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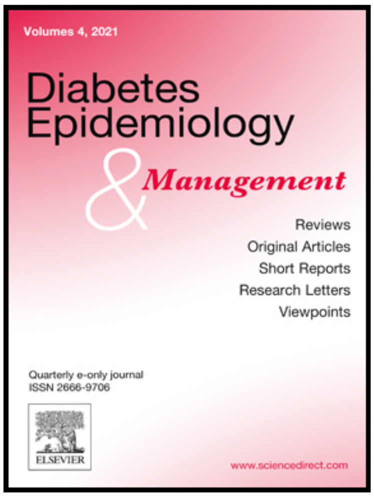

The burden of chronic kidney disease among people with diabetes by insurance schemes: findings from a primary referral hospital in Thailand

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The burden of chronic kidney disease among people with diabetes by insurance schemes: findings from a primary referral hospital in Thailand

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Highlights

- Thailand has achieved Universal Health Coverage (UHC) under three central schemes
- The quality of diabetes care is not equal among different insurance schemes
- The prevalence of CKD was 25.3%, ranges from 11.8% to 26.9% among insurance schemes
- There are variances in the benefits of insurance schemes to provide diabetes care
- This study may be a good lesson for the countries that aspire to complement UHC

Abstract

Background

Chronic Kidney Disease (CKD), a microvascular complication of diabetes, poses a significant threat of pre-mature deaths and morbidities globally, including Thailand. This study aimed to assess the burden of CKD among people with diabetes by their health insurance schemes in rural Thailand.

Methods

Cross-sectional data were collected from a clinical registry of 4050 people with diabetes attending a primary referral hospital in northeastern Thailand between January 2015 and December 2015. CKD was defined based on the determination of the estimated glomerular filtration rate (<60mL/min/1.73m^2). Blood pressure, blood glucose, and anthropometry were measured. Information about insurance schemes, namely, civil service medical benefits, social security, and universal coverage, were obtained from the participant's healthcare card. We performed multivariable logistic regression to determine the association of CKD with the corresponding insurance schemes.

Results

The majority of the participants were aged at or over 60 years (56.6%), were female (64.3%), were farmers (60.1%), completed secondary level education (70.7%), and were hypertensive (57.3%). Among all, 25.3% of participants had CKD (n=1027), ranging from 26.9% in the universal coverage scheme to 11.8% in the social security scheme. Under the civil service medical benefits scheme, people were less likely [adjusted odds ratio: 0.8, 95% confidence interval: (0.6-0.9)] to have CKD than people with universal coverage scheme. CKD was also greater among 50-59 [2.3 (1.3-3.5)], 60-69 [6.4 (4.3-9.5)], and ≥70-year-old [17.2 (12.5-28.1)] people than <50 years. Diabetic people with hypertension also had a higher odd of having CKD [1.8 (1.5-2.1)] than normotensive.

Conclusions

A significant number of people who had CKD attended the primary care hospital for receiving the management of diabetes. Primary healthcare facilities can provide CKD screening opportunities and diabetes care under the universal coverage scheme package and offer self-management education programs for rural people.

Keywords

Chronic kidney disease, Hypertension, Diabetes, Universal Health Coverage, Thailand

Abbreviations: CKD, Chronic Kidney Disease; NCDs, Non-Communicable diseases; eGFR, estimated Glomerular Filtration Rate; MoPH, Ministry of Public Health

Introduction

Non-communicable diseases (NCDs) account for an estimated 41 million deaths per year, with over 85% of these deaths occurring in low- and middle- income countries [1]. Like other countries in South East Asia, Thailand has experienced an increased prevalence of NCDs, including hypertension and diabetes [2]. For example, NCDs are estimated to account for 74% of mortality in Thailand in 2016 [3]. Recently, there have been increasing concerns about diabetes, with an increase from 7.7% in 2004 to 8.3% in 2020 [4, 5]. Considering the high burden of diabetes in Thailand, a growing number of people have been exposed to diabetes-related microvascular complications such as chronic kidney disease (CKD) [6, 7].

CKD is associated with a high risk of cardiovascular morbidities due to a gradual decline in glomerular filtration rate (GFR) [8]. A large number of previous studies investigated the factors associated with CKD, including older age, female gender, hypertension, diabetes, and obesity [6, 9-12]. However, the effect of hypertension and diabetes for CKD is unknown among people living in rural areas. As the number of people with diabetes and hypertension is increasing at an epidemic level in Asia, including Thailand, these two risk factors may have a synergistic effect on CKD [13], which needs investigation.

