Am J Blood Res 2025;15(5):102-109
www.AJBlood.us /ISSN:2160-1992/AJBR0169177

Original Article

Is the coexistence of diabetes and hypertension liable for a higher risk of cardiovascular disorders among Saudis?

Fayez Saud Alreshidi[1], Eldisugi Hassan Mohammed Humida[2], Hussain Gadelkarim Ahmed[3,4]

[1]Department of Family and Community Medicine, College of Medicine, University of Hail, Hail, Kingdom of Saudi Arabia; [2]Department of Medicine, Faculty of Medicine, University of Kordofan, El-Obeid, Sudan; [3]Prof Medical Research Consultancy Center, El-Obeid, Sudan; [4]Department of Histopathology and Cytology, FMLS, University of Khartoum, Khartoum, Sudan

Received October 7, 2025; Accepted December 14, 2025; Epub December 15, 2025; Published December 30, 2025

Abstract: Background: Cardiovascular diseases (CVDs) are experiencing a notable increase globally, largely influenced by the related rise in risk factors, including type 2 diabetes mellitus (T2DM) and hypertension (HTN). This study aimed to evaluate the detrimental effects of CVDs on individuals diagnosed with both T2DM and HTN in Saudi Arabia. Methodology: This descriptive study used samples from approximately 31 primary health clinics (PHCs) that serve the local community in the Hail region of northern Saudi Arabia. Between December 2021 and June 2022, roughly 1,406 individuals were picked using a basic random selection procedure. Of the 1406 subjects, 702 (50%) were diagnosed with both T2DM and HTN, 404 (28.7%) with T2DM only, and 300 (21.3%) with HTN only. Results: There were 42 (65.6%), 59 (60.8%), 26 (70.2%), and 33 (50.7%) cases of stroke, CHD, CHF, and DVT in patients with combined DM and HTN, respectively. Stroke, CHD, CHF, and DVT were prevalent in those with diabetes and hypertension at rates of 6%, 8.4%, 4%, and 5%, respectively. Conclusion: The combination of T2DM and HTN significantly raises the risk of stroke, CHD, CHF, and DVT. Saudi men have much greater rates of CVDs, T2DM, and hypertension than women.

Keywords: Cardiovascular disease, stroke, diabetes, hypertension, coronary artery disease, congestive heart failure, deep vein thrombosis, Saudi Arabia

Introduction

Cardiovascular diseases (CVDs) are a group of diseases that affect both the heart and blood arteries, such as peripheral artery disease and cerebrovascular disease [1, 2]. Despite the recognition of hypertension (HTN) and type 2 diabetes mellitus (T2DM) as risk factors for CVD, our understanding of their underlying and contributing causes remains inadequate. Living with HTN and T2DM was assumed to increase the risk of developing a cardiovascular disorder [3].

According to reports, the frequency of CVDs among Saudis over the age of 15 is 1.6%. Males have a higher prevalence than females, with 1.9% versus 1.4%, respectively. Age is a critical predictor, with cardiovascular disease frequency gradually increasing until the age of 50, followed by a sharp increase [4]. Understanding the health consequences of exposure to risk factors is critical for shaping public health policy and practice. Diabetes and hypertension are the most common risk factors for CVDs in Saudi Arabia. The proportion of Saudis suffering from type 2 diabetes and hypertension is increasing at an alarming rate [5].

Diabetes is an increasing public health concern in Saudi Arabia, with catastrophic consequences. The region's escalating diabetes rate necessitates a thorough investigation into its prevalence, causes, and public health remedies [6]. Hypertension is highly prevalent in Middle Eastern countries, especially Saudi Arabia. The reported prevalence of hypertension in Saudi Arabia is 11.1% [7]. The current study aims to

https://doi.org/10.62347/VJPZ6106

assess the impact of CVDs on people with T2DM and HTN in Saudi Arabia.

Materials and methods

This descriptive cross-sectional study used samples from roughly 31 primary health clinics (PHCs) that serve the local population in the Hail region of northern Saudi Arabia. A total of approximately 1,406 individuals were chosen using a basic random selection procedure between December 2021 and June 2022. Out of the 1406 patients, 702 (50%) had both DM and HTN, 404 (28.7%) had DM alone, and 300 (21.3%) had HTN exclusively.

