International Journal of Research in Medical Sciences
Sharma HS et al. Int J Res Med Sci. 2024 Jan;12(1):328-333
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20233826

Review Article

A schematic review on multifaceted relationship between cardiovascular disease and diabetes

Hem Shanker Sharma*, Sumit Shanker

Department of Medicine, Jawahar Lal Nehru Medical College and Hospital, Bhagalpur, Bihar, India

Received: 15 November 2023
Revised: 28 November 2023
Accepted: 30 November 2023

***Correspondence:**
Dr. Hem Shanker Sharma,
E-mail: hemshanker_s@rediffmail.com

ABSTRACT

Cardiovascular disease (CVD) and diabetes mellitus are health conditions that are closely linked and have a significant impact, on public health systems and personal well-being. The intersection of these two conditions has generated concerns, within the healthcare field and medical research. The importance of understanding the connection, between disease and diabetes cannot be highlighted enough. Diabetes is a chief risk element to the development and progression of state such as peripheral vascular disease, coronary artery disease, and stroke. Individuals with diabetes face a 2 to 4 folds risk of experiencing events as equated to those without diabetes. This simultaneous occurrence of these two health issues has implications, for healthcare professionals, policymakers and the individuals affected by them. Despite the progress made in managing both CVD and diabetes it remains crucial to address the overlap, between these two conditions. The matter, at hand revolves around comprehending the links between these two conditions identifying effective methods, for prevention and treatment and maximizing patient care. It is crucial, for healthcare professionals, policymakers and people who have CVD or diabetes to understand how these two conditions interact with each other. In this review our goal is to present an overview of the multifaceted relationship between CVD and diabetes.

Keywords: Diabetes mellitus, Type 2 diabetes mellitus, CVD, Mortality rate

INTRODUCTION

Cardiovascular disease

Cardiovascular disease (CVD) involves a variety of disorders influencing the blood and heart vessels, majorly including heart failures, strokes, coronary artery disorder and hypertension. It is a key cause of mortality globally. The epidemiology of CVD has seen a number of notable shifts in recent years. According to Tsao, 17.9 million mortalities worldwide each year, or 32% of all deaths, are caused by CVD.[1] Due to urbanization and lifestyle changes, CVD cases have increased in low- and middle-income nations. Although historically CVD has been linked to older persons, there is an alarming pattern of growing CVD prevalence among younger groups, which is partially due to poor lifestyles and obesity.[2] Men and women are both affected by CVD, however there are distinct gender differences. Women often experience CVD after menopause and at a later stage in life.[3]

Diabetes mellitus

Diabetes is a condition of metabolism characterized mostly by high blood glucose levels. It is a significant risk aspect in the epidemiology of CVD and has an important role in that. Globally, the occurrence of DM has amplified. For instance, between 1990-2016, the

occurrence of diabetes increased by 64.3% in India. The large number of occurrences of diabetes are type 2, that is associated with lifestyle factors such a poor diet and obesity. Youth-onset diabetes has alarmingly increased, emphasizing the significance of early preventive and care efforts.4

Table 1: Burden of diabetes/prediabetes in India.[5]

Variables	Year	
	2019	2045
Impaired glucose tolerance (estimated) (20 to 79 years)		
Number of people (million)	25.2	35.7
Rank	4	3
Diabetes (estimates) (20-79 years)		
Prevalence (%)	8.9	-
Age adjusted prevalence (%)	10.4	-
Number of people (million)	77.0	134.2
Rank	2	2
Diabetes (estimates) (>65 years)		
Number of people (million)	12.1	27.5
Rank	3	2
Undiagnosed diabetes (estimates)		
Prevalence (%)	57.0	-
Number of people (million)	43.9	-
Rank	2	
Healthcare expenditure on diabetes		
Mean expenditure per person with diabetes (USD	92.0	-
Deaths related to diabetes		
Total deaths (million)	1.0	-

