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Abstract

Type-2 diabetes (T2DM) is a key public health issue due to its high prevalence and mortality rate. This review estimates future global trends in T2DM prevalence and mortality using the Forecast exponential smoothing (ETS) model. By 2050, estimated prevalence and mortality for all ages are 10.23% and 2.05 million, respectively, and for adults (>20 years) are 11.97% and 1.9 million. Obesity and high BMI are key risk factors. Mortality is higher in adults due to polypharmacy and complications. T2DM prevalence and mortality will continue to rise alarmingly. Urgent international and national measures are needed to address this burden. Collaboration between researchers, clinicians, and policymakers is crucial for optimal health planning and mitigating the impact of T2DM.

Keywords: Type-2 Diabetes, Prevalence, Mortality, Forecast

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Abstract

Type-2 diabetes (T2DM) is a key public health issue due to its high prevalence and mortality rate. This review estimates future global trends in T2DM prevalence and mortality using the Forecast exponential smoothing (ETS) model. By 2050, estimated prevalence and mortality for all ages are 10.23% and 2.05 million, respectively, and for adults (>20 years) are 11.97% and 1.9 million. Obesity and high BMI are key risk factors. Mortality is higher in adults due to polypharmacy and complications. T2DM prevalence and mortality will continue to rise alarmingly. Urgent international and national measures are needed to address this burden. Collaboration between researchers, clinicians, and policymakers is crucial for optimal health planning and mitigating the impact of T2DM.

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Introduction

Type-2 diabetes mellitus (T2DM) is a metabolic disorder, characterised by hyperglycaemia, insulin resistance and progressive loss of adequate insulin production (Galicia-Garcia et al., 2020). It is one of the most pressing public health challenges of the 21st century as its prevalence rate is reaching epidemic proportions globally. Effective public health interventions and

healthcare planning require understanding the prevalence and distribution of T2DM across various populations. T2DM prevalence has alarmingly increased globally, as evidenced by recent epidemiological studies. In adults, the number of diabetes cases has quadrupled since 1980, with most cases being diabetes type 2.

Type-2 diabetes is one of the main causes of morbidity and mortality globally and poses a



heavy financial strain on economies and health systems. According to the latest IDF 2021 report, the health expenditure of diabetes was at least \$966 billion which is a huge financial burden on low-income and middle-income countries (Jalilian et al., [2023](#)). Over the last 3 decades, there has been a noteworthy increase in the prevalence of diabetes (type 2) worldwide, primarily because of changes in lifestyle, ageing, urbanization, and population growth. Based on recent estimates, the age-standardized prevalence of type-2 diabetes has increased by 49% between 1990 and 2019 globally. In addition, in 2019 there were 18.5 deaths per 100,000 people due to type 2 diabetes, a rise of 10.8% from 1990. The T2DM estimated DALY (disability adjusted life years) count was 148.2 million in 2019 (Safiri et al., [2022](#)). Diabetics with type 2 diabetes have an increased risk of renal failure, cardiovascular diseases, blindness, lower limb amputation, and other complications which result in disability and morbidity (UK, [2024](#)). Also, T2DM patients have 20 years of reduced life expectancy and a 15% higher risk of premature death (Tancredi et al., [2015](#)).

The majority of patients with diabetes mellitus have type-2 diabetes, which accounts for about 90% of all cases of the illness. (Chatterjee et al., [2017](#)). In the past, T2DM was most common in older adults but the prevalence of T2DM is also increasing in younger adults and children because of poor diet, high BMI, and sedentary lifestyle ((IDF), [2024](#)). Different countries and regions have different prevalence rates of type-2 diabetes; the Eastern Mediterranean, Western Pacific, and South-East Asia have the highest rates. The prevalence rate is also influenced by sex, age, socioeconomic status, ethnicity, lifestyle, and environmental factors (Abdul Basith Khan et al., [2019](#)) (Sun et al., [2022](#)). The prevalence of T2DM is significantly higher in urban areas as compared to urban areas (Cho et al., [2018](#)). Socioeconomic status, lifestyle, food, BMI, obesity and limited access to healthcare services also play an important role in the

prevalence of T2DM (Bommer et al., [2017](#); Marmot, [2005](#)).