The sample size was calculated based on SurveyMonkey software using the formula:

Sample size: = Z^2 P (1 - P)/e^2/1 + (Z^2 P (1 - P)/e^2 N

N = population size, e = margin of error (percentage in decimal form), Z = Z-score, P = population proportion [8].

Eligibility criteria were all adult Saudi men and women aged 20 to 90, regardless of DM or HTN status, who visited PHCs throughout the assigned study period. Individuals who had previously been diagnosed with DM and/or HTN and were actively undergoing treatment were included in the study, whereas those who showed transitory increases in blood glucose or blood pressure were excluded. HTN diagnosis was based on HTN classification based on blood pressure readings: Normal: Systolic < 120 mmHg and Diastolic < 80 mmHg; Elevated: Systolic 120-129 mmHg and Diastolic < 80 mmHg; Hypertension Stage 1: Systolic 130-139 mmHg or Diastolic 80-89 mmHg; Hypertension Stage 2: Systolic ≥ 140 mmHg or Diastolic ≥ 90 mmHg.

T2DM was diagnosed based on the hemoglobin A1c test, which reflects average blood glucose levels over the past two to three months. Normal: Less than 5.7%; Prediabetes: 5.7% to 6.4%; Diabetes: 6.5% or higher on two separate tests.

Assessment of cardiovascular disease outcomes

For most research participants, stroke was diagnosed by the conventional presentation of neurological symptoms, such as motor and sensory complaints, and immediate brain imaging with non-contrast CT. A few individuals got MRI, MRA, and MRV.

CHD was identified based on chest pain and noninvasive myocardial ischemia testing, such as exercise stress ECG with Bruce protocol, coronary CTA, dobutamine stress echocardiography, PET scans, and invasive coronary angiography in some patients.

Heart failure was diagnosed as three categories: heart failure with reduced ejection fraction (HFrEF) (EF < 40), preserved ejection fraction (HFpEF) (EF < 50), and moderately reduced ejection fraction (HFmrEF) (EF < 40-50). This was with symptoms of heart failure and the transthoracic echocardiography examination in addition to NT-Pro BNP.

Almost all cases of DVT were diagnosed depending on the clinical presentation together with Doppler ultrasound examinations of the limbs.

Ethical Consent: Prior to the collection of any samples, we meticulously ensured that all parties involved reached a consensus, both verbally and in written form, regarding the ethical considerations of the study.

Institutional Review Board (IRB) approval

The Research Ethics Committee (REC) of the health affairs at Hail has evaluated and approved the project and assigned approval number IRB Registration Number with KACS, KSA: H-08-L-074.

Data analysis

The analysis was conducted using SPSS software (version 27, IBM, Chicago, USA), which produced frequencies, cross-tabulations, and relative risk (RR), specifying a 95% confidence interval (95% CI) for the Chi-square test results. To be deemed statistically significant, the *P*-value must be less than 0.05.

Results

This study included 1406 patients aged 20 to 90, with a mean age of 48 years. Of the 1406 patients, 749 (53.3%) were men and 657 (46.7%) were women. Approximately 702/1406 (50%) had both diabetes and hypertension. Of

Table 1. Distribution of the patients by cardiovascular diseases, diabetes, and hypertension

Variable	DM (n = 1106)			HTN (n = 1002)		
	Yes	No	Total	Yes	No	Total
Stroke	43	21	64	40	23	63
CHD	57	40	97	81	16	97
CHF	22	15	37	25	12	37
DVT	21	44	65	18	48	66

CHD, Coronary Heart disease; CHF, Congestive Heart Failure; DVT, Deep Vein Thrombosis; DM, Diabetes Mellitus; HTN, Hypertension.

the 702 patients with the combined disease, 362 (51.6%) were men and 340 (48.4%) were women. Out of 1406 patients, 1106 were diabetics and 1002 were hypertension patients.

Out of 64 stroke patients, 43/64 (67%) were diabetics. The prevalence of stroke among DM was 43/1106 (3.9%). The risk of stroke among diabetic individuals was calculated using the Odds Ratio (OR) and 95% confidence interval (95% CI): OR = 5.383 (3.181-9.111), Pearson Chi-Square (P < 0.0001). Coronary heart disease (CHD) affected 57 (58.7%) diabetic people. The prevalence of CHD among DM was 57/1106 (5.2%).