As CKD requires long-term management, it's better to focus on preventative strategies once people have diabetes. Thailand initiated universal health coverage under three central schemes with the motto of health for all in 2002 [14], exemplary to many developing countries. With the advent of universal health coverage for every citizen, Thailand has experienced an increasing trend in healthcare services [15, 16] and an overall health status improvement [17]. However, a high number of diabetic people with CKD may remain underdiagnosed or undertreated in rural areas. There may have some geographic inequality in care provision and differences in claiming benefits under the universal health coverage in Thailand [18].

Hence, the high cost of managing CKD among diabetic people who live in rural areas can be a burden for the public health system [19, 20].

A few studies have reported CKD in diabetes and its determinants in Thailand at community levels [21], urban and suburban hospitals [22, 23]. However, there is a lack of studies to determine the distribution of CKD among people with diabetes under these three insurance schemes who usually attend primary level hospitals. Understanding this burden may help the Ministry of Public Health (MoPH) to promote awareness programs and screening strategies at the community level for CKD patients.

This study aimed to assess the burden of CKD among people with diabetes under three health insurance schemes in rural Thailand. We hypothesise the burden of CKD, limited only to those with diabetes, differs according to their insurance schemes.

Materials and methods

Study design and setting

This cross-sectional study's data were collected using the clinical registry of people with diabetes from a primary referral hospital in northeastern Thailand. The study design has been described in detail previously [24]. In brief, the study hospital serves a large population, estimated at 114,588 people residing in the district referral facility's catchment area. Eligibility of participation included individuals to be a diagnosed case of type 2 diabetes mellitus, at least 18-year-old, consented to be included in the clinical registry, and maintained the first follow-up schedule to visit the hospital. The clinical registry enrolled 4,050 people with diabetes who attended the study hospital between January 2015 and December 2015.

MoPH diabetes screening program

The clinical registry contains data obtained from the MoPH's community-based screening program (24). In brief, community health volunteers (CHVs) initially screened participants twice using a conventional portable glucometer (Accu-Chek, Roche). Patients with a random blood sugar (≥200 mg/dl) upon screening were referred to the study hospital by local health centres to confirm diabetes. Additionally, CHVs measured the height and weight of the participants. At the local health centres, health workers measured the blood pressure of the participants in addition to fasting blood glucose (FBG). If a participant's FGB was more than 126 mg/dl in the local health centres, they were referred to the diabetic clinic of the study hospital for further evaluation and management. Afterwards, the medical officer re-evaluated the participants to diagnose diabetes based on physical symptoms, and serological (e.g., FBS>126 mg/dl) evidence. Blood pressure was recorded twice for each participant using an automated blood pressure machine (Omron Corporation, Japan). Participants were prescribed both non-pharmacological (lifestyle modification strategy) and/ or pharmacological (drugs) management. Next, medical officers advised participants to attend the clinic for a follow up three months later. The treatment protocol to manage diabetes was the same for the recipients of different insurance schemes; hospital doctors provided care and followed the same monitoring and follow-up procedure for study participants. When the participants attended their follow-up, they were instructed to undergo several serological and biochemical tests such as FBG, two hours after breakfast sugar (2ABF), serum creatinine, and lipid profile for knowing their control of blood glucose level. At the diabetes clinic, medical officer again measured the blood pressure of the participants. Total 4050 people who showed high blood sugar level, such as, FBS>126 mg/dl and 2ABF>140 mg/dl, were diagnosed as having a type 2 diabetes mellitus and subsequently were included in the analysis. We considered a patient as hypertensive if a patient had high systolic (≥140 mmHg) or high diastolic blood pressure (≥90 mmHg) or a history of antihypertensive drug intake in the last three months.