RISK OF CVD IN PEOPLE WITH DIABETES

A "cardiovascular risk equivalent" for a long time has been diabetes. The statement was previously based on a Finnish study conducted by Haffner that found that T2 DM individuals with no CHD (coronary heart disease) occurrence had equal coronary death rate to non-diabetic patients with a history of coronary events.[6] After experiencing their first CHD event, patients with diabetes have the worst prognosis due to an increase in cardiac mortality rates.[7]

It is essential to effectively manage diabetes as a risk factor for CVD because vascular issues can manifest early, potentially even before diagnosis or during pre-diabetic stages. Research has consistently demonstrated a gradual and significant correlation between fasting plasma glucose (FPG) levels and the risk of CVD, extending to levels below the diabetes threshold of 126 mg/dL. This highlights the importance of monitoring FPG as a predictor of cardiovascular health. Elevated glycemia also has a negative impact on prognosis, beginning at FPG conc. of 101 mg/dl. Furthermore, dysglycemia is a significant risk element, particularly in populations with reduced absolute CVD risk, such as adolescent age groups and non smokers.[8] In general, these findings indicate that treating dysglycemia as a continuous risk element, much like blood lipid and blood pressure, may be a more productive preventative method for assessing and preventing cardio-vascular risk than concentrating on specific cutoffs. The link between diabetes and CVD is caused by many pathophysiological pathways.[9]

Recent research shows that the possibility of CHD in people with T2 DM is extremely variable and not often comparable to the possibility of people with pre-existing CVD. The menace of CHD was 43% lesser in people with T2 DM who had never had a previous myocardial infarction than to people without diabetes who had experienced one, according to a study of thirteen epidemiological surveys including 45, 108 individuals with and with-out diabetes [10]. The risk of CHD was significantly lesser among patients with T2 DM with no CHD than in individuals with CHD with-out diabetes in a big population-based dataset with 1, 586, 061 grownups aged 30 to 90 years who were trailed up for 10 years. The coronary artery calcium score (CAC) at starting point was used to evaluate cardio-vascular risk in one more study of observational research with T2 DM patients.[11,12] According to the authors' findings, patients with nil CAC scores had a 28.5% prevalence, which is comparable to patients without diabetes in terms of 5-year survival rates.[13] Therefore, it is possible that there is a subpopulation of T2DM patients with decreased CHD risk, particularly younger individuals with shorter disease duration.

A recent ESC recommendation states that people with diabetes who have had the disorder for longer than ten years, have renal impairment, or have micro-albuminuria are at an increased risk of developing coronary heart disease.[14] Currently, patients who suffered from diabetes for a more brief amount of time and are younger than 40 are categorized as being at lesser risk. It is feasible to determine which diabetics may benefit most from extra intensive cardio-vascular protection by categorizing diabetics into various cardiovascular risk categories. For lower dose aspirin, for instance, taking into account the probability for blood loss from the GI tract and identifying the risk of CVD by using the worldwide risk score may help persons who might benefit more from aspirin use.[15]

Therefore, practical methods for spotting and treating those who are at greater risk should be devised; yet, it may be fair and cost-effective to treat others who have lesser cardiovascular risk with moderate medications.

ASSESSMENT OF RISK ELEMENTS

Many risk elements are related with T2 DM and CVD s. They can be determined by interplay of genetic and metabolic factors. Society, family history, age, gender, smoking, unhealthy dies, obesity, hypertension, blood lipids, and physical inactivity leads to increased risk.

