Research Article ISSN: 2833-0382

International Journal of Family Medicine & Healthcare

Risk Level of Cardiovascular Diseases among Patients with Concurrent Hypertension and Diabetes in Saudi Arabia

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Received: 05 May 2026; **Accepted:** 08 Jun 2026; **Published:** 20 Jun 2026

Citation: Saud Alreshidi F, Abdurrahman Melibari Z, Abdullah Alshammari N, et al. Risk Level of Cardiovascular Diseases among Patients with Concurrent Hypertension and Diabetes in Saudi Arabia. Int J Family Med Healthcare. 2026; 5(3): 1-5.

ABSTRACT

Background: *Several cardiovascular diseases (CVDs) are associated with hypertension (HTN) or Type 2 diabetes (T2DM). The objective of this investigation was to evaluate the pattern of cardiovascular disorders in the Saudi population associated with hypertension and T2DM.*

Methodology: *This descriptive study surveyed 31 community-serving primary health clinics (PHCs) in the Hail region of northern Saudi Arabia. Saudi men and women aged 18–98 who sought diabetes or hypertension medical care at PHCs were included.*

Results: *The overall prevalence rates of stroke, MI, CAD, and DVT were 92/1340 (6.8%), 120/1340 (9%), and 55/1340 (4.1%), respectively. The prevalence rates of stroke, MI, CAD, and DVT among T2DM were 4.5%, 5.2%, 2.2%, and 2.9%, respectively. The prevalence rates of stroke, MI, CAD, and DVT among HTN were 6.7%, 8.2%, 3.4%, and 4.5%, in that order. The prevalence rates of stroke, MI, CAD, and DVT among combined T2DM&HTN were 4.5%, 7.6%, 3.1%, and 1.8%, respectively. The risk of combined (T2DM & HTN) comorbidity to acquire CVD, the relative risk (RR), and 95% confidence interval (95%CI): RR (95%CI) = 0.6321 (0.5015 to 0.7968), P = 0.0001, z statistics = 3.884.*

Conclusion: *A substantial relationship was established between combined T2DM and HTN and CVD risk. MI and stroke were more likely in HTN than in T2DM, whereas DVT was more common in T2DM. The subgroup with combined T2DM and HTN had 4.5% stroke, 7.6% MI, 3.1% CAD, and 1.8% DVT. Males have a higher CVD risk (RR = 1.7825, 95% CI: 1.2503 to 2.5414, P = 0.0014). MI was the most prevalent CVD in men, followed by stroke and CAD. The most common CVD in women is DVT.*

Keywords
Diabetes, Hypertension, Cardiovascular disease, Heart attack, Stroke.

Introduction
Both hypertension and high blood sugar often occur together as signs of the metabolic syndrome. T2DM and HTN are major risk factors for cardiovascular disease (CVD). Inadequate management of T2DM and HTN has significant repercussions that result in increased healthcare expenses and patient mortality. It is crucial to discover the connection between the beginning of diabetes and hypertension, as well as to search for drugs that can simultaneously treat both disorders or specifically target their underlying causes [1-3].

Diabetes and atherosclerosis elevate the likelihood of CVD and stroke. Persistent elevation in blood sugar levels has detrimental effects on the cells lining the blood vessels, known as endothelial cells, and worsens the development of atherosclerosis. These illnesses impact the circulatory system, leading to an increase in cardiovascular and cerebrovascular events. Individuals with diabetes who have cerebrovascular problems have a significantly higher likelihood of experiencing a stroke, with the risk increasing as they age and if they also have hypertension or other vascular abnormalities [4-6]. Endothelial dysfunction, vascular inflammation, arterial remodeling, atherosclerosis, dyslipidemia, and obesity are all factors that increase the risk of developing diabetes and hypertension. These disorders are associated with both microvascular and macrovascular illnesses [7]. The objective of this study was to evaluate the risk level of CVDs among patients with concurrent HTN and T2DM in Saudi Arabia.

Materials and Methods
This study was a prospective descriptive investigation carried out in northern Saudi Arabia from January 2022 to June 2025. The research involved samples from 31 primary health centers (PHCs) located in the Hail region of northern Saudi Arabia, which provided healthcare services to the local population. Approximately 1,340 individuals were selected at random.