Data linkage and management

Linked data were obtained from three distinct sources of the hospital for this study. Firstly, hospital case records were used to get the anthropometric measurement, clinical diagnosis, and treatment. Secondly, demographic information was captured from the 'healthcare card' of participants. Finally, laboratory investigation reports were collected to obtain descriptions of blood tests. Hospital authorities used 'Medisoft' software (Microwize Technology for data management system) to assert the participants' data and financial claims. The quality of biochemical tests was maintained by regular checkups of the laboratory by the supervisor of clinical staff. Under the supervision of a data management officer (DMO), a group of skilled data operators performed the data entry. The DMO's responsibility was to verify the 5% entered data to identify data entry errors and inconsistencies. The head operator of the planning section of the hospital was in charge to routinely monitor the central database.

Operational definitions and measurements

Among the three insurance schemes, the first two are the 'civil servant medical benefit' scheme and the 'social security' scheme, which cover approximately 25% of the Thai population. The third one is the 'universal coverage' scheme, which includes the rest of its population [15]. The civil servant medical benefit scheme and social security scheme are designed for government officers and employees working in private companies, respectively. The universal coverage scheme is for the rest of the people in Thailand, who are not included in the first two schemes [15].

Age was categorised into four sub-groups (<50 years, 50-59 years, 60-69 years, and ≥70 years), and education level was considered '<Secondary (grade 12)' and '≥Secondary (grade 12)' in this study. The secondary school level (grade 12) acts as a milestone of education among Thais, and they are significant for economic and social development. Additionally, LDL-cholesterol level was categorised as optimal (<130 mg/dl) or above normal (≥130 mg/dl) in this study. The occupation was classified as 'farmer,' 'unemployed,' and 'different jobs' in the study region. Different job categories included civil servant, enterprise staff, day labourer, lawyer, retailers, monk, businessperson, student, police, and retiree. Smoking status was categorised as 'non-smoker' or 'current smoker', and alcohol drinking status was classified as 'non-drinker' or 'current drinker' for each patient. Patients were considered as 'non-drinker' or 'non-smoker' if they do not have a self-reported history of alcohol intake or smoking for the last three months.

Primary Outcomes (CKD)

The outcome variable was presence of CKD, which was determined after three months of first visit to the diabetes clinic. A participant with an estimated Glomerular Filtration Rate (eGFR) below 60mL/min/1.73m^2 was considered to have CKD. We used 'CKD Epidemiology Collaboration (CKD-EPI)' equations based on creatinine, age, sex, and a two-level variable for race, to calculate eGFR [25] in this study. CKD-EPI equation does not consider the clinical albuminuria level of a participant to provide a CKD risk prediction.

Data analysis

Participants were categorised according to CKD status to explore their demographic and biomarker levels. Means and standard deviations (SD) were used to present continuous variables, while numbers (n) and percentages (%) were used for the categorical variables. There were some missing data, however, we did not consider imputation of the data. Missing data in these covariates were determined to be missing completely at random (MCAR), which ensures the estimated parameters are not biased by the absence of the data. Thus, individuals with missing data were not included in the analysis. We performed chi-square tests for the categorical variables and one-way analysis of variance (ANOVA) for the continuous variables to compare participants. Bivariate logistic regression was used to quantify the associations between the dichotomous outcome of CKD and the independent variables. We incorporated covariates with a P value of ≤0.2 from univariable logistic regression into the multivariable models. Stepwise backward regression and likelihood-ratio (LR) test were conducted to assess 'the goodness of fit' of two competing statistical models. We also tested the variance inflation factors (VIF) for multi-collinearity between variables. Multivariable logistic regression was used to determine the likelihood of CKD in people with three health insurance schemes. Odds ratios (COR) and adjusted odds ratios (AOR) with 95% confidence intervals (CI) were reported. We used Stata version 14.0 to perform the analysis [26].

Ethical statement

This study was approved by the Human Research Ethics Committee of Khon Kaen University (approval number HE2247) of Thailand. The community-based screening program operated by MoPH, obtained written informed consent from the patients for inclusion in the registry, and strict confidentiality was maintained in preserving the data. Furthermore, to use the hospital data, permission was obtained from the authority of the study hospital.

Results

Participant's characteristics, stratified by CKD status

Most of the participants were aged at or over 60 years (56.6%), were female (64.3%), were farmers (60.1%), and completed secondary level education (70.7%) (Table 1). Approximately half of the participants (57.3%) were hypertensive, and one-quarters of them showed an above-normal level of LDL-cholesterol. The frequency of current alcohol drinkers and current smoking status was less than 3% among the participants. Most of the participants (78.2%) had health insurance under the universal coverage scheme compared to the other two insurance schemes, such as civil servant medical benefit scheme (16.2%) and social security scheme (5.8%).