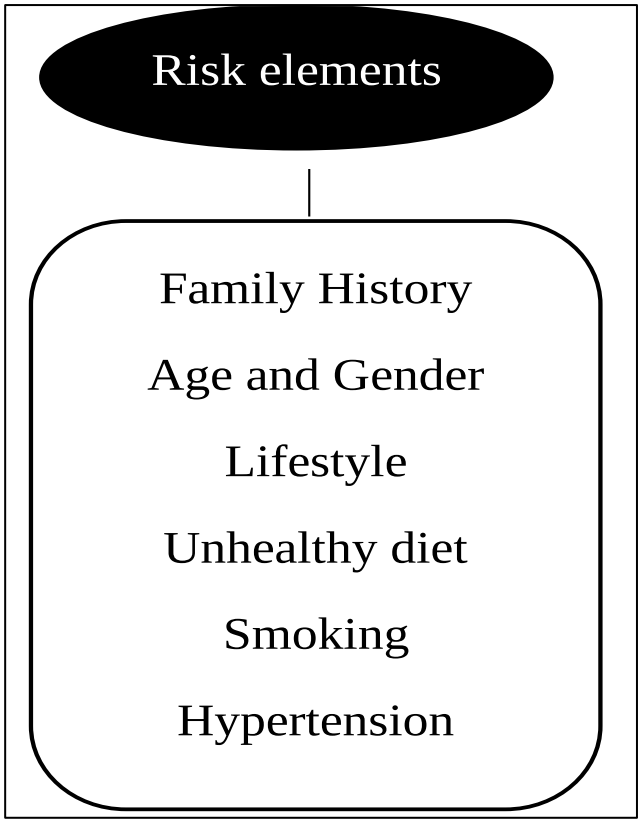

Figure 1: Risk element assessment in CVD and diabetic patients.

Age is the most important CVD risk element that cannot be changed. The probability of CVD is increasing in both men and women. However, the age at which a person enters the category of high-risk individuals for CVD seems to be fixed for every gender. A significant retrospective study conducted by Booth analyzed the age thresholds at which individuals with diabetes transition from moderate to high cardiovascular risk.[16] The study encompassed a vast population, comprising 379,003 individuals with diabetes and 9,018,082 adults without the condition. The research findings suggest that to be categorized as low risk, characterized by a risk estimate of less than 10% over a decade, individuals with diabetes should generally be between the ages of 35 to 45, depending on gender. Additionally, they should exhibit no supplementary risk factors or symptoms associated with cardio-vascular disease. Therefore, almost all of efforts to prevent incidences should concentrate on patients who are older than these age restrictions.

According to the research done by Booth, gender is a significant risk element as well.[16] The age-adjusted Hazard Ratio of 2.56 suggests that men are more likely than women to experience a new myocardial infarction in the general population. In diabetic individuals, the male to female proportion is substantially smaller but still favors men more. As a result, when compared to people without diabetes, the risk that a individual having diabetes may experience an AMI (acute myocardial infarction) merely because of gender is significantly reduced.

Another investigation by Li and his colleagues found a substantial link between family history of MI and CHD in diabetic patients, albeit the degree of the correlation differs between studies.[17] There are two major studies looking at this connection. A prospective sample of 2642 post-menopausal women who had diabetes but no CHD at reference point and were followed for up to seven years had been included in the women's health study. CHD incidence was 14.3% over this time. The frequency of CHD was 50% greater in patients with diabetes who had at least one first-degree relative than in those without. CHD incidence was 79% greater in people with 2 or more 1st degree relatives who had the disease than in people without such relatives. Both the no. of relatives who had CAD and whether or not CAD was regarded as premature had an impact on the survival function. It's important to note that several uncertainties, such as systolic and diastolic BP, smoking, cholesterol medications, physical activity, race, and others, were thoroughly accounted for in this study.

History of family of mortal or non-mortal CHD in siblings, children, and parents was regarded as a separate risk element and outperformed better than ankle brachial index, flow mediated dilation, and c-reactive protein in the MESA investigation carried out by Yeboah.[18] Even after controlling for conventional risk variables, a family history of early CHD was found to be an accurate predictor of CHD in a systematic review. However, the prejudice was not made worse by including family history in a conventional risk element model. According to the AHA/ACC 2013 guidelines, an important risk element to consider is a family past of CHD that manifests in males younger than 55 and females older than 65 in any 1st degree relation.[19]