Diabetic individuals had a higher risk of coronary heart disease (CHD), with an odds ratio (OR) of 3.762 and a 95% confidence interval (CI) ranging from 2.497 to 5.669, as indicated by the Pearson Chi-Square test (P < 0.001). We detected congestive heart failure (CHF) in 22 (59%) diabetic patients. The prevalence of CHF among DM was 22/1106 (2%). Diabetic patients had a higher risk of congestive heart failure (CHF), with an odds ratio (OR) of 3.784 and a 95% confidence interval (CI) ranging from 1.956 to 7.320, as indicated by the Pearson Chi-Square test (P < 0.01).

Deep vein thrombosis (DVT) was found in 21 (31.8%) diabetic patients. The overall prevalence of DVT in the study population was 21 out of 1106 patients (1.9%). Diabetic patients have a higher prevalence of DVT (OR 95% CI = 1.221 (0.723-2.063), Pearson Chi-Square (P < 0.454)).

We observed stroke in 40 (63.4%) of the hypertension patients. The prevalence of stroke among HTN was 40/1002 (4%). There is a strong link between high blood pressure and the chance of having a stroke. The odds ratio is 5.156 (95% CI: 3.073-8.652), and the Pearson Chi-Square value is 0.001, which means the link is statistically significant.

Coronary heart disease was identified in 81 (83.5%) of hypertensive patients. The prevalence of CHD among HTN was 81/1002 (8%). An OR of 15.612 and a 95% confidence interval (CI) of 9.090-26.814 show that the link between CHD and high blood pressure is statistically significant (P < 0.0001).

CHF was identified in 25 hypertensive patients, representing 67.5% of the cohort. The prevalence of CHF among HTN was 25/1002 (2.5%). The risk of congestive heart failure (CHF) in hypertensive patients is indicated by an OR of 6.102 with a 95% CI of 3.055 to 12.187 and a Pearson chi-square value with a significance level of P < 0.0001.

We observed DVT in 18 hypertensive patients, accounting for 27.2% of the study. The prevalence of DVT among HTN was 18/1002 (1.8%). The risk of DVT in hypertensive patients is represented by an OR of 1.077 with a 95% CI of 0.624 to 1.859, as shown by the Pearson Chi-Square test (P < 0.791), detailed in **Table 1**, **Figure 1**.

A total of 42 (65.6%), 59 (60.8%), 26 (70.2%), and 33 (50.7%) cases of stroke, CHD, CHF, and DVT, respectively, were identified in patients with combined DM and HTN, as shown in **Table 2**.

The prevalence rates of stroke, CHD, CHF, and DVT among individuals with both diabetes and hypertension were 6%, 8.4%, 4%, and 5%, respectively, as illustrated in **Figure 2**.

Stroke was detected in 42 (65.6%) males and 22 (34.3%) females. Male stroke risk: Relative risk (RR) (95% CI) = 1.894 (1.126-3.183), P = 0.014. CHD was detected in 72 (74.2%) males and 25 (25.8%) females. The risk of CHD in men: RR (95% CI) = 2.936 (1.856-4.642), *P* value = 0.001. CHF was detected in 17 (51.5%) males and 20 (60.6%) females. Females have a higher risk of developing CHF (RR (95% CI) = 0.833 (0.435-1.594), *P* value = 0.58). DVT was detected in 16 (24.6%) males and 49 (75.3%) females. Females have a higher risk of DVT; RR (95% CI) = 1.546 (1.344-1.778), *P* value = 0.001.