It is expected that the global prevalence and mortality of T2DM may rise at an alarming rate in the future due to urbanization, ageing, population growth, poor dietary lifestyle, and absence of physical activity. The estimates of the World Health Organization indicate that diabetes would be the 7th leading cause of death globally in 2030 (United Nations, [2015](#)).

The prevention and management of T2DM is essential to reduce its global burden and quality of life of people become better. This review article aims to overview the future trends of prevalence and mortality of type-2 diabetes globally.

Methods

Study Overview

We analysed the global population, prevalence rate, and mortality rate of type-2 diabetes to estimate its future trends in 2023 and 2050. We considered that the prevalence and mortality rates follow past trends from 1990 to 2019 (Guzman-Vilca & Carrillo-Larco, [2024](#)). Two age groups (both male and female) were selected in this study:

1. All ages group.
2. Adults (>20 years) group.

Data Sources

Prevalence and mortality data of T2DM was collected from the global burden of the disease study 2019 database and IDF Atlas 2021 (10th edition) ((GBD), [2019](#); Magliano & Boyko, [2022](#); Ong et al., [2023](#)). The majority of data was extracted from GBD 2019 as IDF 2021 didn't include separate epidemiological data for T2DM. In addition, a detailed literature search of PubMed, Google Scholar, and Medline was performed on 03 February 2024 with restrictions to studies published in English. The terms "type 2 diabetes", "type 2 diabetes mellitus", "type 2 diabetes AND prevalence", "type 2 diabetes AND number of deaths", "T2DM", "Epidemiology of

type 2 diabetes", "type 2 diabetes prevalence AND mortality", and "type 2 diabetes AND incidence" were used along with Medical Subject Headings (MESH). Also, relevant cited references were reviewed to include in this study.

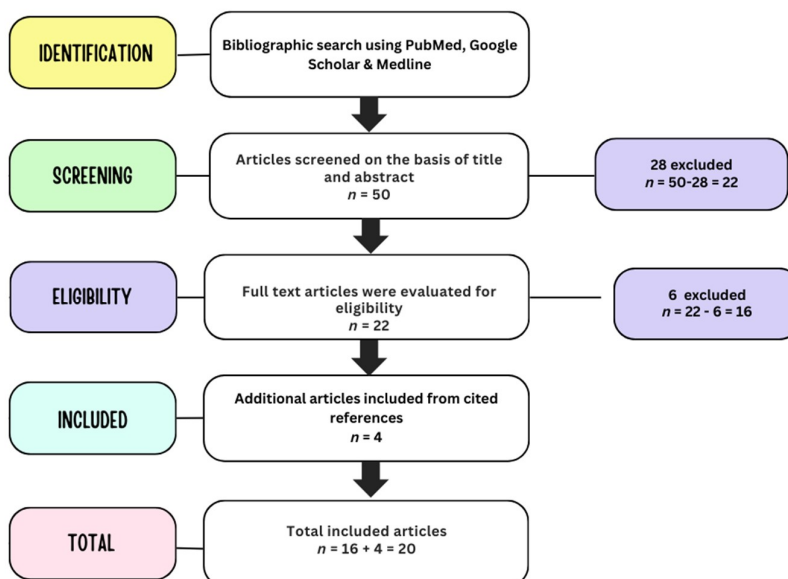
The global population data of different age groups from 1990 to 2050 was retrieved from the United Nations (UN) World Population Prospects 2022 (Nations, [2022](#)).

The criteria for inclusion and exclusion were founded on PRISMA recommendations as shown below in fig. 1. Studies were excluded if they:

- are published before 1990.
- report non-population-based samples such as clinical trials or hospital-based studies.
- did not include the prevalence or incidence of type-2 diabetes.
- did not provide mortality data (Diaz-Valencia et al., [2015](#)).