Smoking is a prominent and reversible risk factor for CHD and is classified as such. A comprehensive meta-analysis of 46 studies encompassing 130,000 individuals with diabetes revealed compelling statistics. Smokers, in comparison to non-smokers, exhibited a relative risk of 1.48 for total mortality, 1.54 for CHD events, 1.36 for Cardiovascular (CV) mortality, 1.52 for acute myocardial infarction (AMI), and 1.44 for stroke.[20] Among diabetes patients, active smoking is linked to the highest risk of overall mortality and cardiovascular events. However, quitting smoking is associated with a substantial reduction in the likelihood of both total fatality and cardiovascular events among individuals with diabetes.

Hypertension, like CHD, is a well-established risk factor for stroke-related mortality. James notes that isolated systolic hypertension is a significant risk factor for CHD across all age groups and genders.[21] In the Framingham study, diastolic blood pressure emerged as the most consistent indicator of CHD risk in individuals under the age of fifty.[22] For those aged 50 to 59, all blood pressure

measurements were associated with CHD risk, with pulse pressure being the most potent indicator in those over 60. Hypertension plays a substantial role in both types 1 and 2 diabetes, contributing to atherosclerotic CVD (ASCVD) events and microvascular complications. In type 1 diabetes, hypertension is often a result of underlying diabetic kidney impairment. The American Diabetes Association recommends managing individuals with diabetes and hypertension to achieve systolic blood pressure goals of 140 mmHg and diastolic blood pressure goals of 90 mmHg.[23]

Blood cholesterol levels play a significant role in influencing CVD risk. Among the adjustable risk factors for CVD morbidity and mortality, LDL-c (low-density lipoprotein cholesterol) stands out. According to a study conducted by the Cholesterol Treatment Trialists (CTT) Collaborators, reducing LDL-c by 1 mmol/l with the use of statins can cut the relative risk of CVD in half.[24] This reduction is observed as a linear phenomenon and is likely effective at any baseline LDL-c level, especially for LDL-c levels of 50 mg/dL or lower. Statins demonstrate the ability to proportionally decrease mortality from all causes by 9% and reduce the incidence of major vascular events by 21% in diabetic patients for every mmol/l decrease in LDL-c. This reduction in LDL-c levels has also led to a significant decrease in the occurrence of acute myocardial infarction, coronary revascularization, and stroke.

MORTALITY

Diabetes stands as a significant global contributor to mortality, largely attributed to its vascular implications. Data from the international diabetes federation revealed that in 2017, diabetes was responsible for four million deaths and accounted for 10.7 percent of all fatalities among individuals aged 20-79 worldwide.[25] Intriguingly, on a global scale, females experience a higher mortality rate due to diabetes compared to males, with statistics indicating a ratio of 2.1 to 1.8. This gender-specific variation in mortality rates is primarily driven by women's increased susceptibility to cardiovascular-related fatalities.[26] With wildly divergent outcomes, a no. of epidemiological researches have attempted to quantify the risk of mortality amongst diabetics, but they have all concluded that CVD the primary cause of death.[27] According to a recent systematic evaluation of 57 publications including 4,549,481 people who had T2DM and were published between 2007 and 2017, fatalities from CVD accounted for 50.3 percent of all the fatalities in relation with T2DM.[28] Data from numerous researches indicate a decrease in CVD-related mortality amongst diabetics in the majority of high-income nations. According to a new study from the national health interview survey linked mortality data from 1985 to 2015, the death rate from vascular causes amongst US individuals with diabetes decreased by 32% every 10 years to 5.2.[29] Similar to this, the occurrence of diabetes in grown-ups in India elder than twenty years grew from 5.5 percent in 1990 to 7.7 percent in 2016, and the age-standardized (64%) and crude (131%) death rates from diabetes also increased.[30] This was directly related to a rise in the occurrence of overweight in both countries. Therefore, we can say that cardio-vascular lingers to be the major global cause of fatalities in diabetics.[31,32]