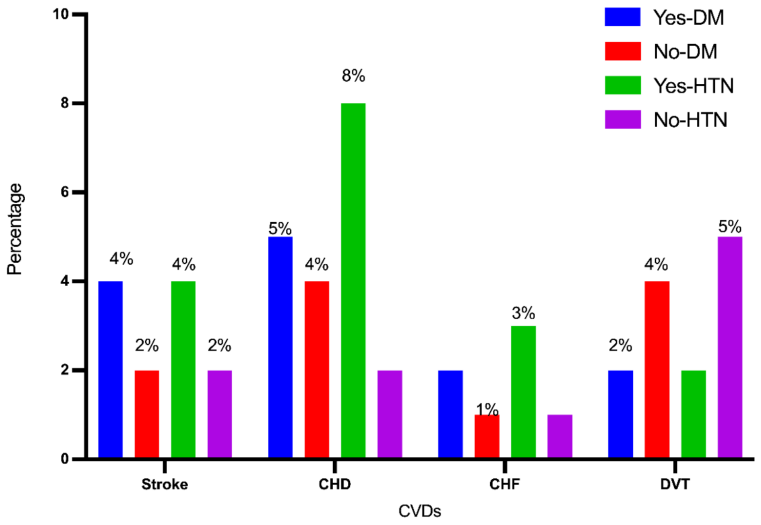

Figure 1. Description of the prevalence rates of CVDs by DM and HTN.

Table 2. Distribution of patients with combined DM & HTN by CVDs

Variable	Combined DM & HTN (n = 702)	Either DM or HTN	Total
Stroke	42	22	64
CHD	59	38	97
CHF	26	11	37
DVT	33	32	65

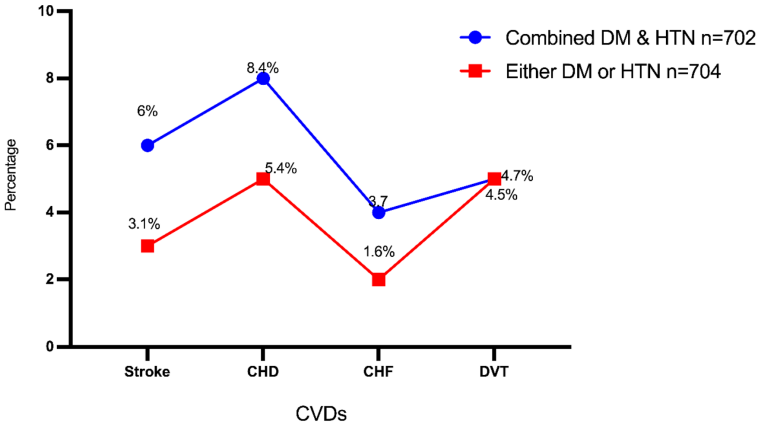

Figure 2. Description of the combined effects of diabetes mellitus (DM) and hypertension (HTN) on cardiovascular diseases (CVDs).

Table 3 and **Figure 3** show that approximately 48 (80%), 55 (63.2%), 27 (81.8%), and 55 (94.8%) of patients with stroke, CHD, CHF, and DVT were smokers, respectively.

Discussion

Cardiovascular diseases represent a major health challenge affecting communities worldwide. Researchers have identified numerous risk factors associated with the occurrence of cardiovascular diseases, specifically diabetes mellitus and hypertension. As a result, this study evaluated the impact of cardiovascular diseases on mortality among patients who have both diabetes mellitus and hypertension. There are various vascular mechanisms through which both hypertension and diabetes elevate the risk of cardiovascular disease. Diabetes and high blood pressure are two common risk factors. Atherosclerosis, vascular inflammation, endothelial dysfunction, and structural remodeling are associated with these conditions and can lead to both large and small vascular diseases. The simultaneous presence of diabetes and hypertension exacerbates vascular damage and endothelial dysfunction [9].

The results of the current study indicate that the prevalence of stroke among individuals with both diabetes mellitus and hypertension is 6%, while the prevalence among those with diabetes mellitus alone is 3.9%, and among those with hypertension alone is 4%. The incidence of stroke among individuals with type 2 diabetes mellitus (T2DM) is significant, and the aggregation of risk factors correlates with the onset of stroke in this population. Risk factors vary across distinct stroke subtypes. It is essential to identify risk factors for a particular high-risk group. Approximately 50% of stroke patients presented with clusters comprising more than four risk factors. The presence of more than four risk factor clusters significantly increased the risk of stroke by 3-4 times compared to no-risk factor clustering ($P < 0.001$). The primary risk factors include diabetes and hypertension [10]. A recent study esti-

