

## RESEARCH ARTICLE

## Characteristics of Patients with Type 2 Diabetes Mellitus in Al-Ihsan Regional General Hospital

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### Abstract

The prevalence of type 2 diabetes mellitus (T2DM) in Indonesia is high, contributing to the fourth mortality rate for non-communicable diseases in Indonesia. The population of T2DM patients spread across all provinces, including West Java, which is the most populous province in Indonesia. One of the referral hospitals in West Java is Al-Ihsan Regional General Hospital in Bandung regency. The purpose of this study was to describe the characteristics of T2DM patients who came to Al-Ihsan Regional General Hospital according to age, gender, and comorbidities parameters. It was a descriptive cross-sectional study using secondary data from medical records of T2DM patients between January 2017 and November 2020. The results were the highest prevalence and incidence of T2DM were in 2017 with as many as 5,051 and 653 respectively; the highest gender each year was female, range between 584–3,333, with the highest male: female ratio of 1:2 in 2017; the age group with the highest prevalence was 55–65 years which was 3,468 (39.53%); and top five comorbidities were hypertension (35.68%), cataracts (6.01%), osteoarthritis (3.58%), pulmonary tuberculosis (2.92%) and dyspepsia (2.91%). This study concluded that the prevalence and incidence of T2DM in Al-Ihsan Regional General Hospital were high, with the predominant female patients, elderly, and comorbid hypertension.

**Keywords:** Age group, characteristics, comorbid, gender, T2DM

## Karakteristik Pasien Diabetes Melitus Tipe 2 di RSUD Al-Ihsan

### Abstrak

Angka kejadian diabetes melitus tipe 2 (DMT2) di Indonesia cukup tinggi, menyumbangkan angka kematian keempat penyakit tidak menular di Indonesia. Penderita DMT2 tersebar di seluruh provinsi, termasuk Jawa Barat yang merupakan provinsi terpadat di Indonesia. Salah satu rumah sakit rujukan di Jawa Barat adalah RSUD Al-Ihsan di Kabupaten Bandung. Tujuan penelitian ini adalah menggambarkan karakteristik pasien DMT2 yang datang ke RSUD Al-Ihsan dilihat dari usia, jenis kelamin, dan komorbid. Penelitian ini merupakan penelitian deskriptif *cross-sectional* menggunakan data sekunder berupa rekam medis pasien DMT2 periode Januari 2017 hingga November 2020. Didapatkan bahwa prevalensi dan insidensi DMT2 tertinggi pada tahun 2017 sebesar 5.051 dan 653 masing-masing; jenis kelamin terbanyak pada setiap tahun adalah wanita sebesar 584–3.333 dengan rasio pria:wanita tertinggi 1:2 pada tahun 2017; kelompok usia dengan prevalensi tertinggi adalah 55–65 tahun sebesar 3.468 (39,53%); dan lima komorbid tertinggi adalah hipertensi (35,68%), katarak (6,01%), osteoartritis (3,58%), tuberkulosis paru (2,92%), dan dispepsia (2,91%). Simpulan penelitian ini adalah prevalensi dan insidensi DMT2 di RSUD Al-Ihsan tinggi dengan pasien terbanyak wanita, lanjut usia, dan komorbid hipertensi.

**Kata kunci:** DMT2, jenis kelamin, karakteristik, kelompok usia, komorbid

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## Introduction

Like several other Asian countries, Indonesia has a high incidence of type 2 diabetes mellitus (T2DM). Based on data from the International Diabetes Federation (IDF),<sup>1</sup> Indonesia is on diabetes alert status because it is in seventh place in the top 10 countries or territories for number of adults (20–79 years) with diabetes in 2019 and 2030. The prevalence of patients with diabetes in Indonesia reaches 6.2%, which means that more than 10.8 million people had diabetes in 2020. The mortality rate due to diabetes in Indonesia is in the fourth position after cancer, stroke, and kidney disease.<sup>2,3</sup> T2DM patients are distributed across all provinces in Indonesia, and the highest distribution is on the island of Java.<sup>2</sup>

West Java is the most populated province in Indonesia, with a DM prevalence of 1.28% of its 49.94 million population, i.e., 639,232 people.<sup>3,4</sup> Several hospitals in West Java have become referral centers for T2DM patients, including the Al-Ihsan Regional General Hospital West Java Province in Bandung regency. Therefore, this study aimed to describe the incidence, prevalence, and characteristics of the T2DM patients based on gender, age group, and comorbidities in Al-Ihsan Regional General Hospital within the year 2017–2020 (four years) period.

