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EPIDEMIOLOGY OF TYPE 2 DIABETES MELLITUS IN ADULTS AGED 40 YEARS AND OLDER: PREVALENCE, DEMOGRAPHIC CHARACTERISTICS, AND REGIONAL DIFFERENCES

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Abstract:

Type 2 diabetes mellitus (T2DM) has emerged over the past decades as one of the most pressing non-communicable diseases confronting global health systems. Population aging, rapid urbanization, lifestyle transitions, and unhealthy dietary patterns have been identified as the primary drivers of the increasing disease burden. This study provides a systematic analysis of the epidemiological characteristics of T2DM among individuals aged 40 years and older, focusing on demographic and regional disparities as well as the key biological and behavioral factors contributing to disease development.

The findings indicate that, in low- and middle-income countries, the existing scientific evidence supporting preventive and therapeutic interventions for T2DM remains limited. Most available studies are short-term in nature and lack sufficient methodological rigor. In particular, the evidence base is inadequate to draw reliable conclusions regarding the long-term effects of nutritional therapies and behavior-based interventions on sustained glycemic control. Furthermore, women with a history of gestational diabetes exhibit a substantially elevated risk of developing T2DM, while dose-response relationships between body mass

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index, central obesity, and disease risk highlight the distinct epidemiological significance of this population group.

Overall, the results underscore that pharmacological approaches alone are insufficient for effective prevention and management of T2DM. Instead, comprehensive strategies that incorporate individual, genetic, social, and cultural determinants are essential for achieving meaningful and sustainable outcomes.

Keywords: Type 2 diabetes mellitus; epidemiology; metabolic syndrome; prevention; glycemic control.

Introduction

In low- and middle-income countries, the available evidence regarding the impact of nutrition education and other therapeutic interventions on glycemic control among patients with type 2 diabetes mellitus is of very low certainty, which precludes drawing definitive conclusions about their effectiveness. This limitation is further exacerbated by the small number of studies, insufficient long-term follow-up data, and the presence of publication bias. Consequently, given the rapidly increasing burden of type 2 diabetes mellitus in these settings, there is a critical need for context-specific, high-quality, and long-term research, as well as comprehensive efforts to identify effective nutritional therapies [3].

According to data from the International Diabetes Federation, the prevalence of type 2 diabetes mellitus (T2DM) has increased dramatically over the past decade and is projected to reach 783 million people worldwide by 2045. T2DM is associated with genetic predisposition, lifestyle factors, and environmental influences, with unhealthy dietary habits, insufficient physical activity, and obesity identified as the primary modifiable risk factors. Hypertriglyceridemia (HTG), as a component of metabolic syndrome, is closely linked to central obesity, insulin resistance, and pancreatic beta-cell dysfunction, thereby playing a significant role in the development of T2DM. Indices such as the triglyceride-

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to-high-density lipoprotein cholesterol ratio (TG/HDL-C) and the triglyceride-glucose (TyG) index have emerged as promising indicators for predicting T2DM risk. Evidence suggests that HTG and increased waist circumference exhibit dose-response relationships with T2DM risk, and that regular monitoring of these biomarkers, combined with the implementation of lifestyle modification strategies, is effective in preventing the development of T2DM. Future research should focus on validating these indicators across diverse populations and integrating them into clinical guideline frameworks [6].

This study assessed the prevalence of diabetes in Türkiye and evaluated the utilization of healthcare services among individuals living with diabetes using national electronic health records (EHR). The findings indicate that by the end of 2020, 11.12% of the population aged 14 years and older had been registered with a diagnosis of diabetes, with a higher prevalence observed among women compared to men. Individuals with diabetes demonstrated significantly higher frequencies of healthcare facility visits and prescription use than those without diabetes. In addition, approximately one-third of individuals with diabetes remained undiagnosed, the majority of whom were men. This finding highlights the need to strengthen early screening and preventive interventions among men. Overall, the results confirm that large-scale national EHR databases represent a valuable scientific resource for epidemiological surveillance and healthcare system planning [5].

This meta-analysis demonstrated that women who experienced gestational diabetes mellitus (GDM) during pregnancy have a substantially elevated risk of subsequently developing type 2 diabetes mellitus (T2DM). The probability of diabetes onset increases progressively with each passing year, and approximately one-third of affected women develop T2DM within 15 years. A higher body mass index is associated with an increased risk, while a comparatively lower risk has been observed among European White populations. The findings underscore the necessity of regular screening and long-term follow-up for women with a history

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of GDM, as well as the importance of strengthening interventions focused on weight management and the adoption of healthy lifestyle behaviors. These approaches constitute key strategies for the prevention of T2DM and for reducing its overall disease burden [8].

