Risk of coronary heart disease and stroke based on United Kingdom prospective diabetes study in type 2 DM patients in Medan

R Amelia¹, J Harahap¹, H Wijaya² and I I Fujiati¹

¹Department of Community Medicine, Faculty of Medicine, Universitas Sumatera Utara, Medan, North Sumatra 20155, Indonesia
²Department of Pediatrics, Faculty of Medicine, Universitas Sumatera Utara, Medan, North Sumatra 20155, Indonesia

*E-mail: rina2@usu.ac.id

Abstract. Cardiovascular disease is one of the most prevalent diabetic consequences that can lead to death. The purpose of this study was to use The United Kingdom Prospective Diabetes Study (UKPDS) Risk Engine to determine the risk of CVD complications in type 2 DM patients. The study's design is analytic using a cross-sectional approach, and the samples include 108 type 2 diabetes patients in Medan who fulfill the inclusion and exclusion criteria. The results showed that most patients had a high risk for CHD and a low risk for stroke. Education must be carried out intensively to patients that blood sugar is more controlled to reduce the risk of complications.

1. Introduction
The major consequences of type 2 diabetes Mellitus (T2DM) include hypertension, myocardial infarction (MI), congestive heart failure, stroke, and peripheral arterial disease. This condition is caused by accelerated arteriosclerosis, covering almost 50% of all comorbidities and deaths in patients with DMT2 [1]. Cardiovascular disease (CVD) has been identified as the major cause of mortality in T2DM patients. It has been estimated that 3/4 of patients die from CVD [2]. Therefore, assessing the risk of CVD complications is essential to prevent adverse outcomes in this population. This assessment is also helpful to prevent inappropriate treatment of this population. The risk of cardiovascular disease complications has so far been estimated by various algorithms. However, the Framingham Risk Score (FRS) and the United Kingdom Prospective Diabetes Study (UKPDS) are two frequently utilized risk predictors [3]. The UKPDS Risk Engine was created to investigate the risk of CVD in diabetes individuals. It is regarded as a strong technique for assessing CVD risk and identifying high-risk diabetic individuals without a CVD history [3]. The UKPDS risk engine and risk calculator make it easier to evaluate the risk of cardiovascular disease consequences in T2DM patients over the next 10 years [4]. The UKPDS technique to evaluating the risk of cardiovascular disease consequences in T2DM patients is more specific. This is evidenced in contrast to the variable HbA1C and the duration of diabetes [3]. The purpose of this study is to assess the risk of coronary heart disease (CHD) and stroke consequences in T2DM patients in Medan.
2. Materials and methods
This was an observational analytical study design using a cross-sectional methodology. The Faculty of Medicine at Universitas Sumatera Utara's study protocol has been approved by the Ethics Committee. The study was conducted on DM patients who come to treatment regularly in primary health services in Medan. The number of samples was 108 people recruited with consecutive sampling. The inclusion criteria in this study are patients who regularly come to primary health services and are willing to follow this study.

In contrast, patients with a history of vascular disorders before diabetes, a history of limb trauma, patients who have had a stroke, and blood clotting disorders are exclusion criteria in this study. Total cholesterol levels and HDL-C were measured using enzymatic colorimetry (oxidase cholesterol method). HbA1C levels are measured through the HPLC method. The UKPDS risk engine (version 2.0) [4], [5]. The following variables were included into the UKPDS risk engine equation: age, gender, ethnicity, smoking status, atrial fibrillation status, diabetes duration, HbA1c, systolic BP, TC, and HDL-C. All participants were categorized into three groups: low risk (15%), medium risk (15%), and high risk (30%) [4].

3. Results and discussion
All T2DM patients who participated in this study numbered 108 people; the characteristics of all patients numbered 108 people and were observed based on gender characteristics, age, nutritional status, length of diabetes, and family history of diabetes.

| Table 1. Characteristics of type 2 DM patients (n=108) |
|---------------------------------|-----------------|-----------------|
| Characteristics | Frequency (people) (n=89) | Percentage (%) |
| Gender | | |
| Man | 24 | 22.2 |
| Woman | 84 | 77.8 |
| Age, years (mean, SD) | 55.5 (9.2) | |
| Duration of DM, (mean, SD),years | 4.3 (4.2) | |
| HbA1c, (%) | 9.1 (2.8) | |
| Systolic Blood Pressure (mmHg) | 147.7 (23.1) | |
| Total Cholesterol (mg/dl) | 224.7 (41.7) | |