Inclusion and Exclusion criteria
Individuals in Saudi Arabia, regardless of age or gender, who have T2DM or HTN and have sought treatment at PHCs are eligible. Diabetics had HbA1c values above 6.4%, while non-diabetics maintained HbA1c levels of 5.7% or below. Considering the patient's data in the PHC, it is important to include hypertension and conduct a retest of blood pressure to determine if it is 140/90 mmHg or higher. As a result, individuals with blood pressure readings ranging from 90/60 mmHg to 120/80 mmHg were classified as non-hypertensive.

Blood sample
Every individual had a blood sample taken from a vein to determine their HbA1c levels. A typical HbA1c level is below 5.7%, whereas a reading of 6.5% or higher suggests the presence of diabetes.

Data analysis
The analysis conducted using SPSS produced frequencies, cross-tabulations, relative risks, odds ratios (OR), and statistically significant findings. The results of the Chi-square test were accompanied by a confidence interval with a 95% level of confidence. For a P-value to be deemed statistically significant, it must be below 0.05.

Results
This study examined a sample of 1340 Saudi volunteers aged 18 to 98, with an average age of 50. There were approximately 697 females (52% of the total) and 643 males (48%). The majority of participants were between the ages of 51 and 60, followed by those aged 41 to 50 and 31 to 40, with 308 (23%), 276 (21%), and 201 (15%), respectively. Table 1 and Figure 1 provide a general idea of the contributors' educational levels. The results indicate that the predominant category consisted of illiterates (44.7%).

Table 1: Distribution of the study population by gender, age, and educational attainment.

Variable	Males(n=643)	Females(n=697)	Total (n=1340)
≤30 years	91	104	195
31-40	90	111	201
41-50	94	182	276
51-60	148	160	308
61-70	106	89	195
71+	114	51	165
Education			
Illiterate	222	377	599
Read and write	55	61	116
Primary	77	62	139
Intermediate	64	32	96
Secondary	104	55	159
Higher education	111	65	176

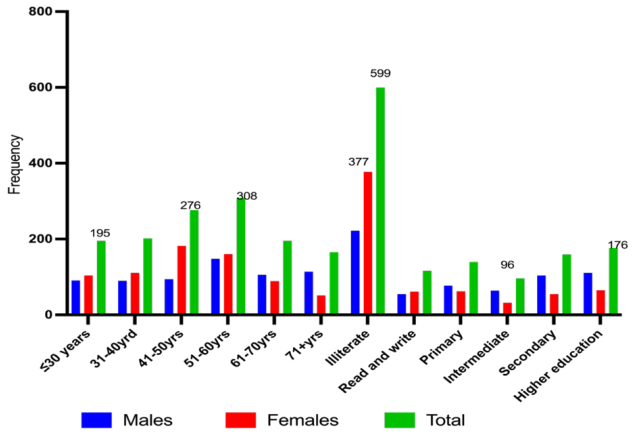

Figure 1: Description of the study participants by gender, age, and level of education.

CVDs, including stroke, MI, CAD, and DVT, were found in 119/1340 (9%) patients. The prevalence rates of stroke, MI, CAD, and DVT were 2.7%, 3.1%, 1.3%, and 1.7%, respectively. The prevalence of CVDs among males was 11.5%, and among females,

it was 6.5%. The risk of CVDs among males: RR (95% CI) = 1.7825 (1.2503 to 2.5414), P = 0.0014. The most common CVD among males was MI, followed by stroke and CAD, representing 34/74 (46%), 25/74 (34%), and 10/74 (13.5%), respectively. The most common CVD among females was DVT, followed by stroke, constituting 18/45 (40%) and 11/45 (24.4%), in that order, as indicated in Table 2 and Figure 2.

Table 2: Distribution of CVDs by gender.