## Methods

It was a cross-sectional study using secondary

data sourced from outpatient medical records of T2DM patients of Al-Ihsan Regional General Hospital West Java Province between January 2017 and November 2020. The data were tabulated and grouped based on gender, age group, and comorbidities.

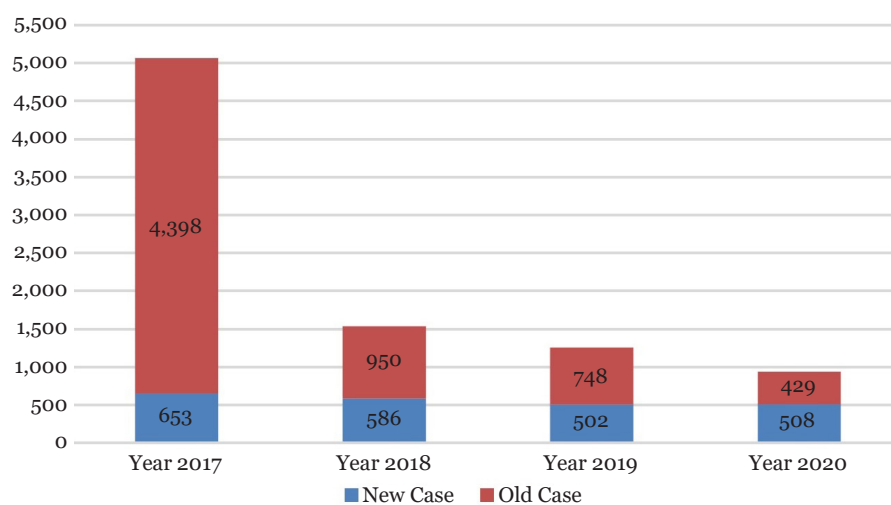
The Health Research Ethics Committee of the Universitas Islam Bandung has approved this research, with the ethical approval number: 093/KEPK-Unisba/X/2020.

## Results

From 8,773 T2DM patients admitted to the Outpatient Department of Al-Ihsan Regional General Hospital for four years, the highest number of patients was in 2017 (5,051) and the least in 2020 (936). The incidence in each year ranges from 502 (in 2019) to 653 (in 2017). However, the number of new cases in 2017 was only 12.93% compared to all patients in that year, while in fact, the year with the highest percentage of new cases was in 2020, which is 54.27% (Figure).

In all years of study, T2DM was more prevalent in females than males. The highest prevalence of females was in 2017 which was 3,333 patients, with the highest ratio also in 2017 which was 1:2, while the lowest prevalence in 2020 as many as 584 patients, and the lowest ratio was in 2019 which was 3:5 (Table 1).

From Table 2, we may observe that the age group 55–65 years is the age group with



**Figure Incidence and Prevalence of T2DM over Four Years of Study**

Showing a large composition of old cases visiting the outpatient department in 2017, and a high incidence of T2DM in 2020 compared with all cases in that year

the highest incidence of T2DM in all years of observation (39.53%), followed by the age group 45–54 years (29.10%).

Top 15 highest comorbid changes every year, but in all years of observation, hypertension is always the first most comorbid, it was the highest in 2017 at 48.71% and the lowest in 2020 at 14.06%. The distribution of comorbid in each year can be seen in Table 3, while a summary of the top 5 comorbid of all years can be seen in Table 4.

## Discussion

In general, the incidence of T2DM each year is relatively even, ranging from 502–653. It is consistent with IDF predictions that in Southeast Asia, there is a tendency to increase the incidence by 74% from 2019 to 2030.<sup>1</sup> This means that T2DM is a non-communicable disease that still needs to be observed. Prevention is even more encouraged, in this case, efforts to improve lifestyle.<sup>5</sup>

The highest prevalence of T2DM was seen in 2017 but decreased drastically in the following years. Whether this situation was caused by mortality, or due to decreased patient compliance, or switching treatment to another hospital/treatment center, still needs further investigation. The high prevalence of T2DM in

Asian countries, most of which are developing countries, is related to several things, including urbanization, rapid economic growth, changes in lifestyle and diet, and also: aging.<sup>6,7</sup>