Table 3. Distribution of CVDs by gender and smoking habits

Variable	Males	Females	Total	Smokers	None-smokers	Total
Stroke	42	22	64	48	12	60
CHD	72	25	97	55	32	87
CHF	17	20	37	27	6	33
DVT	16	49	65	55	3	58

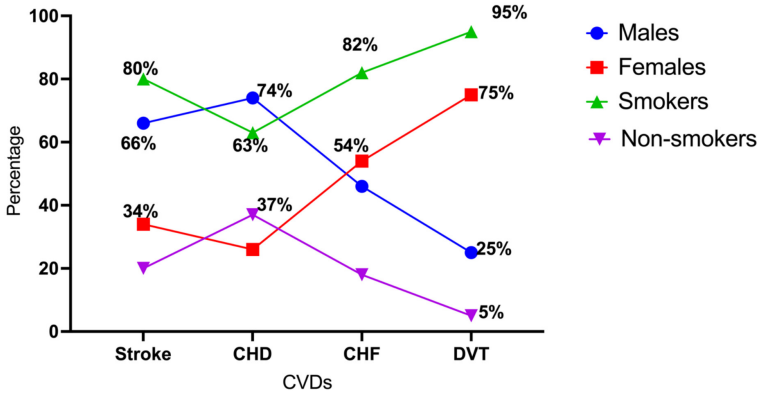

Figure 3. CVDs by gender and smoking habits.

mated the prevalence of multimorbidity, which includes hypertension, diabetes, and stroke/heart attack, to be 3.5% within the sampled population [11]. Individuals diagnosed with T2DM and HTN exhibit an increased incidence of new strokes and recurrence following a one-year follow-up period. Proactively recognizing the modifiable risk factors, including smoking and lack of physical activity, will contribute to lowering the risk of stroke and its recurrence in individuals with T2DM and HTN [12]. Even though there is a strong link between T2DM and HTN and the risk of both VE and stroke, the group with HTN had a higher overall risk of both events compared to the group with T2DM [13].

The findings of the present study reveal that the prevalence of CHD in individuals with both diabetes mellitus and hypertension is 8.4%, whereas it is 5.2% in those with diabetes mellitus alone and 8% in those with hypertension alone. Although the cause remains unknown, observational studies have linked gestational diabetes mellitus to an increased risk of cardiovascular disease. Researchers have found a possible link between genetic predisposition to gestational diabetes mellitus and the risk of coronary artery disease. T2DM and high blood pressure mostly mediate this link. These findings suggest that addressing modifiable cardiometabolic risk factors may minimize the incidence of CHD in women with a history of gestational diabetes [14].

A study revealed a link between increased risks of cardiovascular disease and both T2DM and HTN, as well as hypertension and diabetes. The average incident rates of coronary artery disease for T2DM cohorts, HTN cohorts, and comorbid cohorts were 16.80, 23.18, and 31.53 per 1000 person-years, respectively [15].

The current study's findings indicate that the prevalence of CHF in adults with both diabetes mellitus and hypertension is 4%, compared to 2% in those with diabetes mellitus alone and 2.5% in those with hypertension alone. Defined by the American College of Cardiology (ACC) and the American Heart Association (AHA), CHF is a multifaceted clinical syndrome arising from structural or functional impairments in ventricular filling or blood ejection [16]. Hypertension is a major risk factor for heart failure (HF) across all left ventricular ejection fractions. A lot of research shows that controlling blood pressure (BP) can prevent cardiovascular problems, including HF. The pathophysiology of hypertension and its epidemiological association with heart failure (HF) are well elucidated; however, blood pressure targets, particularly in HF patients, remain ambiguous [17]. T2DM impairs cardiac function and causes HF directly and indirectly through related conditions such as hypertension [18]. Diabetes can cause HF, which affects up to 22% of diabetics and is on the rise. HF may develop in diabetics without hypertension, coronary heart disease, or valvular heart disease, making it a major cardiovascular complication in this vulnerable population. For many diabetics, HF is the first sign of cardiovascular disease [19].

The findings of the present study reveal that the prevalence of DVT among adults with concurrent T2DM and HTN stands at 5%. In contrast, the prevalence is 1.9% for individuals with T2DM alone and 1.8% for those with HTN alone.