Figure. 1

Prisma flow-diagram for bibliographic search strategies



Calculation of type-2 diabetes forecast

On the basis of GBD-2019, IDF 2021, UN population Prospect 2022 and other published articles data, we forested the prevalence rate (%) and number of deaths from 2020 to 2050. The data was forecasted by using the forecast exponential smoothing (ETS) model with 95% confidence intervals on Microsoft Excel.

However, this type-2 diabetes future projection data did not include any risk factor (especially high BMI or obesity) which may lead to high prevalence and high death rate of type-2 diabetes.

Results

All ages group

Globally, from 1990 to 2023 and 2050, the increase in the occurrence of type 2 diabetes for all ages group is 228% and 355% respectively. In 2023, 520 million people of all ages were suffering from diabetes mellitus (type 2) with an average prevalence of 6.57%. Similarly, there will be 993 million (approximately 1 billion) people living with diabetes type 2 with an average prevalence of 20.23%. Between 2023 and 2050, there is a surge of 156% in the prevalence of T2DM for all ages. The prevalence of T2DM is

expected to increase from 6.57% to 10.23% (table 1, fig. 2 and 4).

The increase in prevalence rate also leads to an increase in the number of deaths. In our forecast data estimation, 1.4 million type-2

diabetic patients would have died in 2023. It is expected that the number of deaths would be increased to 2.05 million in 2050 (table 1, fig. 3 and 4). However, these number of deaths doesn't include the number of deaths due to other complications or diseases.

Table 1

Global T2DM prevalence rate (%) and number of deaths for all ages group in 2023 and 2050

2023				2050			
Population (Billion)	Patients (Million)	Prevalence (%)	Deaths (Millions)	Population (Billion)	Patients (Million)	Prevalence (%)	Deaths (Million)
8.05	520	6.57	1.4	9.71	993	10.23	2.05

Figure. 2

Global T2DM prevalence rate (%) for all ages group from 1990 to 2050 (dashed lines indicate future forecast and dotted lines shows 95% confidence interval).

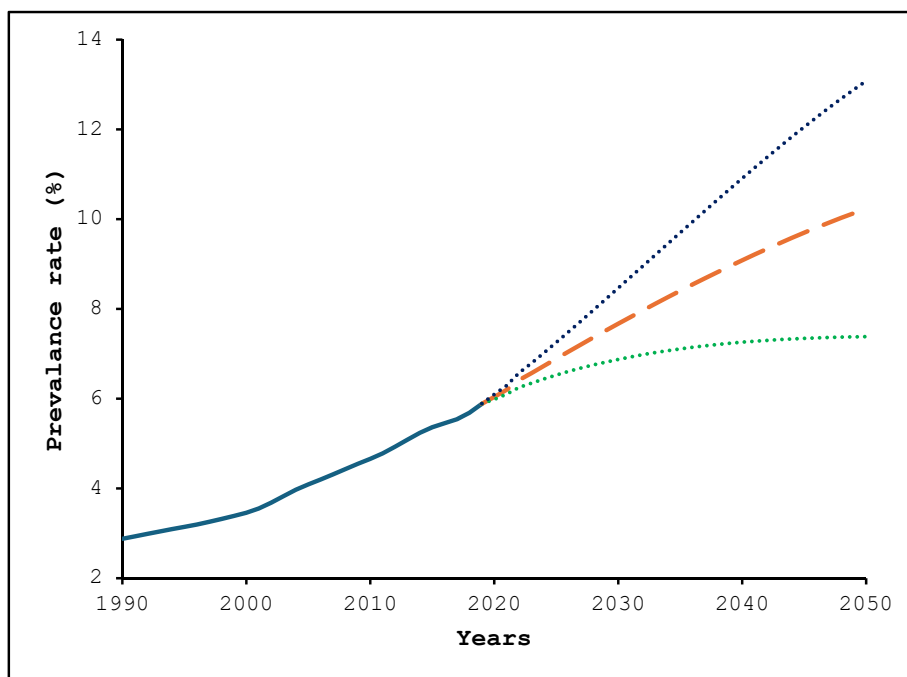


Figure. 3

Global number of deaths in all ages group from 1990 to 2050.