CONCLUSION

In conclusion, a number of demographic and lifestyle factors, particularly in countries with low and moderate incomes, are contributing to the alarming rise in diabetes prevalence worldwide. Although affluent nations have made strides in preventing diabetes-related problems through improved diagnoses and prevention, diabetes care is still complicated and, in some situations, insufficient. Since CVD is a foremost contributor to mortality in this population, people with diabetes continue to have greatly increased cardiovascular risks. There is an urgent need for novel techniques to monitor and control diabetes, get more knowledge of its complications, and precisely estimate their incidence given the immense strain that diabetes places on health care systems as a primary cause of CVD. This crucial change in therapeutic approaches will be crucial in lessening the combined healthcare issue provided by CVD and diabetes, thereby enhancing the general health and wellbeing of impacted people and communities around the world.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Tsao CW, Aday AW, Almarzooq ZI, Anderson CA, Arora P, Avery CL et al. Heart disease and stroke statistics-2023 update: a report from the American Heart Association. Circulation. 2023;147(8):e93-621.
2. Huang H, Liu J, Liang X, Fang L, Yang C, Ke K et al. Trends in the prevalence of elevated cardiovascular risk and the control of its risk elements Among US adults, 2001-2020. Front Cardiovasc Med. 2023;10:1153926.
3. World Heart Federation, 2023. World Heart Report 2023: Confronting the World's Number One Killer. 2023.
4. Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. Indian J Ophthalmol. 2021;69(11):2932-8.
5. International Diabetes Federation. IDF Diabetes Atlas. 9th ed. Brussels, Belgium: International Diabetes Federation. 2019.
6. Haffner SM, Lehto S, Rönnemaa T, Pyörälä K, Laakso M. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. N Eng J Med. 1998;339(4):229-34.