CVDs	Males	Females	Total
Stroke	25	11	36
MI	34	8	42
CAD	10	8	18
DVT	5	18	23
Total	74	45	119

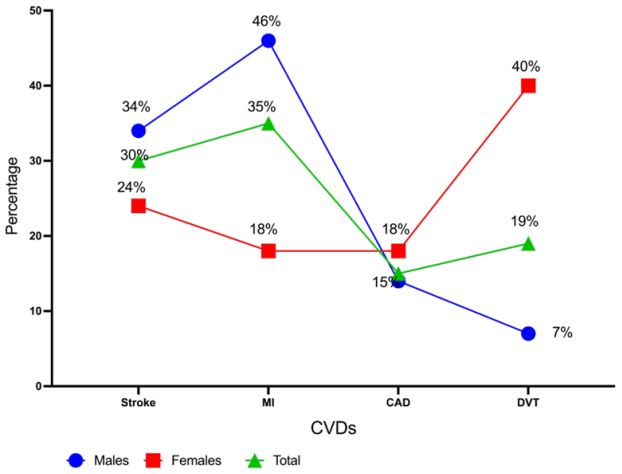

Figure 2: Description of CVDs by gender.

About 804 (60%) of the 1340 individuals had T2DM, 536 (40%) had HTN, and 446 (33%) had both conditions. The overall prevalence rates of stroke, MI, CAD, and DVT were 92/1340 (6.8%), 120/1340 (9%), and 55/1340 (4.1%), respectively. The prevalence rates of stroke, MI, CAD, and DVT among T2DM were 36/804(4.5%), 42/804(5.2%), 18/804(2.2%), and 23/804(2.9%), respectively. The prevalence rates of stroke, MI, CAD, and DVT among HTN were 36/536(6.7%), 44/536(8.2%), 18/536(3.4%), and 24/536(4.5%), in that order. The prevalence rates of stroke, MI, CAD, and DVT among combined T2DM&HTN were 20/446(4.5%), 34/446(7.6%), 14/446(3.1%), and 8/446(1.8%), respectively. The risk of combined (T2DM & HTN) comorbidity to acquire CVD, the relative risk (RR), and 95% confidence interval (95%CI): RR (95%CI) = 0.6321 (0.5015 to 0.7968), P = 0.0001, z statistics = 3.884, Table 3, Figure 3.

Table 3: Distribution of the thrombotic conditions by DM and HTN.

Variable	T2DM n=804	HTN n=536	T2DM&HTN n=446
Stroke	**36**	**36**	20
MI	**42**	**44**	34
CAD	**18**	**18**	14
DVT	**23**	**24**	8

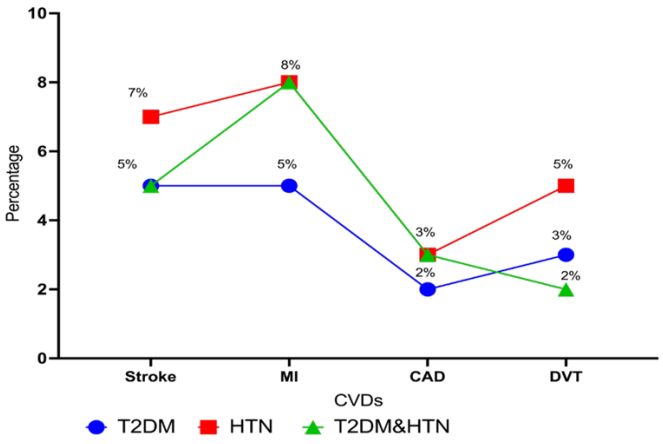

Figure 3: Prevalence rates of CVDs by comorbidities.

Discussion

This study assessed the prevalence of significant cardiovascular thrombotic and thromboembolic outcomes in Saudi patients with varying metabolic and vascular disease profiles, specifically those with T2DM alone, HTN alone, and the combined comorbidity of T2DM and HTN. Overall, MI and stroke had the highest prevalence of the examined CVDs, with 9.0% and 6.8%, respectively. In comparison, CAD and DVT had lower overall prevalence rates. Overall, these findings suggest that arterial events (stroke and MI) are a significant burden in this population, especially in connection with vascular risk factors [9].