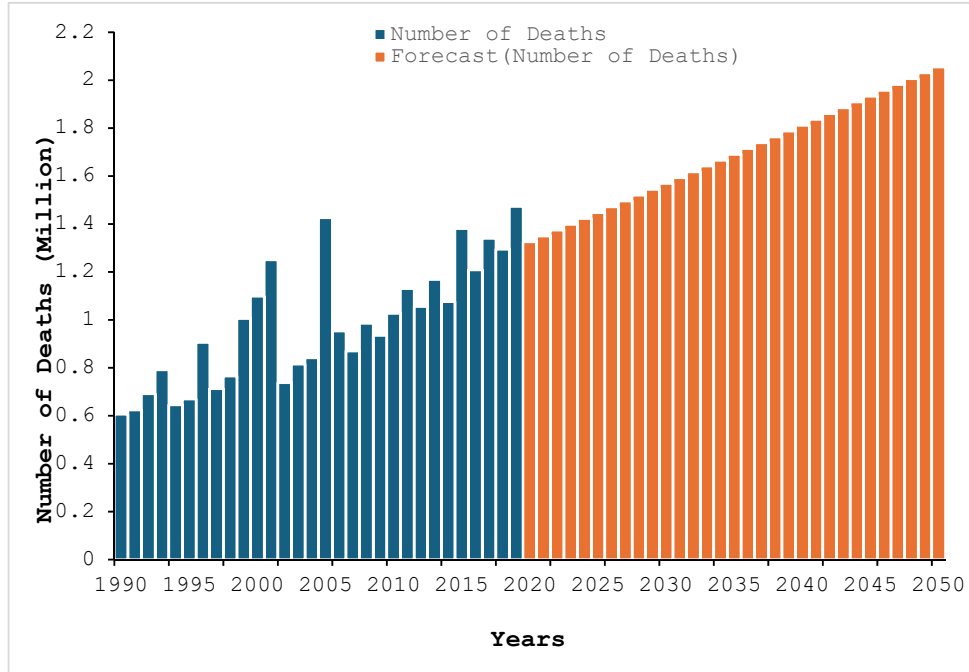
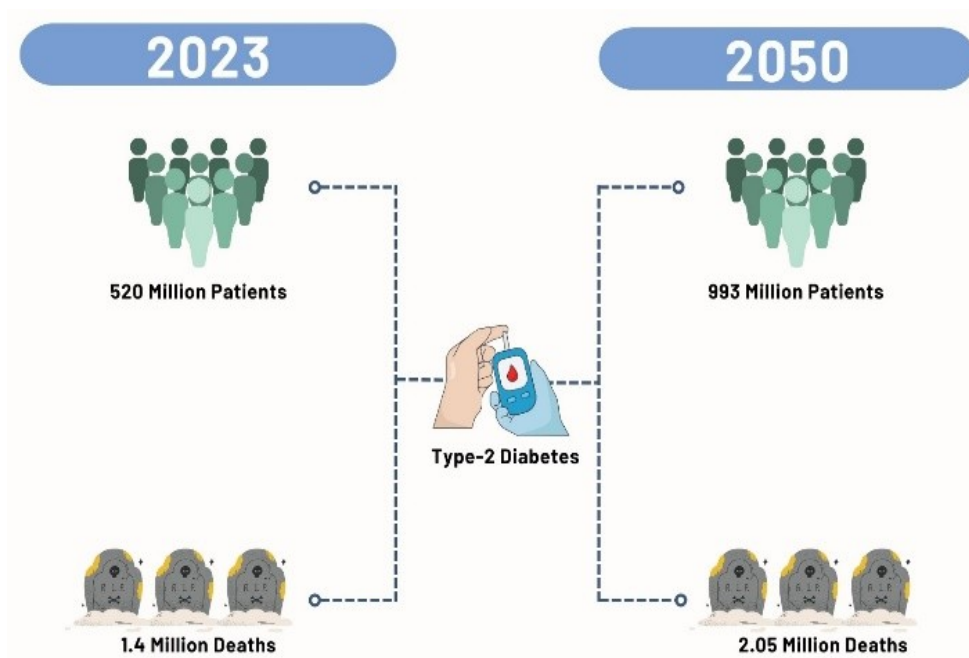


