM compared with their counterparts, respectively. Patients who retired were nearly 2 times (AOR: 2.12; 95% CI, 1.04-4.30) more at risk for CKM compared with those currently employed (Table 5).

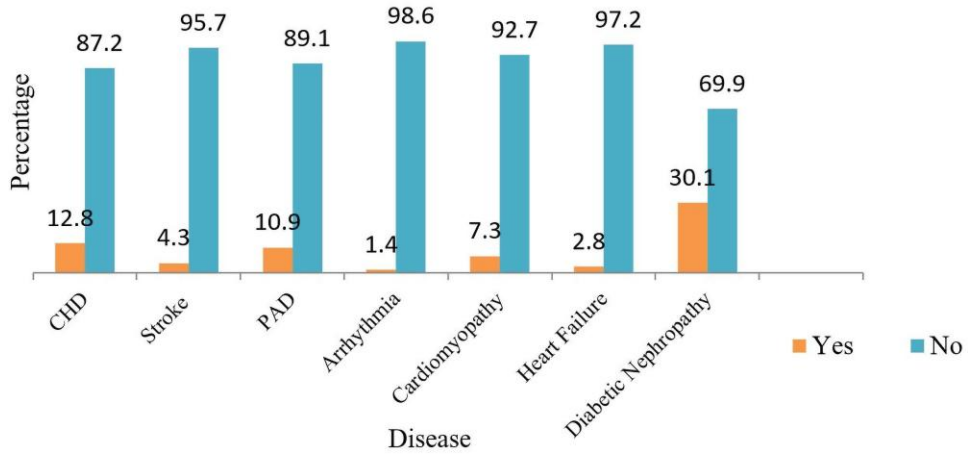

Figure 1. Percentage of each disease of cardiovascular kidney-metabolic syndrome among patients with diabetes at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia.

Discussion

Our finding revealed that more than half (52.4%; 95% CI, 47.6%-56.9%) of the individuals with diabetes among study participants had CKM syndrome. Our finding was higher than a study conducted in the United States that reported 26.3% of US adults between 2015 and 2020 have at least one CKM condition [24]. It is also higher than a study conducted in Israel in 2022 that showed that 12.63% of the patients had at least one condition within the diabetic cardiorenal spectrum [25]. This discrepancy might be due to lower socioeconomic status and a poor health-care setup, including limited medication availability, high patient-to-doctor ratios, inconsistent laboratory services, and associated late diagnosis in our study area. The other reason may be the inconsistent definitions and terms used in CKM syndrome. Furthermore, the frequency of chronic kidney disease (CKD) varies by race, with Black individuals having the highest prevalence due to high-risk genotypes such as *APOL1*, as demonstrated in ARIC and other research [26, 27]. This higher prevalence of CKM syndrome also implies that the diabetes is not well managed so it has progressed to a more advanced stage where multiple systems are affected. It underscores the need for integrated care that simultaneously addresses all aspects of the syndrome.

Our analysis reveals that male sex, loss of follow-up due to financial constraints, disability, missed appointments due to lack of transportation in the past 1 year, hypertension, employment status, and BMI are all significantly associated with CKM syndrome. Male patients with diabetes are more likely to acquire CKM syndrome, suggesting a sex difference in susceptibility to the illness [28]. This could be because estrogen has a cardiovascular protective effect in women, men have greater visceral obesity than women, and men have delayed health-care–seeking behavior [29, 30]. Except for a Saudi Arabian study [31], our finding is consistent with previous research indicating that men had a higher risk of cardiovascular and metabolic disorders [3, 32, 33].

The statistically significant association between loss to follow-up for more than a year due to lack of money and missed appointments due to transportation in the past 1 year due to issues with CKM syndrome proves the critical role of economic and logistical barriers in disease management. These findings are consistent with previous research that identifies financial constraints and access to transportation as substantial barriers to effective disease management and preventive care [2, 34]. This limited access to health-care facilities may lead to a lack of specialists and expert evaluation and a lack of better treatment, which may cause CKM disease. Patients with disabilities have nearly double the risk of CKM syndrome compared to those without disabilities, similar to other studies conducted in the United States [35]. Similarly, in a Korean study conducted between 2009 and 2019, the hazard ratio of disability for the occurrence of heart disease in people with diabetes increased significantly [36]. A retrospective study in China showed a higher incidence of coronary heart disease in the physical disability group compared to the non–physical disability group [37]. This could be explained by the fact that disabilities can limit access to health care, increase the risk of traditional cardiovascular risk factors, and make it difficult to manage chronic diseases, all of which contribute to their increased risk.

The prevalence of hypertension (62.6%) in this study was high, which emphasizes the need for integrated care approaches and public health interventions among patients with diabetes. The strong associations between hypertension and obesity with CKM syndrome also emphasize the role of these traditional risk factors similar to other studies conducted in Spain, Nigeria, and Ethiopia [38-41]. Both conditions are well-documented contributors to metabolic and cardiovascular syndromes, reinforcing the need for integrated management strategies that address these comorbidities [42]. Hypertension damages the endothelium of blood vessels, promoting inflammation and plaque formation, accelerates atherosclerosis, is linked to insulin resistance, and causes hypertensive nephrosclerosis [43]. Obesity also increases blood volume and cardiac output, RAAS-induced inflammation, and dyslipidemia [44]. However, it contradicts other studies that obesity has a protective effect [45, 46]. This difference may be due to more specific studies in CKD and heart failure patients only in those research studies.