According to Table 1, women account for the vast majority of diabetics (77.8 percent). with an average age of 55.5 years (SD=9.2), the average pain duration is 4.3 years (SD ±4.2). Average Hba1c levels were 9.1% (SD±2.8), blood pressure averaged 147.7 mmHg, and average total cholesterol and HDL-C was 224.7 mg/dl (41.7) and 46.9 (11.9) mg/dl.

| Table 2. Risk of CHD Complications and Stroke in DM Type 2 patients |
|---------------------------------------------------------------|-----------------|-----------------|
| Complications | Frequency (n) | Percentage (%) |
| CHD | | |
| Low risk | 0 | 0 |
| Medium risk | 30 | 27.8 |
| High risk | 78 | 72.2 |
| Stroke | | |
| Low risk | 77 | 71.3 |
| Medium risk | 21 | 19.4 |
| High risk | 10 | 9.3 |

Table 2 showed that for ten years of risk of CHD in DM patients, the majority have a high risk of 78 orange (72.2%), while for the 10-year risk of stroke, it is known that the majority of diabetic patients have a low risk of 77 people (71.3%). Then the risk value is attributed based on the sex of the diabetes patient; for more details, we can see in the table below:
Based on Table 3, it is known that the distribution of CHD and stroke risk by gender, for CHD, for medium and high risk is more experienced by female patients, namely 27.4% and 72.6%, while for stroke risk is known for low and medium risk more experienced by female patients as much as 81% and 17.9%, while the high risk is more relayed by male patients as much as 37.5%.

The findings revealed that the majority of patients had a high risk of suffering CHD complications and a low risk of stroke. Diabetic was found to be independently linked with an elevated risk of PAD in a national register-based cohort analysis of all patients receiving Coronary Angiography (CAG), depending on the degree of coronary heart disease (CHD) [6]. Diabetic patients have a 2-4 times higher risk of cardiovascular disease when compared to normal populations. Dyslipidemia is a common metabolic disease associated with diabetes that is characterized by a range of quantitative and qualitative alterations in lipids and lipoproteins, including hypertriglyceridemia and lower HDL-C concentrations and higher LDL-C values [7].

The term diabetic dyslipidemia has been used to describe lipids abnormalities due to the effects of insulin resistance. This concept explains that defects in insulin and increased blood sugar levels lead to increased lipoprotein in the blood. This condition triggers the progressivity of the formation of atherosclerosis and cardiovascular disease. The impact of dyslipidemia on diabetics is significantly greater than on non-diabetics; even a modest rise in lipid levels in diabetics has demonstrated a considerable elevated influence of cardiovascular disease. Therefore, diabetic dyslipidemia should be of particular concern in managing CVD [8-10]. The results showed that for CHD, more high risk is transmitted by women, while for stroke, more men are at high risk, this is in line with previous research that men are more at risk of stroke than women, but men are also more at risk of CHD suffering than women [11-12]. While the incidence of acute myocardial infarction is higher in males, however, when viewed from the death rate due to cardiovascular disease, it is higher in women compared to men [4].

Several interrelated factors can cause high complications of CHD and stroke in T2DM patients. Age is the most vital non-modifiable risk factor. The increased risk of cardiovascular disease is more progressive in men than women. However, the transition to high risk, moderate risk, or low risk occurs at a certain age in each gender. Transitioning into the high-risk category often occurs at the age of 41-48 years, and the transition into the moderate risk category often occurs at the age of 35-45 years [4,12,13]. The longer a person has diabetes, the higher the risk of CHD and stroke. The duration of DM disease is a crucial determinant of the risk of cardiovascular disease in T2DM patients. Patients who have had diabetes for more than ten years are considered at high risk [4,14].

This increase in systolic blood pressure indicates the presence of early signs of hypertension or related comorbid factors. Hypertension is a risk factor for CVD and stroke mortality. Isolated systolic hypertension is a major risk factor for CVD problems in men and women of all ages [4,15]. In diabetic individuals, active smoking is connected with an increased risk of mortality and cardiovascular events. The incidence of cardiovascular disease increased six times in smoking women and three times in men who smoked. Meta-analysis of 46 studies showed that diabetic patients who smoked when compared to those who did not smoke, the relative risk was 1.48 for mortality, 1.36 for mortality rates due to cardiovascular disease, 1.54 for cardiovascular disease events, and 1.44 for stroke events, and 1.52 for acute myocardial infarction events [4,16].