Figure. 4

Global T2DM patients and deaths for all ages group in 2023 and 2050



Adults (>20 Years) Group

The type-2 diabetes prevalence is more common in the adults (>20 years) group. The previous

data and our forecast data show that the type-2 diabetes prevalence in adults is high as compared to all ages group. In our forecast data estimation,

the type-2 diabetes prevalence (%) in 2023 and 2050 is 8.90% and 11.97% respectively. It means that 490 million and 840 million adults (>20 years) population would be T2DM patients in 2023 and 2050 respectively (table 2, fig. 5 and 7).

Similarly, the mortality rate in the adults (>20 years) group is also higher than all ages group. As per our forecast data estimation, the quantity of fatalities among adults (>20 years old) in 2023 and 2050 would be 1.37 million and 1.9 million respectively (table 2, fig. 6 and 7).

Table 2

Global T2DM prevalence rate (%) and number of deaths for adults (>20 years) group in 2023 and 2050.

2023				2050			
Population (Billion)	Patients (Million)	Prevalence (%)	Deaths (Millions)	Population (Billion)	Patients (Million)	Prevalence (%)	Deaths (Million)
5.40	490	8.90	1.37	7.04	840	11.97	1.9

Figure. 5

Global T2DM prevalence rate (%) for adults (>20 years) group from 1990 to 2050 (dashed lines indicate future forecast and dotted lines shows 95% confidence interval).