This study evaluated the effectiveness of an intervention delivered by female community health volunteers (FCHVs) among adults with type 2 diabetes mellitus (T2DM) in a semi-urban area of Nepal. A total of 244 participants were enrolled in a cluster-randomized clinical trial conducted across 14 clusters. The intervention group received home visits every four months over a 12-month period, which included counseling on healthy lifestyle practices and glucose monitoring. As a result, the intervention group experienced a mean reduction in fasting blood glucose of 22.86 mg/dL, whereas the control group showed an increase of 7.38 mg/dL. The between-group difference of -27.90 mg/dL was statistically significant ($P < 0.001$). Additionally, systolic blood pressure decreased, and medication adherence improved in the intervention group. In conclusion, simple, low-cost, community-based interventions delivered by FCHVs can substantially improve the management of T2DM in resource-limited settings [1].

Considering the high prevalence of type 2 diabetes mellitus (T2DM) among American Indian populations, this study describes the baseline characteristics of families participating in Together Overcoming Diabetes (TOD), a culturally adapted, intergenerational, home-based preventive intervention. The findings indicate that the mean HbA1c level among adult participants was 7.93%, reflecting suboptimal glycemic control, and that nearly 19% of children were identified with prediabetes or diabetes. These results highlight the familial and intergenerational nature of diabetes risk. The data further underscore the need for interventions aimed at improving dietary and physical activity behaviors, as well as the importance of policy and systemic measures to address the social determinants of health [9].

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The utility of a polygenic score (PS) for type 2 diabetes mellitus (T2DM) in predicting disease risk, in addition to traditional clinical indicators, was evaluated. The results demonstrated that a PS constructed from 293 genetic variants identified in European populations reliably and independently predicted T2DM development in an indigenous population. Incorporation of the PS into prediction models improved accuracy across all three cohorts-adults, adolescents, and birth cohorts-with particularly notable improvements observed in children and birth cohorts. The discriminative power of the PS was comparable to conventional clinical indicators such as HbA1c, and the inclusion of PS in clinical assessments enables early identification of high-risk individuals during childhood. These findings suggest that integrating PS into clinical evaluation may be valuable for the early prevention of T2DM [2].

In the UPDATES study conducted in Saudi Arabia, 561 patients with type 2 diabetes mellitus (T2DM) were treated with insulin degludec over a period of 26–34 weeks. The results demonstrated that degludec significantly reduced HbA1c and fasting plasma glucose levels (by -1.1% and -39.1 mg/dL, respectively), decreased the risk of hypoglycemia, and did not raise new safety or tolerability concerns. The majority of patients expressed a desire to continue treatment (95.5%) and preferred degludec over their previous insulin regimen (93.0%). Epidemiological data from Saudi Arabia between 2016 and 2022 indicate a T2DM prevalence of 28% in the adult population, with a markedly higher risk observed in individuals aged over 40 years. Factors such as sex, smoking, and excess body weight/central obesity were associated with an increased risk of T2DM, although these associations were not statistically significant. Further research, including randomized controlled trials and cohort studies, is warranted to clarify the relationships between these risk factors and T2DM development [4]. This study identified clinical and genetic factors influencing the degree of glucosuria. The results demonstrated that blood glucose levels, estimated glomerular filtration rate (eGFR), sex, and the rs9934336 polymorphism in the

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SLC5A2 gene were independently associated with glucosuria. Furthermore, meta-analysis findings indicated that the rs9934336 A allele was modestly associated with a reduced risk of developing type 2 diabetes mellitus (T2DM). In conclusion, glucosuria is determined not only by glycemic control but also by renal function and genetic factors, underscoring the importance of individualized clinical approaches in the management of diabetes [10].

The prevalence of prediabetes and type 2 diabetes mellitus (T2DM) was assessed in the general population of Malaysia. The findings indicated high prevalence rates of diabetes (14.39%) and prediabetes (11.62%), representing a significant epidemiological burden for the country's healthcare system. Notably, substantial differences were observed among ethnic groups, with the highest diabetes prevalence reported among individuals of Indian ethnicity, followed by Malays and Chinese. Meta-regression analyses revealed a significant association between diabetes prevalence, the passage of time, and increasing age, suggesting a further rise in the diabetes burden in the context of population aging and ongoing urbanization. The high degree of heterogeneity among studies ($I^2 > 98\%$) necessitates cautious interpretation of the results; however, the absence of publication bias partially supports the reliability of the findings. Although the quality of evidence was rated as low based on the GRADE system, this meta-analysis confirms the widespread prevalence of diabetes and prediabetes in Malaysia. These findings underscore the urgent need to develop and implement comprehensive national strategies aimed at diabetes prevention, early detection, awareness promotion, and effective management [12].

Studies have shown that individuals living with type 1 and type 2 diabetes mellitus (T1DM and T2DM) have significantly shorter life expectancy compared to the non-diabetic population. The greatest loss of life expectancy is observed in individuals with T1DM, who experience the most pronounced reductions not only in overall lifespan but also in potential years of life lost. While life expectancy among individuals with T2DM is relatively higher, it remains substantially lower

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than that of healthy populations. Furthermore, the analysis indicates that disparities in life expectancy persist across sex and geographic regions. Although some modest improvements have been observed over time, current measures are insufficient to fully eliminate these differences. Therefore, there is a critical need to strengthen effective preventive, clinical, and public health policy interventions aimed at reducing diabetes-related mortality and life years lost [14].