<<Insert Table 1 here>>

Approximately 25.3% of participants had CKD (n=1027). Among people with diabetes with the universal coverage scheme, more than one-quarter had CKD, 26.9%, compared to 22.6% of people who were covered by the civil servant medical benefit scheme and 11.8% in the social security scheme.

The CKD distribution varied among the age groups, ranging from 3.0% in <50 years to 48.7% in ≥70 years in people with diabetes (Table 1). Women were presented with CKD two times higher than men. In addition, compared with participants without CKD, those who had CKD were more likely to be a farmer (66.8%), completed secondary education (69.2%), were hypertensive (72%), were with optimal control of LDL-cholesterol (67.7%), were non-smoker (96.4%), or were non-alcohol drinker (98.5%). Moreover, we found that CKD was common among people with the universal coverage scheme (82.9%), compared to the civil servant medical benefit scheme (14.4%), and social security scheme (2.7%).

Characteristics of diabetic people with or without CKD and associated factors

In bivariate logistic regression, the likelihood of CKD was progressively greater among older people, 50-59 years (OR: 2.5, 95% CI: 1.7-3.8), 60 – 69 years (OR: 7.9, 95% CI: 5.4-11.6), ≥ 70 years (OR: 23.4, 95% CI: 16.1-34.3) (Table 2). In addition, CKD was likely to be 1.2-fold greater for women than men, 2.3-fold greater in those who had hypertension. In contrast, CKD was less likely in those who were farmers (0.54-fold) or employed with different jobs (0.2-fold) than unemployed, had health insurance under the civil servant medical benefit scheme (0.8-fold), or social security scheme (0.4-fold) than universal coverage scheme. However, we did not find a significant association of education, smoking, alcohol drinking, or LDL-cholesterol with CKD.

<<Insert Table 2 here>>

In multivariable logistic regression, the likelihood of having CKD was 2.3-fold greater for those aged 50-59 years, 6.4-fold greater among 50-59 years, 17.2-fold greater among people with ≥ 70 years than people who were less than 50 years, and 1.8-fold greater in those who had hypertension. Under the civil servant medical benefit scheme, people were less likely (0.8-fold) to have CKD than the people with universal coverage scheme.

Discussion

People with diabetes are more exposed to microvascular complications such as CKD, which require immediate attention among the rural Thais. Although this study was not conducted with nationally representative samples, however, having one CKD patient in every four diabetic patients can be alarming for any primary health system for countries like Thailand. We also determined that the likelihood of presenting with CKD was higher in participants with the universal coverage scheme than the other two insurance schemes. We found that people who had hypertension were approximately two times more likely to have CKD. In addition to that, older age groups (at or more than fifty) showed a progressive increase of CKD burden among people with diabetes.

Due to the high burden of CKD, the primary healthcare system requires more attention to manage diabetes efficiently in rural areas. If people in lower socioeconomic areas do not receive proper diabetes care, addressing the enormous burden of diabetes-related complications such as nephropathy, and CKD will require more resources, costs, and effort from the Thai health care system [27]. While efforts to implement insurance system for all have improved the uptake of healthcare services [15, 16] among general people, this study indicates that the magnitude of diabetes-related complications such as CKD was higher in the universal coverage scheme but lower in the civil servant medical benefit scheme and social security scheme. One explanation could be that diabetic people with the universal coverage scheme referred to the hospital were older or may have arrived at a more advanced stage of kidney disease, making it harder to control. Another possible assumption could be that people in social security scheme are government employees, and they may belong to a certain age group. In addition, beneficiaries of civil servant medical benefit scheme are mostly employees working in a private organisation, where people may also have an age limit to work. Comparing to other countries, similar inequalities of receiving care among people with diabetes have been reported in the United States under different health insurances [28]. This gap can be avoided if people with CKD have better adherence to drugs, life modification strategies, and improve health-seeking behaviours. In doing so, widespread innovation of electronic (e)-health technology is urgently needed to implement [29]. The use of technology such as telehealth and telemedicine, along with routine service provision by CHVs, may help the nationwide extension of diabetic care and management in Thailand.