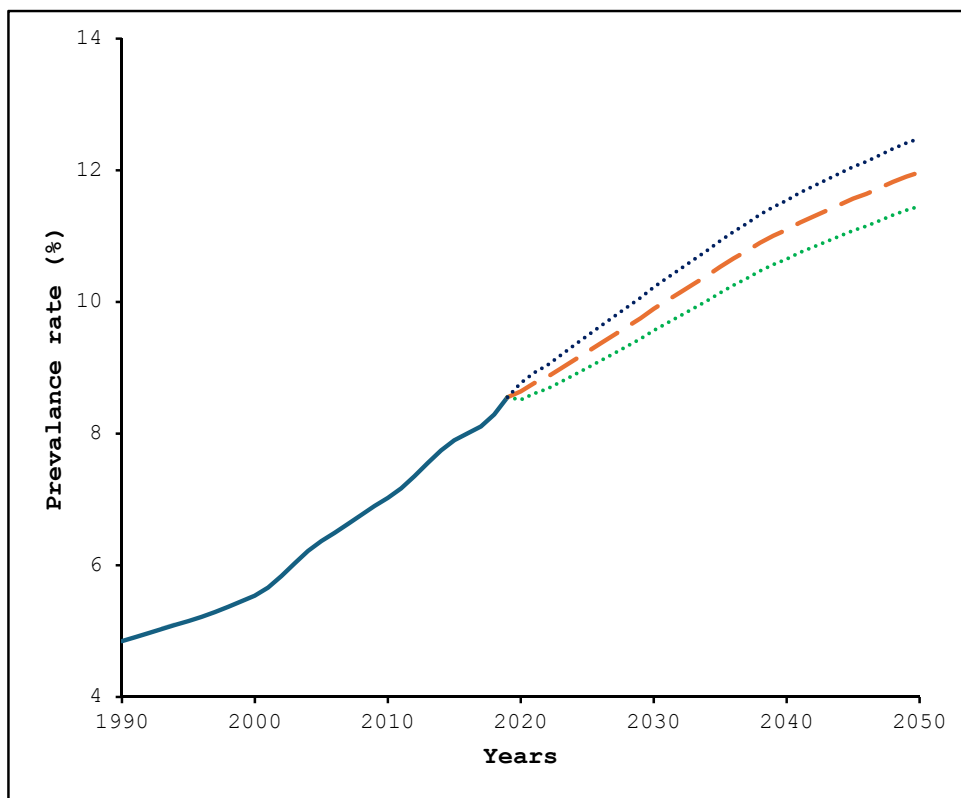


Figure. 6

Global number of deaths in adults (>20 years) group from 1990 to 2050.

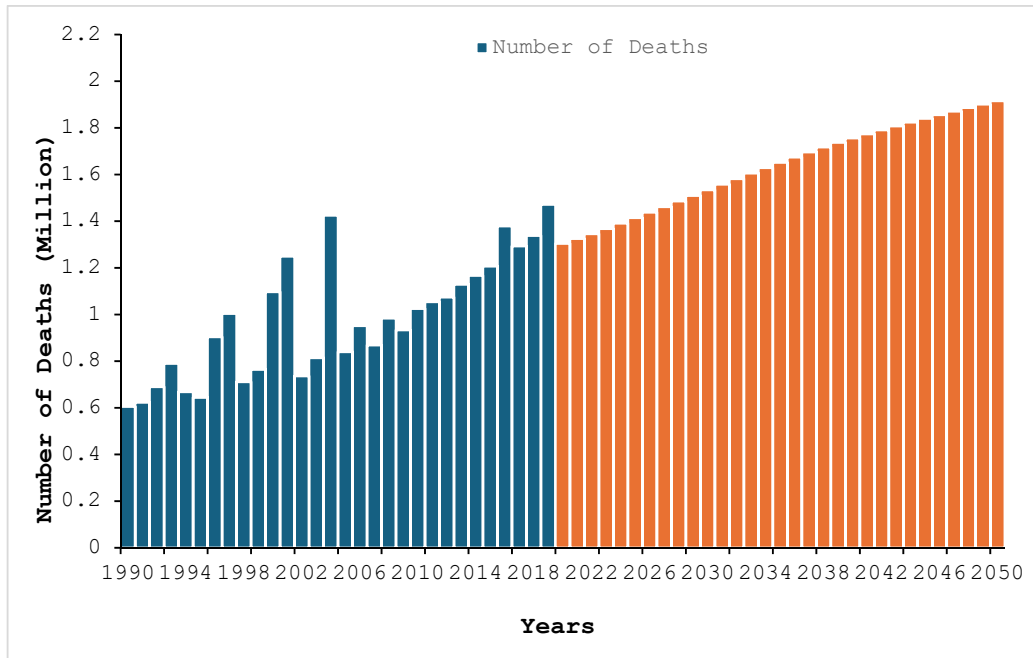
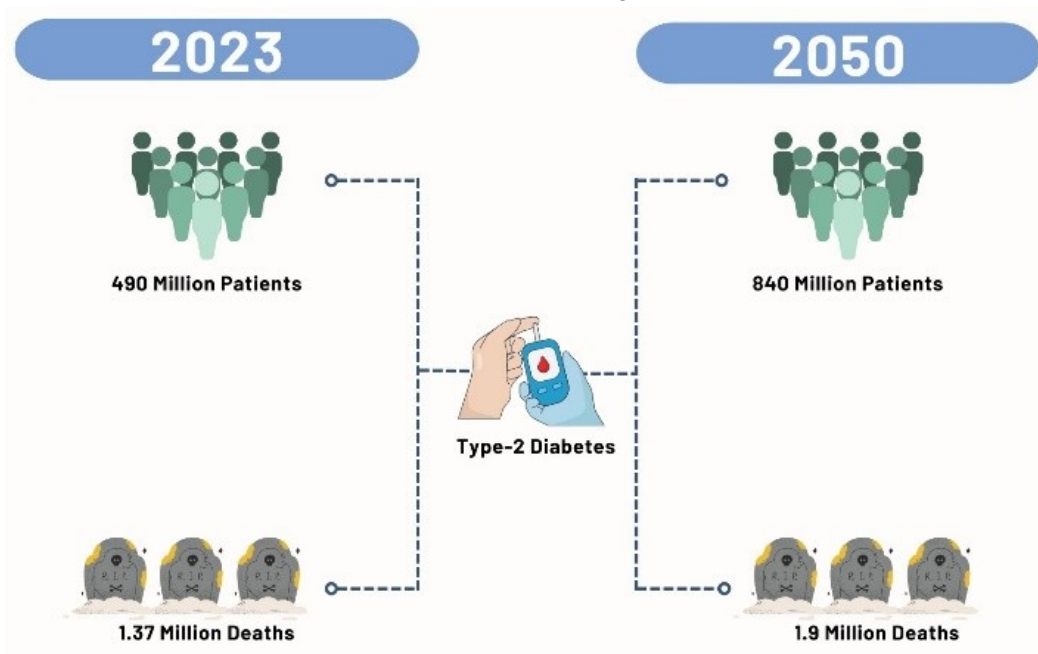