The population of Bandung regency, which is the coverage area of Al-Ihsan Regional General Hospital, is a developing urban area. Cultural changes, including diet and lifestyle, and stressful life such as increasing living standards, long working hours, rush hours can increase stress, all of which are a risk of prediabetes.<sup>8–10</sup>

From Figure, we can observe that the lowest prevalence was in 2020. This situation was most likely due to patient restrictions related to the COVID-19 pandemic, which reduced patient visits. More than half (53%) of the 155 countries globally have partially or entirely disrupted services for hypertension treatment; 49%, 42%, and 31% for diabetes and diabetes-related complications treatment; cancer treatment, and cardiovascular emergencies, respectively.<sup>11</sup> However, as shown in Figure 1, the incidence of T2DM, when compared to its prevalence, is the highest in 2020. As we all know, at the beginning of 2020, the whole world experienced a COVID-19 pandemic, and we were all forced to adapt to this situation. The existence of lockdown, work from home, school from home, and other online activities causes sedentary behavior, which in turn leads to weight gain, which is one of the risk

**Table 1 Characteristics of T2DM Patients in Outpatient Department Al-Ihsan Regional General Hospital**

Gender	2017	2018	2019	2020	Σ
Male (M)	1,732	590	505	355	3,182
Female (F)	3,333	946	751	584	5,614
Ratio M:F	1:2	3:5	2:3	3:5	1:2.1

**Table 2 Age Distribution of T2DM Patients in Outpatient Department Al-Ihsan Regional General Hospital**

Age Distribution (Years)	2017	2018	2019	2020	Σ	%
10–24	29	23	15	14	81	0.92
25–44	399	171	170	131	871	9.93
45–54	1,406	483	367	305	2,561	29.19
55–65	2,106	557	467	338	3,468	39.53
66–74	828	229	188	108	1,353	15.42
75–90	277	72	43	39	431	4.91
>90	6	1	0	1	8	0.09

**Table 3 Top 15 Comorbid of T2DM in Al-Ihsan Regional General Hospital**

No.	2017	n	%	2018	n	%	2019	n	%	2020	n	%
1	Hypertension	2,467	48.71	Hypertension	292	19.01	Hypertension	247	19.67	Hypertension	132	14.06
2	Osteoarthritis	192	3.79	Cataract	112	7.29	Diabetic foot ulcer	62	4.94	Diabetic foot ulcer	70	7.45
3	Cataract	177	3.49	Diabetic foot ulcer	53	3.45	Osteoarthritis	40	3.18	ESRD	46	4.90
4	Dyspepsia	149	2.94	Dyspepsia	50	3.26	Dyspepsia	35	2.79	Pulmonary TB	27	2.88
5	Mononeuropathy	82	1.62	Osteoarthritis	28	1.82	Coronary artery disease	33	2.63	CKD grade I	23	2.45
6	Diabetic foot ulcer	62	1.22	Retinal disorder	22	1.43	Cataract	29	2.31	Dyspepsia	22	2.34
7	Kidney disorder	35	0.69	CKD grade I	16	1.04	CKD grade I	19	1.51	Coronary artery disease	17	1.81
8	Pulmonary TB	24	0.47	Mononeuropathy	14	0.91	Polyneuropathy	18	1.43	GERD	15	1.60
9	Coronary artery disease	21	0.41	Polyneuropathy	13	0.85	Pulmonary TB	13	1.04	Heart failure	13	1.38
10	Unspecified asthma	21	0.41	Heart failure	13	0.85	Retinal disorder	13	1.04	Osteoarthritis	13	1.38
11	Heart failure	20	0.39	Pulmonary TB	11	0.72	GERD	11	0.88	Polyneuropathy	12	1.28
12	Retinal disorder	15	0.30	Coronary artery disease	9	0.59	Cellulitis	9	0.72	Cataract	11	1.17
13	Acute URTI	15	0.30	Acute gastritis	8	0.52	Stroke	8	0.64	Mononeuropathy	10	1.06
14	Hyperlipidemia	11	0.22	Hyperlipidemia	7	0.46	Pneumonia	8	0.64	Retinal disorder	8	0.85
15	Polyneuropathy	8	0.16	Nontoxic goiter	5	0.33	Lumbar radiculopathy	7	0.56	Presbyopia	8	0.85