Controlling hypertension should get a top priority in preventing CKD progression in people with diabetes. We found that hypertension was significantly associated with CKD [8], which illustrates the pathophysiological sequence of the urinary system. The kidney plays a critical role in developing hypertension by the process of sodium retention and increased peripheral vascular resistance [30]. The pathways to develop CKD include electrolyte imbalance, activation of Renin-Angiotensin-Aldosterone System, endothelial cell dysfunction, and increased oxidative stress [31]. Thus, uncontrolled hypertension plays a vital role in CKD progression by increasing glomerular filtration pressure [32]. Previous studies also showed a positive correlation between these two variables [33, 34]. To counter this synergistic effect, the current management of hypertension and diabetes should focus on the combination of pharmacological (antihypertensive and antidiabetic drugs) and non-pharmacological interventions (lifestyle modifications). Patients with CKD can also be benefitted from participating in diabetes self-management education (DSME) programs and by adopting lifestyle changes. DSME programs incorporate both pharmacological and non-pharmacologic interventions and are proven to help patients improve their diabetes status and reduce diabetes-related complications such as CKD [35].

Diabetes care among older adults is challenging because of several epidemiological, clinical, and economic issues, which are amplified in the presence of chronic complications [36]. We observed a significant association of hypertension in diabetic CKD patients among older adults. The physiological decline of renal function with age may be associated with a gradual reduction of eGFR [37]. Interestingly, our data also showed that a large number of people with diabetes aged more than 50 years were presented with non-CKD, thus indicating CKD may not be due to loss of renal function for increased age.

Finally, attention is required to improve CKD diagnosis by measuring creatinine in primary level facilities. While Thailand has achieved universal health coverage, now it will be a challenge to identify and manage people who have diabetes and at risk to develop CKD through mass screening [38]. Future studies could examine diabetes management data over a more extended period, representing the quality of care more effectively and identifying barriers or downfalls in the current healthcare delivery model.

The limitations of the present article also warrant discussion. The clinical registry utilised for the analysis did not contain adequate information on pre-treatment status or illness severity, the timing of the first confirmed diagnosis of diabetes (i.e., the duration of risk), and detailed drug information for diabetes and hypertension, which may limit the comparison between CKD and non-CKD patients. This study did not document some of the social covariates and extensive demographics of participants, which may influence the association with diabetes. Poor comparability among beneficiaries covered by the three insurance schemes could be a concern, especially as this study lacks relevant individual-level data as mentioned above. However, this study was one of the first few attempts to identify factors associated with CKD under different insurance schemes in rural Thai areas. Since the concept of universal health coverage is gaining popularity globally, results from this Thai study will benefit other LMICs on policy making and evaluation. It may also enable them to plan for achieving universal health coverage, the most encircling targets of the Sustainable Development Goals for 2030, for all in the primary care leaving no one behind. We also used a large sample size in this study, which increased the overall power of the study.

Conclusions

A large number of diabetic people who attended the primary care hospital for receiving the management of diabetes have CKD. The burden of CKD among people with diabetes differs by insurance schemes. People can get benefit if primary healthcare facilities provide screening opportunities for CKD under the universal health coverage. Community intervention such as diabetes self-management or hypertension awareness can be a promising intervention for rural people at high risk of complications.

Author's contribution

Study design and acquisition of data: SBZ, NH
Analysis and interpretation of data: SBZ, RDG, GMK, SMSI
Drafting and final approval: SBZ, RDG, PP, RKK, CS, NH, MRH, MNK, GMK, SMSI

Data availability

The data set supporting the conclusions of this article can be obtained from the authors upon request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1. General characteristics of study participants (N=4050), stratified by chronic kidney disease status

Characteristics	Overall (N=4,050)	CKD Status		p-value
		Non-CKD (N=3023)	CKD (N=1027)	
Age (in years)				<0.001
< 50	671 (16.6)	640 (95.3)	31 (4.7)	
50 – 59	1,083 (26.7)	964 (89.0)	119 (11.0)	
60 – 69	1,356 (33.4)	979 (72.2)	377 (27.8)	
≥ 70	940 (23.3)	440 (46.8)	500 (53.2)	
Gender				0.008