DVT represents a considerable health threat, especially among hospitalized individuals who exhibit various risk factors, including hypertension and diabetes. Despite advancements in treatment, DVT continues to be a common complication associated with hospitalization [20]. Diabetes mellitus is linked to conditions that promote thrombosis and occurrences of thrombotic events. There is an observed association between preoperative hyperglycemia and DVT in patients with lower limb fractures. Multiple approaches exist for managing hyperglycemia, presenting opportunities for future breakthroughs [21]. Researchers conducted a study to determine the prevalence of DVT, and the variables associated with its occurrence in hypertensive patients. DVT was identified in 13.5% of the hypertensive individuals examined [22]. Conflicting evidence links high blood pressure (BP) to venous thromboembolism (VTE). Lower BP increases VTE risk, as demonstrated by two Mendelian randomization analyses. In most patient groups, BP reduction benefits outweigh the risks; however, those at risk for VTE should be careful [23].

T2DM and hypertension constitute a significant health issue in Saudi Arabia, as they are on a continuous rise. The International Diabetes Federation has indicated that the standardized prevalence of diabetes among adults in the Kingdom of Saudi Arabia was 18.7% in 2021, with projections suggesting an increase to 21.4% by the year 2045 [24]. Several studies need to explore the prevalence of hypertension (HTN) on both national and regional scales within Saudi Arabia. The prevalence of hypertension was recorded at 9.2% within the Saudi demographic aged 15 years and above. The prevalence was greater among women at 10.0% compared to 8.5% in men. The incidence of hypertension escalates with age, particularly in individuals aged 65 and above, where it affects 55.3% of women and 48.0% of men. Conversely, its occurrence remains minimal in the younger demographic, represented by just 0.1% among those aged 15-19 years. A significant disparity was observed in the prevalence of hypertension across various regions, with figures ranging from 6.0% in the Najran region to 10.0% in the Makkah region [25].

Nevertheless, most of the research conducted in Saudi Arabia within this framework has indicated a correlation between hypertension and cardiovascular diseases, or T2DM and cardiovascular disorders. Furthermore, many of these investigations focused on small sample sizes and primarily took place in clinical settings. To the best of our understanding, the present research represents the most noteworthy community-based investigation carried out in Saudi Arabia regarding the impacts of both hypertension and diabetes. Addressing the coexistence of hypertension and diabetes in Saudi Arabia necessitates a comprehensive strategy that integrates public health initiatives, policy reforms within the healthcare system, and active community participation. Emphasizing prevention and integrated care can substantially enhance the future prospect for effectively mitigating the impact of these chronic diseases.

However, in addition to evident cardiovascular disorders, diabetes-related hypertension encompasses underlying molecular mechanisms such as inappropriate activation of the renin-angiotensin-aldosterone system, sympathetic nervous system dysregulation, mitochondrial dysfunction, oxidative stress, and systemic inflammation. Active epithelial sodium channels, modified extracellular vesicles and microRNAs, dysregulated gut microbiota, and increased renal sodium-glucose cotransporter activity contribute to the susceptibility of diabetics to hypertension [26].

Combining T2DM and HTN increases the risk of CVDs and other health concerns. Understanding this link is crucial for prevention and management, especially in demographically diverse Saudi Arabia. HTN and T2DM harden arteries, increasing ischemic and hemorrhagic stroke risk. The two illnesses can narrow coronary arteries, increasing heart attack risk. Heart failure can result from excessive blood pressure and diabetes. Obesity, poor mobility, and circulation in T2DM and HTN enhance DVT risk. Saudi men have greater CVD, T2DM, and HTN than women. Lifestyle, diet, and culture affect this trend. These disorders may be more common in men due to smoking, inactivity, and poor diets. Women have a lower prevalence of T2DM and HTN than males, but their rising prevalence illustrates the importance of focused therapy. Public health administrators must educate Saudi men about T2DM and HTN. Early diabetes/hypertension screening

can identify at-risk patients. Community-based diet, exercise, and smoking cessation programs lower chronic diseases.

Although this study provided essential information regarding HTN and T2DM for health policy, it has some limitations, including its cross-sectional design and absence of an apparently healthy control group.