7. National Cholesterol Education Program (US). Expert Panel on Detection and Treatment of High Blood Cholesterol in Adults. Third report of the National Cholesterol Education Program (NCEP) Expert Panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III) (No. 2). The Program. 2002.
8. Sarwar N, Gao P, Seshasai SR, Gobin R, Kaptoge S, Di Angelantonio E et al. Emerging Risk elements Collaboration Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease: a collaborative meta-analysis of 102 prospective studies. Lancet. 2010;375(9733):2215-22.
9. Dal Canto E, Ceriello A, Rydén L, Ferrini M, Hansen TB, Schnell O et al. Diabetes as a cardiovascular risk element: An overview of global trends of macro and micro vascular complications. Eur J Prevent Cardiol. 2019;26(2):25-32.
10. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J. Evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). JAMA. 2014;311(5):507-20.
11. Rana JS, Liu JY, Moffet HH, Jaffe M, Karter AJ. Diabetes and prior coronary heart disease are not necessarily risk equivalent for future coronary heart disease events. J General Internal Med. 2016;31:387-93.
12. Kramer CK, Zinman B, Gross JL, Canani LH, Rodrigues TC, Azevedo MJ et al. Coronary artery calcium score prediction of all cause mortality and cardiovascular events in people with type 2 diabetes: systematic review and meta-analysis. BMJ. 2013;346.
13. Raggi P, Shaw LJ, Berman DS, Callister TQ. Prognostic value of coronary artery calcium screening in subjects with and without diabetes. J Am Coll Cardiol. 2014;43(9):1663-1669.
14. Piepoli MF, Hoes AW, Agewall S, Albus C, Brotons C, Catapano AL et al. Guidelines: Editor's choice: 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention and Rehabilitation (EACPR). Eur Heart J. 2016;37(29):2315.
15. Bertoluci MC, Rocha VZ. Cardiovascular risk assessment in patients with diabetes. Diabetol Metabolic Syndrome 2017;9:1-13.
16. Booth GL, Kapral MK, Fung K, Tu JV. Relation between age and cardiovascular disease in men and women with diabetes compared with non-diabetic people: a population-based retrospective cohort study. Lancet. 2006;368(9529):29-36.
17. Li R, O'Sullivan MJ, Robinson J, Safford MM, Curb D, Johnson KC. Family history of myocardial infarction predicts incident coronary heart disease in postmenopausal women with diabetes: the Women's Health Initiative Observational Study. Diabetes/ Metabol Res Rev. 2009;25(8):725-32.
18. Yeboah J, McClelland RL, Polonsky TS, Burke GL, Sibley CT, O'Leary D et al. Comparison of novel risk markers for improvement in cardiovascular risk assessment in intermediate-risk individuals. JAMA, 2012;308(8):788-95.
19. Goff Jr DC, Lloyd-Jones DM, Bennett G, Coady S, D'agostino RB, Gibbons R et al. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation. 2014;129(25-2):S49-73.
20. Qin R, Chen T, Lou Q, Yu D. Excess risk of mortality and cardiovascular events associated with smoking among patients with diabetes: meta-analysis of observational prospective studies. Int J Cardiol. 2013;167(2):342-50.
21. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J et al. Evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). JAMA. 2014;311(5):507-20.
22. Lloyd-Jones DM, Larson MG, Beiser A, Levy D. Lifetime risk of developing coronary heart disease. Lancet. 1999;353(9147):89-92.
23. American Diabetes Association. Standards of medical care in diabetes-2017: summary of revisions. Diabetes Care. 2017;40(1):S4.
24. Kearney PM, Blackwell L, Collins R, Keech A, Simes J, Peto R et al. Efficacy of cholesterol-lowering therapy in 18,686 people with diabetes in 14 randomised trials of statins: a meta-analysis. Lancet (London, England). 2008;371(9607):117-25.
25. Cho NH, Shaw JE, Karuranga S, Huang Y, Da Rocha Fernandes JD, Ohlrogge AW et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Res Clin Pract. 2018;138:271-81.
26. Ballotari P, Ranieri SC, Luberto F, Caroli S, Greci M, Giorgi Rossi P et al. Sex differences in cardiovascular mortality in diabetics and nondiabetic subjects: a population-based study (Italy). Int J Endocrinol. 2015.
27. Tancredi M, Rosengren A, Svensson AM, Kosiborod M, Pivodic A, Gudbjörnsdottir S et al. Excess mortality among persons with type 2 diabetes. N Eng J Med. 2015;373(18):1720-32.
28. Einarson TR, Acs A, Ludwig C, Panton UH. Prevalence of cardiovascular disease in type 2 diabetes: a systematic literature review of scientific evidence from across the world in 2007–2017. Cardiovascular Diabetol. 2008;17(1):1-19.

29. Gregg EW, Cheng YJ, Srinivasan M, Lin J, Geiss LS, Albright AL et al. Trends in cause-specific mortality among adults with and without diagnosed diabetes in the USA: an epidemiological analysis of linked national survey and vital statistics data. Lancet. 2018;391(10138):2430-40.
30. Meza R, Barrientos-Gutierrez T, Rojas-Martinez R, Reynoso-Noverón N, Palacio-Mejia LS, Lazcano-Ponce, E et al. Burden of type 2 diabetes in Mexico: past, current and future prevalence and incidence rates. Preventive Med. 2015;81:445-50.
31. Goraya TY, Leibson CL, Palumbo PJ, Weston SA, Killian JM, Pfeifer EA et al. Coronary atherosclerosis in diabetes mellitus: a population-based autopsy study. J Am Colle Cardiol. 2002;40(5):946-53.
32. Tandon N, Anjana RM, Mohan V, Kaur T, Afshin A, Ong K et al. The increasing burden of diabetes and variations among the states of India: the Global Burden of Disease Study 1990-2016. Lancet Global Heal. 2018;6(12):e1352-62.

Cite this article as: Sharma HS, Shanker S. A schematic review on multifaceted relationship between cardiovascular disease and diabetes. Int J Res Med Sci 2024;12:328-33.