Men	1,446 (35.7)	1,114 (77.1)	332 (22.9)	
Women	2,604 (64.3)	1,909 (73.3)	695 (26.7)	
Occupation				<0.001
Unemployed	456 (11.2)	265 (58.1)	191 (41.9)	
Farmer	2,431 (60.1)	1,745 (71.8)	686 (28.2)	
Different jobs	1,163 (28.7)	1,013 (87.1)	150 (12.9)	
Education level†				0.92
<Secondary (grade 12)	1,151 (29.3)	859 (74.6)	292 (25.4)	
≥Secondary (grade 12)	2,786 (70.7)	2,075 (74.4)	711 (25.6)	
Hypertension				<0.001
No	1,731 (42.7)	1,443 (83.4)	288 (16.6)	
Yes	2,319 (57.3)	1,580 (68.1)	739 (31.9)	
LDL cholesterol‡				0.57
Optimal	2,825 (75.7)	2,130 (75.4)	695 (24.6)	
Above normal	909 (24.3)	677 (74.5)	232 (25.5)	
Smoking status				0.46
Non-smoker	3,905 (96.4)	2,911 (74.5)	994 (25.5)	
Current smoker	145 (3.6)	112 (77.2)	33 (22.8)	
Alcohol drinking status				0.68
Non-drinker	3,996 (98.7)	2,984 (74.6)	1,012 (25.4)	
Current drinker	54 (1.3)	39 (72.2)	15 (27.8)	
Health insurance				<0.001
Universal coverage scheme	3,159 (78.2)	2,308 (73.1)	851 (29.9)	
Civil service medical benefits scheme	655 (16.2)	507 (77.4)	148 (22.6)	
Social security scheme	236 (5.8)	208 (88.2)	28 (11.8)	

Abbreviations: LDL, low-density lipoprotein; CKD, chronic kidney disease
Data are presented as the proportion (%)
CKD has been defined based on estimated glomerular filtration rate (eGFR< 60mL/min/1.73m^2), and presented here as row percentage.
p-values for differences between CKD and Non-CKD generated using the X^2 test
There are 113 missing observations on education level, and 316 on LDL-cholesterol level, so these individuals were not included in the analysis.

Table 2. Factors associated with chronic kidney disease among people with diabetes

Characteristics	**Univariable analysis**	**Multivariable analysis**
	OR [95% CI]	AOR [95% CI]
Age		
< 50 years	Ref.	Ref.
50 - 59	2.5 [1.7-3.8] ***	2.3 [1.5-3.5] ***
60 – 69	7.9 [5.4-11.6] ***	6.4 [4.3-9.5] ***

≥ 70 years	23.4 [16.1-34.3] ***	17.2 [12.5-28.1] ***
Gender		
Male	Ref.	Ref.
Female	1.2 [1.1- 1.4] **	0.9 [0.8-1.1]
Hypertension		
No	Ref.	Ref.
Yes	2.3 [2.1-2.7] ***	1.8 [1.5-2.1] **
Education		
<Secondary (grade 12)	Ref.	-
≥Secondary (grade 12)	1.1 [0.8-1.2]	
Occupation		
Unemployed	Ref.	Ref.
Farmer	0.54 [0.4-0.6] ***	1.1 [0.8-1.3]
Different jobs	0.2 [0.1-0.3] ***	0.8 [0.6-1.1]
Smoking status		
Non-smoker	Ref.	
Current smoker	0.8 [0.6-1.2]	
Alcohol drinking		-
Non-drinker	Ref.	
Current drinker	1.1 [0.2-2.1]	
LDL-cholesterol		-
Optimal	Ref.	
High	1.1 [0.9-1.3]	-
Health insurance		
Universal coverage scheme	Ref.	Ref.
Civil service medical benefits	0.8 [0.6-0.9] **	0.8 [0.6-0.9] **
Social security scheme	0.4 [0.2-0.6] **	0.8 [0.6-1.7]

Abbreviations: CI, confidence interval; OR, odds ratio; AOR, adjusted odds ratio; LDL, low-density lipoprotein;

Data are presented as the odds ratios (95% confidence interval)

'-'Denotes a non-significant ($p > 0.05$) relationship in the multivariable logistic regression model. Thus, the variable was excluded from the final model

There are 113 missing observations on education level, and 316 on LDL-Cholesterol level, so these individuals were not included in the analysis

*Significant at $p < 0.05$

**Significant at $p < 0.01$ level

***Significant at $p < 0.001$