Retired individuals are at nearly twice the risk for CKM syndrome compared to those currently employed. In retired individuals with diabetes, the combination of aging, longer duration of diabetes, changes in lifestyle like decreased physical activity, comorbidities like hypertension and dyslipidemia, and

Table 5. Social determinants of health for cardiovascular-kidney-metabolic syndrome among patients with diabetes at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia

Variable		CKM		Crude odds ratio (COR) (95% CI)	Adjusted odds ratio (AOR) (95% CI)	*P*
		Yes	No			
Sex	Male	95	128	1.53 (1.04-2.25)	1.73 (1.01-2.94)	.043[a]
	Female	106	93	1	1	
Age, y	<45	79	36	1	1	
	45-55	38	58	3.34 (1.89-5.91)	2.08 (0.96-4.49)	.060
	56-65	53	64	2.65 (1.55-4.53)	0.89 (0.38-2.06)	.795
	>65	31	63	4.46 (2.48-7.99)	1.14 (0.43-3.03)	.780
Educational level	No formal education	6	17	1.24 (0.79-1.94)	1.43 (0.83-2.46)	.189
	Primary school	44	43	3.01 (1.11-8.08)	2.95 (0.89-9.73)	.074
	Secondary school	70	66	1.03 (0.60-1.77)	0.88(0.46-1.67)	.707
	≥College	81	95	1	1	
Marital status	Widowed/divorced	22	15	1.36 (0.56-3.31)	0.46 (0.15-1.41)	.174
	Married	147	190	2.58 (1.36-4.89)	1.04 (0.44-2.48)	.916
	Single	32	16	1	1	
Skipped medication due to lack of money in past 1 y	No	163	159	1	1	
	Yes	38	62	0.02 (1.67-1.05)	1.47 (0.84-2.57)	.174
Lost to follow-up due to lack of money >1 y	No	188	199		1	
	Yes	13	22	1.59 (0.78-3.26)	2.69 (1.01-7.22)	.049[a]
Having disability	No	172	157		1	
	Yes	29	64	2.41(1.48-3.94)	1.97(1.12-3.48)	.019[a]
BMI	Normal	92	83	1	1	
	Overweight	74	82	1.22 (0.79-1.89)	1.0(0.59-1.685)	.999
	Obese	35	56	1.77(1.05-2.97)	2.27(1.17-4.40)	.015[a]
Self-manage to take medication	No	12	27	2.19(1.07-4.45)	2.24 (0.91-5.53)	.079
	Yes	189	194	1	1	
Missed appointment due to lack of transportation in past 1 y	Yes	22	13	1.96 (0.96-4.01)	2.98(1.21-7.33)	.017[a]
	No	179	208	1	1	
Family member death within 1 y	No	176	181	1	1	
	Yes	25	40	1.55 (0.90-2.67)	1.83(0.96-3.46)	.063
Hypertension	No	105	53	1	1	
	Yes	96	168	3.46 (2.29-5.24)	3.12 (1.85-5.28)	<.001[a]
Type of diabetes	I	49	22	1	1	
	II	152	199	2.91 (1.69-5.03)	1.06 (0.43-2.61)	.897
Duration of diabetes in year	<5	56	49		1	.318
	5-10	36	40	1.27(0.70-2.29)	1.52(0.75-3.08)	.244
	>10	109	132	1.38 (0.87-2.19)	1.53 (0.86-2.72)	.147
Employment status	Employed	90	67	1	1	
	Unemployed	56	60	1.43 (0.88-2.33)	1.36 (0.73-2.50)	.322
	Retired	42	75	2.39 (1.46-3.92)	2.12 (1.04-4.30)	.037[a]
	Other/Students	13	19	1.96 (0.90-4.253	2.19 (0.87-5.46)	.093
Vegetable intake/wk	≤3 d	136	162	1.31 (0.86-1.99)	1.32 (0.80-2.16)	.270
	>3d	65	59	1	1	
Smoking history	Yes	24	37	1.48 (0.85-2.58)	1.12 (0.58-2.18)	.726
	No	177	184	1	1	

Abbreviations: BMI, body mass index; CKM, cardiovascular-kidney-metabolic.
[a]Statistically significant association (*P* value <.05).

cumulative oxidative stress and inflammation all may contribute to an elevated risk of cardiovascular, kidney, and metabolic diseases. Proper management of diabetes, regular physical activity, dietary control, and monitoring of comorbid conditions are essential in reducing these risks. However, those complications alone might contribute to the early retirement of patients. In one study workers with CVD or diabetes had a significantly increased probability of early retirement [47].

Study Strengths and Limitations

Putting it all together, our research confirmed the statistically significant association between different SDOH and CKM diseases. It also strengthened the already established association of male sex, hypertension, and obesity as a risk for diabetes, CKD, and CVD. This study has the following limitations. The cross-sectional design restricts our ability to infer causality, and the reliance on self-reported data introduces potential biases. We also did not assess the different stages of CKM syndrome. However, this is the first study in Africa that has focused on SDOH and CKM diseases, which could be a baseline research for physicians and further researchers.

Conclusion

The prevalence of CKM syndrome among patients with diabetes was high. Being male, loss to follow-up for more than

a year due to lack of money, missing appointments due to lack of transportation in the past 1 year, having a disability, presence of hypertension, being retired from work, and a BMI of 30 or greater increased risk of CKM syndrome.

Recommendation

For health-care providers in low- and middle-income countries, recognizing the increased risk associated with disability, financial constraints, and employment status can inform more tailored and supportive care strategies. The Ministry of Health and other nongovernmental organizations should address financial and logistical barriers through targeted support programs. Initiatives aimed at improving transportation options and financial assistance for health-care costs are crucial in mitigating these barriers. Future researchers investigating the effectiveness of interventions designed to address financial, logistical, and social barriers will be valuable in developing targeted strategies to prevent and manage CKM syndrome.

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Disclosures

The authors have nothing to disclose.

Data Availability

Data are available on request from the corresponding author.

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