Diabetes mellitus is an increasingly serious global health concern, often associated with severe complications. Given the growing recognition of the importance of behavioral interventions in the prevention and management of this disease among adults, this study aimed to evaluate the effectiveness of behavior-based programs in reducing and managing diabetes within adult populations. The findings indicate that behavioral interventions are effective in improving glycemic control and preventing the development of type 2 diabetes mellitus (T2DM) among adults. In particular, diet-focused and culturally adapted programs resulted in significant reductions in HbA1c levels, whereas cognitive-behavioral and technology-based approaches demonstrated clinically meaningful, albeit relatively smaller, effects. These results underscore the necessity of implementing behavioral interventions alongside pharmacological treatment in diabetes prevention and management and highlight the importance of integrating such programs into healthcare systems [17].

The analysis indicated a high prevalence of diabetes-related distress (DRD) among adults living with type 2 diabetes mellitus (T2DM) in Africa. Emotional burden was identified as the primary component of DRD, with patients' psychological well-being significantly affecting effective diabetes management. The presence of diabetes-related complications and insufficient physical activity were associated with an increased risk of DRD, whereas being married appeared to confer a modest protective effect. These findings highlight the necessity of viewing diabetes not solely as a metabolic disorder but also as a condition closely linked with psychosocial challenges, and underscore the importance of

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implementing integrated, patient-centered, and culturally adapted approaches within African healthcare systems [15].

The risk of developing type 2 diabetes mellitus (T2DM) increases in women experiencing early or late menopause. Women with early menopause exhibit a higher risk of T2DM, whereas late menopause may be associated with a modestly elevated risk. These findings underscore the need to consider age at menopause as a potential risk factor for T2DM and highlight the necessity for further research to elucidate the underlying mechanisms and to develop targeted preventive strategies. In clinical practice, healthcare providers should incorporate this association when assessing and managing T2DM risk in women [16].

Type 2 diabetes mellitus (T2DM) is one of the leading non-communicable diseases worldwide, contributing to increased morbidity and mortality. In Nigeria, its prevalence is associated with various risk factors. This review evaluates the national and regional prevalence of T2DM in Nigeria and examines the associated risk factors. The prevalence of T2DM in Nigeria is estimated at 7.0%, nearly double the 2019 International Diabetes Federation (IDF) estimate of 3.7% and representing a 21.3% increase compared to the 2019 review. These findings underscore the need to strengthen preventive measures aimed at mitigating identified risk factors. Key risk factors include genetic predisposition, physical inactivity, and obesity, which, if addressed, may substantially reduce the diabetes burden [11].

Lifestyle interventions aimed at preventing type 2 diabetes mellitus (T2DM) among South Asian populations have generally produced only modest improvements in weight and glycemic control, potentially limiting their overall effectiveness. Studies that combined lifestyle counseling with structured physical activity programs demonstrated slightly more favorable outcomes. Therefore, alternative lifestyle interventions that are co-designed with community members and incorporate as much personalized guidance as possible should be explored to reduce diabetes risk within these ethnic groups [13].

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Meat consumption may increase the risk of developing type 2 diabetes mellitus (T2DM). Previous evidence has primarily been based on populations in Europe and North America, with varying analytical approaches and a greater focus on red meat than on poultry intake. This study evaluated the association between the consumption of unprocessed red meat, processed meat, and poultry and the risk of T2DM using a standardized analytical approach across global cohorts. Meat consumption, particularly of processed and unprocessed red meat, was identified as a significant risk factor for T2DM development. These findings highlight the public health importance of reducing meat intake and should inform dietary recommendations [7].

Conclusion:

The conducted analysis reaffirms that type 2 diabetes mellitus (T2DM) represents a steadily increasing global and regional public health challenge. Its widespread prevalence is closely linked not only to metabolic disturbances but also to lifestyle factors, social inequalities, and access to healthcare services. The particularly high prevalence of T2DM among populations aged over 40 underscores the need to prioritize this age group in primary prevention and screening strategies.

The findings further indicate that women with a history of gestational diabetes, individuals with elevated body mass index, and populations exhibiting markers of metabolic syndrome constitute high-risk groups for T2DM development. Accordingly, early detection, regular monitoring, and long-term follow-up-based preventive approaches should be implemented for these populations. The integration of metabolic biomarkers and polygenic scores into clinical practice is critical for early disease identification and individualized risk assessment.

Moreover, the results highlight that effective T2DM management requires a comprehensive approach that extends beyond pharmacological treatment to include dietary modifications, physical activity, behavioral interventions, and

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psychosocial support. Community-based and culturally adapted interventions have demonstrated efficacy in resource-limited settings. Overall, reducing the burden of T2DM necessitates the implementation of integrated, long-term, and evidence-based strategies within healthcare systems.

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