**Table 4 Five Most Common Comorbid in Patients with T2DM**

No.	Comorbid	n	%
1	Hypertension	3,138	35.68
2	Cataract	529	6.01
3	Osteoarthritis	315	3.58
4	Pulmonary tuberculosis	257	2.92
5	Dyspepsia	256	2.91

factors for T2DM.<sup>12,13</sup>

In addition, restrictions on hospital services, delays in elective and palliative care, insufficient staff and closure of hospital services, transportation restrictions due to lockdown have caused people to postpone appointments with their doctors, making it too late to prevent T2DM that happens in almost all countries.<sup>14–16</sup>

In the results of this study, it was found that the prevalence of female T2DM patients was higher male in all years of observation, despite the ratio of the male and female population in Bandung regency and West Java where Al-Ihsan Regional

General Hospital located was 1:1.<sup>4,17</sup> Similar result also occurred in studies in Mexico, Kerala India, and Saudi Arabia, where the prevalence of T2DM was higher in women.<sup>18–20</sup>

A pre-existing theory states that males tend to be at higher risk for T2DM, associated with a higher visceral fat distribution (2:1). However, total fat in females is higher, distributed in other parts of the body, i.e., subcutaneous and gynoid fat. The relationship between visceral fat and the risk of insulin resistance is well established.<sup>21,22</sup>

The explanation of the results of this study that differs from the theory is that in females, there are certain risks related to reproductive factors and reproductive history. Women with early menarche, irregular menstrual cycles, polycystic ovary syndrome (high androgen levels), and a history of gestational diabetes increase the risk of T2DM later in life.<sup>23</sup> In addition, female patients are more compliant to treatment and more aware of their body condition, so more females come to the treatment center.<sup>24,25</sup>

The highest incidence of T2DM was in the 55–65 age group (39.53%), although the increase began to be seen in the 45–54 age group (29.19%).

This result is consistent with the results obtained in Mexico, India, Saudi Arabia, and China, which found that the highest incidence of T2DM was in the age group above 45 years.<sup>6,18–20</sup> The average onset of T2DM is at the age of 45 years. This onset is influenced by the interplay between modifiable and nonmodifiable factors and genetic and environmental factors. Obesity, characterized by an increase in BMI and waist circumference, low physical activity, high sedentary behavior, and socioeconomic status, are modifiable factors. In contrast, ethnicity, family history with T2DM, puberty, low birth weight, previous gestational diabetes are nonmodifiable factors.<sup>26,27</sup> These conditions begin long before the onset of DM and progress to a condition known as prediabetes and metabolic syndrome. The state of prediabetes can begin at the age of young adults around 25–34 years (prevalence pre-DM in Arabic), some even as early as 18 y.o. (CDC) (prevalence pre-DM in the USA), with a peak prevalence at 45–64 years (CDC). This situation is still reversible if lifestyle modifications are made, especially physical activity and diet.<sup>5</sup>

Prediabetes is when the plasma glucose is elevated above normal range but below clinical diabetes, manifested as either impaired fasting glucose or impaired glucose tolerance. Prediabetes commonly becomes the underlying cause of metabolic syndrome. Both, in turn, are closely associated with obesity or vice versa.<sup>28</sup>

The persistence condition of prediabetes and metabolic syndrome leads to T2DM development, and many studies predict that from the onset of prediabetes to progress to diabetes, the average time required is about 2.49 to less than ten years.<sup>5,29</sup> This fact is according to the age group with the highest prevalence of T2DM, i.e., 55–65 years.

From Table 4, we can see that T2DM patients have hypertension as the most common comorbid, followed by cataracts, osteoarthritis, pulmonary TB, and functional dyspepsia. Hypertension is also the most common comorbid in Saudi Arabia, China, Bangladesh, Pakistan, and Srilanka.<sup>30–33</sup>

The presence of hypertension in T2DM can occur before or after T2DM itself. Before T2DM, there was low-grade chronic inflammation whose mediators were released into the circulation, initiating the process of atherosclerosis which ended in narrowing of blood vessel diameter, which resulted in increased peripheral resistance and hypertension.<sup>34,35</sup>

In T2DM patients, an increase in blood pressure

is closely related to elevated peripheral resistance due to vascular remodeling and an increase in vascular volume due to hyperinsulinemia and hyperglycemia caused by insulin resistance.<sup>36</sup>