These findings imply that HTN alone is associated with a greater prevalence of most cardiovascular events than T2DM alone, notably MI and stroke, which are strongly linked to long-term hypertension-related vascular damage. Importantly, the subgroup with dual comorbidities (T2DM and HTN) demonstrated a unique risk profile. Although MI remained reasonably high in the combined group (7.6%), the combined comorbidity group had a lower prevalence of stroke and CAD, as well as a significantly lower DVT prevalence (1.8%) than would be expected if risk were just additive. This suggests that, in this dataset, the risk of CVD outcomes associated with combined T2DM and HTN does not consistently exceed that seen in the individual disease groups, which could be due to differences in patient characteristics, group selection, sample composition, and diagnostic practices [10,11]. This pattern indicates that the association between comorbidity status and cardiovascular disease outcomes in this study may be affected by contextual factors, including variations in disease duration, severity, medication utilization (e.g., antihypertensives, antidiabetics, antiplatelets), survivorship bias, and healthcare accessibility.

Recent investigations have linked adult diabetes to atherosclerotic CVD [12,13]. Genetic variant studies have been conducted in epidemiology to better understand risk variables and the link between DM and CVD. The disease is frequent, but patients cannot identify its genetic and metabolic risk factors. All races and genders are at risk of cardiovascular disease death from T2DM.

Diabetics often have heart failure, peripheral artery disease, and CHD. DM may raise cardiovascular disease risk, but not always [14]. A comprehensive review indicated that 33.2% of T2DM patients worldwide have cardiovascular illness. CVD killed over 50% of T2DM patients in the study group, making it the leading cause of death. A study identified heart disease and stroke as the leading causes of mortality [15]. According to Xiong X [16], a HbA1c level of 6.15% or greater is a major risk factor for DVT.

Hypertension is more common with T2DM. Diabetes may worsen HTN due to sensitivity or a cardiovascular disease mechanism [17]. CVD and HTN are linked. HTN is linked to heart failure, atrial fibrillation, CKD, heart valve disorders, aortic syndromes, dementia, CHD, and stroke in numerous studies. Multivariate models showed that lower blood pressure increased stroke and CAD risk. In a meta-analysis of randomized controlled trials, lowering blood pressure had the same effect as in cohort studies. Addressing age-associated blood pressure increases and treating HTN proactively could eliminate a large part of cardiovascular illness attributable to high blood pressure [18]. Hypertension increases the risk of DVT, especially after surgery [19]. Understanding the most frequent DVT risk factors, especially in hypertensive patients, is essential for early detection and prevention. This knowledge helps recognize and value these risk variables [20].

The study found a surge in CVD in elderly people, although some younger people had it too. Many CVDs develop with age. Atherosclerosis, vascular stiffness, and heart failure are strongly linked to aging [21]. CVD deaths before 70 are premature. Men under 70 have higher cardiovascular disease morbidity and death than women. Addressing morbidity, treatment, and death inequities is critical to improving health. Townsend et al. stressed the importance of reliable surveillance and monitoring systems for global prevention and treatment [22]. The biology of aging may link unusual and prevalent CVDs. These links support the creation of new anti-aging medicines that target the core systems. They also suggest age could soon be a controlled cardiovascular risk factor [22]. Atherosclerosis shortens diabetics' lives, and diabetic nephropathy and retinopathy cause most end-stage renal disease and blindness. Better treatment for diabetic vascular complications may block injury mechanisms and promote protective or regenerative factors, such as improving insulin-regulated genes in endothelial cells, antioxidant or anti-inflammatory gene programs, or vascular cell survival factor sensitivity. Treatments may avoid complications despite inadequate metabolic management [23].

This research is unique because if a strong synergistic effect is found, hypertensive patients should be tested for prediabetes and diabetics for prehypertension. This screening may reduce disease and its effects. Despite its unique topic and interesting insights, this study has limitations. One issue is the lack of cardiovascular disease clinical data.

In conclusion, overall, the study found a strong link between combined T2DM and HTN and CVD risk.

When stratified, MI and stroke were more common in HTN than in T2DM, whereas DVT was more common in the T2DM group. Stroke was 4.5% in the subgroup with coupled T2DM and HTN, MI 7.6%, CAD 3.1%, and DVT 1.8%. At RR =1.7825 (95% CI: 1.2503 to 2.5414, P = 0.0014), males have a significantly greater risk of CVDs. The most common CVD in men was myocardial infarction (46%), followed by stroke and CAD. DVT was the most frequent cardiovascular ailment in women, followed by stroke.

Acknowledgment

The authors would like to thank the participants in this study for offering the samples.

Funding

The Scientific Research Deanship of the University of Ha'il in Saudi Arabia funded this study under project number RG-20 166.

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