In conclusion, the presence of T2DM significantly elevates the risk of stroke, CHD, CHF, and DVT by factors of more than 5.3, 3.7, 3.7, and 1.2-fold, respectively. The presence of hypertension elevates the likelihood of stroke, CHD, CHF, and DVT by factors of 5.2, 15.6, 6.1, and 1.07-fold, respectively. The coexistence of T2DM and HTN significantly amplifies the risk of stroke, CHD, CHF, and DVT. Saudi men exhibit a higher prevalence of CVDs, T2DM, and hypertension compared to their female counterparts. The coexistence of hypertension and T2D indicates a significant mortality risk, highlighting the urgent necessity for targeted interventions aimed at enhancing health span in Saudi Arabia.

Acknowledgements

The authors extend their gratitude to Miss Najla Adam Elsharif at the Prof Medical Research Consultancy Center for her assistance in data analysis.

Disclosure of conflict of interest

None.

Address correspondence to: Hussain Gadelkarim Ahmed, Prof Medical Research Consultancy Center, North Kordofan State, El-Obeid 51111, Sudan. E-mail: hussaingad5@gmail.com

References

[1] Vervoort D, Wang R, Li G, Filbey L, Maduka O, Brewer LC, Mamas MA, Bahit MC, Ahmed SB and Van Spall HGC. Addressing the global burden of cardiovascular disease in women: JACC state-of-the-art review. J Am Coll Cardiol 2024; 83: 2690-2707.

[2] Wang Y and Magliano DJ. Special issue: "new trends in diabetes, hypertension, and cardiovascular diseases-2nd edition". Int J Mol Sci 2025; 26: 449.

[3] Christian AK, Osei-Appaw AA, Sawyerr RT and Wiredu Agyekum M. Hypertension, diabetes, and cardiovascular disease nexus: investigating the role of urbanization and lifestyle in Cabo Verde. Glob Health Action 2024; 17: 2414524.

[4] Alqahtani BA and Alenazi AM. A national perspective on cardiovascular diseases in Saudi Arabia. BMC Cardiovasc Disord 2024; 24: 184.

[5] Gutierrez J, Alloubani A, Mari M and Alzaatreh M. Cardiovascular disease risk factors: hypertension, diabetes mellitus and obesity among Tabuk citizens in Saudi Arabia. Open Cardiovasc Med J 2018; 12: 41-49.

[6] Alhur AA, Alhur A, Alhasan BA, Alshahrani S, Almalki H, Alzahrani N, Alwagdani W, Althobaiti R, Alwadei R, Alblwi S, Alosaimi S, Altwirqi R, AlThawwab M, Alotaibi H and Meerkhan L. Prevalence and determinants of diabetes in Saudi Arabia: a cross-sectional analysis. Niger Med J 2024; 65: 569-580.

[7] Nasser SM, Shubair MM, Fatani F, Alhawiti NM, Aleissa B, Saleh Aldubikhi AI, Angawi K, Alshahrani A, Ali SA, Javed S and El-Metwally A. Prevalence of hypertension and associated factors: a cross-sectional study in Riyadh, Saudi Arabia. BMC Health Serv Res 2025; 25: 351.

[8] SurveryMonkey. Sample size calculator. Available at: https://www.surveymonkey.com/mp/sample-size-calculator/. Accessed on: December 2020.

[9] Petrie JR, Guzik TJ and Touyz RM. Diabetes, hypertension, and cardiovascular disease: clinical insights and vascular mechanisms. Can J Cardiol 2018; 34: 575-584.

[10] Xie ZL, Wang CC, Huang X, Wang Z, Shangguan HY and Wang SH. Prevalence and risk factors of stroke in inpatients with type 2 diabetes mellitus in China. Curr Med Sci 2024; 44: 698-706.

[11] Ntiyani N, Letamo G and Keetile M. Prevalence of and factors associated with hypertension, diabetes, stroke and heart attack multimorbidity in Botswana: evidence from STEPS 2014 survey. PLoS One 2022; 17: e0265722.