Cataract was the second most common comorbid after hypertension (Table 4). In other studies, the prevalence of cataracts in T2DM patients also ranged from 40–60%.<sup>37,38</sup> In DM patients, there is the polyol pathway activation, which causes the aldose reductase enzyme to convert glucose into sorbitol. Aldose reductase in cataract formation plays an important role as an initiation factor. Intracellular accumulation of sorbitol will cause osmotic changes, resulting in hydropic lens fibers, which then degenerate and form cataracts. In the lens, the production of sorbitol occurs more rapidly than its conversion to fructose by the enzyme sorbitol dehydrogenase, and it is more difficult to remove this sorbitol by diffusion. The accumulated sorbitol creates a hyperosmotic state so that fluid moves inward to balance the osmotic gradient, then collapse and liquefaction of lens fibers occur, leading to the formation of lens opacity.<sup>34,35,39,40</sup>

Osteoarthritis (OA) was the third most common comorbid; following previous studies, almost half (47–52%) of T2DM patients have some form of arthritis.<sup>41,42</sup> The relationship between diabetes mellitus and OA has been confirmed in several studies. T2DM has a pathogenic effect on OA through several pathways: a) chronic hyperglycemia, which induces oxidative stress, overproduction of proinflammatory cytokines and AGEs in joint tissue; b) insulin resistance, which can both act locally and causes a systemic low-grade inflammatory state; c) leptin, which causes chondrocyte apoptosis while increasing MMP and cytokine production from chondrocytes; d) increased FFA associated obesity and insulin resistance may also modulate the development of OA; e) GLUT-1, the amount is increased in the plasma membrane of joint cells and chondrocytes, thereby increasing glucose uptake in hyperglycemic conditions, causing the production of IL-1 $\beta$ , TGF- $\beta$ 1, and MMP—oxidative stress, and AGEs which ultimately leads to OA.<sup>41–44</sup>

The close relationship between TB and DM has long been known. Evidence that DM is often comorbid for TB and vice versa has also been confirmed.<sup>45</sup> In this study, it was found that TB became the 4<sup>th</sup> comorbid with 257 patients or 2.92% of all patients studied. This result is in line with research in Jember, East Java, which even

shows the TB-DM rate is higher than Indonesia in general.<sup>46</sup>

*Mycobacterium tuberculosis (M.tb)* immunity is dysfunctional in DM patients, with an exaggerated and delayed response.<sup>47</sup> Monocytes from DM patients had a significantly decreased association in binding and phagocytosis of *M.tb*. This defect affects the changes in serum monocytes and opsonins for *M.tb*, especially the C3 component that mediates *M.tb* phagocytosis. DM patients also found it delayed innate immunity to *M.tb* due to delayed delivery of *M.tb*-bearing APCs to lymph nodes that drain the lungs. Similarly, it was found that levels of the inflammatory cytokines interleukin-6 and interleukin-17 were significantly increased in T2DM patients, which correlated with increased oxidative stress. This situation causes a downstream effect, where there is a decrease in interleukin-12, which plays a role in activating NK cells and differentiating and activating CD4<sup>+</sup> T cells, which play a role in resistance to intracellular microorganisms (*M.tb*).<sup>47,48</sup>

In the study results, dyspepsia was the fifth most common comorbid of T2DM patients, with 2.91%. These manifestations are typically due to gastroparesis. Gastroparesis is a syndrome characterized by slowed gastric emptying without the mechanical obstruction of the stomach, often found in patients with diabetes >10 years and microvascular complications. Despite the controlled blood sugar, this condition persists and is stable for 12–25 years. The cardinal symptoms are postprandial fullness, nausea, vomiting, and bloating.<sup>49,50</sup>

DM patients may exhibit diabetic autonomic neuropathy (DAN). Autonomic nerves are prone to metabolic attacks because they are unmyelinated. DAN affects several organ systems, including the gastrointestinal system, causing gastroparesis with manifestations similar to dyspepsia.<sup>49</sup>

As many as 5–12% of DM patients experience gastroparesis with variations in prevalence up to 24–30% in a different center.<sup>51,52</sup> The possible pathophysiology of gastroparesis is associated with poor glycemic control, sympathetic vagal neuropathy, Cajal interstitial cell abnormalities, and loss of neuronal nitric oxide synthase.<sup>50</sup>

## Conclusions

The prevalence and incidence of T2DM in Al-Ihsan General Regional Hospital were high, with the predominant female patients, highest age

group were in the elderly, and hypertension as the most common comorbid.

## Conflict of Interest

The authors have no conflict of interest to declare.

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