| Complications | Man | Woman |
|---------------|-----|-------|
|               | n   | %     | n   | %     |
| CHD           |     |       |     |       |
| Low risk      | 0   | 0     | 0   | 0     |
| Medium risk   | 7   | 29.2  | 23  | 27.4  |
| High risk     | 17  | 70.8  | 61  | 72.6  |
| Stroke        |     |       |     |       |
| Low risk      | 9   | 37.5  | 68  | 81.0  |
| Medium risk   | 6   | 25.5  | 15  | 17.9  |
| High risk     | 9   | 37.5  | 1   | 1.2   |

Table 3. CHD and Stroke Risk Distribution by gender of T2DM patients
Atrial fibrillation is one of the most common types of arrhythmias in the world. Diabetes mellitus is one of the risk factors for atrial fibrillation, and atrial fibrillation is a risk factor for stroke. Thus, atrial fibrillation in DM patients increases complications of cardiovascular events compared to the general population. Indirectly, AF predicts a worse prognosis and increases mortality in T2DM patients [17]. HbA1c values are closely related to the risk of diabetes complications. The higher the HbA1c value, the higher the risk of complications. Any 1% decrease in HbA1c levels can lower the risk of microvascular vascular disorders by 35%, reduce other complications by 21% and reduce the risk of death by 21%. Normality of HbA1c can be attempted by maintaining normal blood sugar levels at all times [17].

4. Conclusion
The study showed that most T2DM patients have a high risk for CHD while having a low risk of suffering a stroke. Men are more at risk of having a stroke than female diabetic patients, while CHD is more at risk of men. Blood sugar control and regular exercise could help control blood sugar and prevention of cardiovascular complications.

Acknowledgements
The authors would like to acknowledge The Ministry of Research and Technology/ National Research and Innovation Agency for the 2021 Fiscal Year by the Research Contract Amendment No. 12 / E1 / KP. PTNBH / 2021, dated 8 March 2021.

References
[1] Vaidya V, Gangan N and Sheehan J 2015 Expert review of pharmacoeconomics and outcomes research 15 487
[2] Yu D, Shang J, Cai Y, Wang Z, Zhang X, Zhao B, Zhao Z and Simmons D 2019 BMJ Open Diabetes Research and Care 7 000735.
[3] Pokharel D R, Khadka D, Sigdel M, Yadav N K, Sapkota L B, Kafle R, Nepal S, Sapkota R M and Choudhary N 2015 North American journal of medical sciences 7 347
[4] Bertoluci M C and Rocha V Z 2017 Diabetology and metabolic syndrome 9 1
[5] https://www.dtu.ox.ac.uk/riskengine/
[6] Kamil S, Sehested T S, Carlson N, Houllin K, Lassen J F, Bang C N, Dominguez H, Pedersen C T and Gislason G H 2012 BMC cardiovascular disorders 19 1
[7] Wu L and Parhofer K G 2014 Metabolism 63 1469
[8] David S and Paul Z 2011 World Journal of Cardiovascular Diseases 31
[9] Amelia R, Harahap J, Lelo A, Wijaya H, Harahap N S and Yamamoto Z 2020 Family Medicine & Primary Care Review 22 197
[10] Amelia R, Wahyunii A S and Yunanda Y 2019 Maced J Med Sci 7 3400
[11] Chun M, Clarke R, Cairns B J, Clifton D, Bennett D, Chen Y, Guo Y, Pei P, Lv J, Yu C and Yang L 2021 Journal of the American Medical Informatics Association 28 1719
[12] Amelia R, Harahap N S 2019 Maced J Med Sci 7 2643
[13] Thiruvoipati T, Kiellhorn CE and Armstrong E J 2015 World journal of diabetes 6 96
[14] Bansal D, Nuyakallu R S, Gudala K, Vyamasuni R and Bhansali A 2015 Diabetes and metabolism journal 39 321
[15] De Sensi F, De Potter T, Cresti A, Severi S and Breithardt G 2015 Cardiovascular diagnosis and therapy 5 364.
[16] Richmond D, Quindry J, Migliaccio C T and Ruby B 2020 Implementation of a Dose Response to Wood Smoke PM: A Potential Method to Further Explain CVD in Wildland Firefighters (Missoula: University of Montana)
[17] Kilpatrick ES, Winocour PH 2010 Practical Diabetes International 27 306