Figure. 7

Global T2DM patients and deaths for adults (>20 years) group in 2023 and 2050



Discussion

This systematic review overviewed the global prevalence & mortality trends of type-2 diabetes from 1990 to 2019 in different age groups.

Additionally, the prevalence and mortality data were forecasted from 2020 to 2050 to analyse its future trends. The previous studies have used a linear regression model to calculate the future trends of type-2 diabetes but it may provide inconsistent results when the data is sparse or missing (Ye et al., [2023](#)). In this study, we used forecast exponential smoothening (ETS) model as it can fill missing points with interpolation and detect seasonality automatically.

We found that the global prevalence and mortality rate of type-2 diabetes is growing at a concerning rate. The upsurge in global prevalence is due to different risk factors. Approximately 90% of patients with T2DM are obese or overweight (Whitmore, [2010](#)). High BMI or BMI >25 could be the primary contributing factor to the rise in the frequency of T2DM (Ng et al., 2014; Topór-M dry, [2017](#)). From 1990 to 2023 and 2050, the global prevalence rate is higher in adults (>20 years) as compared to all ages group. It's because due to the fact that T2DM is more common in adults especially older adults than children and adolescents (Bellary et al., [2021](#)).

However, the mortality (number of deaths) difference between these age groups is not very significant. In 2050, the estimated number of deaths for all ages group and adult group would be 2.05 million and 1.9 million respectively. The deaths figures are more common in adults (>20 years) as compared to children or adolescents because the old adults have more underlying

diseases, polypharmacy and hyperglycaemic episodes resulting in death (Remelli et al., [2022](#)).

In addition, previous studies reported that SARS-CoV-2 (COVID-19 virus) may damage the beta-cells of the pancreas resulting in hyperglycaemia and insulin resistance (Müller et al., [2021](#); Starling, [2021](#)). Another study reported that the patients of COVID-19 are more vulnerable to the incidence of T2DM than other upper respiratory tract infection patients (Rathmann et al., [2022](#)). So, the prevalence and mortality of type-2 diabetes may be even higher in the future than our forecasted estimates.

Conclusion

The trajectory of T2DM prevalence and mortality is concerning as its continuously rising. Urgent and aggressive action is required at the international and national levels to start diabetes prevention programs with continuous monitoring and evaluation. Healthcare organisations and healthcare professionals (doctors, pharmacists, nurses, dieticians, and diabetes educators) should be funded and trained as they can educate and take care of people in local communities. The collaboration between researchers, clinicians, diabetes specialists, community and policymakers should be encouraged for optimal health policy and planning. Without these interventions, the burden of T2DM continues to escalate, posing a serious threat to healthcare systems globally.

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