[12] Chang WW, Fei SZ, Pan N, Yao YS and Jin YL. Incident stroke and its influencing factors in patients with type 2 diabetes mellitus and/or hypertension: a prospective cohort study. Front Cardiovasc Med 2022; 9: 770025.

[13] Liu Y, Li J, Dou Y and Ma H. Impacts of type 2 diabetes mellitus and hypertension on the incidence of cardiovascular diseases and stroke in China real-world setting: a retrospective cohort study. BMJ Open 2021; 11: e053698.

[14] Zhang Y, Yu S, Chen Z, Liu H, Li H, Long X, Ye F, Luo W, Dai Y, Tu S, Chen W, Kong S, He Y, Xue L, Tan N, Liang H, Zhang Z, He P, Duan C and Liu Y. Gestational diabetes and future cardio-

vascular diseases: associations by sex-specific genetic data. Eur Heart J 2024; 45: 5156-5167.
[15] Yen FS, Wei JC, Chiu LT, Hsu CC and Hwu CM. Diabetes, hypertension, and cardiovascular disease development. J Transl Med 2022; 20: 9.
[16] Malik A and Chhabra L. Congestive Heart Failure. 2023 Nov 5. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. PMID: 28613623.
[17] Gallo G and Savoia C. Hypertension and heart failure: from pathophysiology to treatment. Int J Mol Sci 2024; 25: 6661.
[18] Palazzuoli A and Iacoviello M. Diabetes leading to heart failure and heart failure leading to diabetes: epidemiological and clinical evidence. Heart Fail Rev 2023; 28: 585-596.
[19] Pop-Busui R, Januzzi JL, Bruemmer D, Butalia S, Green JB, Horton WB, Knight C, Levi M, Rasouli N and Richardson CR. Heart failure: an underappreciated complication of diabetes. A consensus report of the American diabetes association. Diabetes Care 2022; 45: 1670-1690.
[20] Raya-Benítez J, Heredia-Ciuró A, Calvache-Mateo A, Martín-Núñez J, Valenza-Peña G, López-López L and Valenza MC. Effectiveness of non-instrumental early mobilization to reduce the incidence of deep vein thrombosis in hospitalized patients: a systematic review and meta-analysis. Int J Nurs Stud 2025; 161: 104917.
[21] Liu X, Li T, Xu H, Wang C, Ma X, Huang H, Hu Y and Chu H. Hyperglycemia may increase deep vein thrombosis in trauma patients with lower limb fracture. Front Cardiovasc Med 2022; 9: 944506.
[22] Alanazi OA, El-Fetoh NMA, Mohammed NA, Alanizy TMA, Alanazi YW, Alanazi MS, Alrwaili AA, Alruwaili AH, Alanazi AH and Alanazi AS. Deep venous thrombosis among hypertensive patients in King Abdulaziz University (KAU) hospital, Jeddah, Kingdom of Saudi Arabia. Electron Physician 2017; 9: 5472-5477.
[23] Nazarzadeh M, Bidel Z, Mohseni H, Canoy D, Pinho-Gomes AC, Hassaine A, Dehghan A, Tregouet DA, Smith NL and Rahimi K; INVENT Consortium. Blood pressure and risk of venous thromboembolism: a cohort analysis of 5.5 million UK adults and Mendelian randomization studies. Cardiovasc Res 2023; 119: 835-842.
[24] AlHarbi M, Othman A, Nahari AA, Al-Jedai AH, Cuadras D, Almalky F, AlAzmi F, Almudaiheem HY, AlShubrumi H, AlSwat H, AlSahafi H, Sindi K, Basaikh K, AlQahtani M, Lamotte M, Yahia M, Hassan ME, AlMutlaq M, AlRoaly M, AlZelaye S and AlGhamdi Z. Burden of Illness of type 2 diabetes mellitus in the Kingdom of Saudi Arabia: a five-year longitudinal study. Adv Ther 2024; 41: 1120-1150.
[25] Alenazi AM and Alqahtani BA. National and regional prevalence rates of hypertension in Saudi Arabia: a descriptive analysis using the national survey data. Front Public Health 2023; 11: 1092905.
[26] JiA Jia G and Sowers JR. Hypertension in Diabetes: an update of basic mechanisms and clinical disease. Hypertension 2021; 78: 1197-1205.