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The Tripple Load of Diabetes: How Diet Consumption, Physical Inactivity, and Unequal Access to Care Shape Global Prevalence

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Abstract

The prevalence rate of diabetes mellitus has been rapidly risen becoming the major public health problem in the world due to complex interactions between diets, lifestyles, environment, and socioeconomic factors. The relevant studies were comprehensively searched through five electronic databases: PubMed, ScienceDirect, MDPI, Scopus, and Web of Science. The findings of the selected relevant studies were analyzed through a narrative synthesis approach to find out the significant trends and associations of dietary sugars, physical inactivity, and unequal access to health care with diabetes prevalence. Based on the findings of the relevant literatures reviewed, the prevalence and incident risk of type 2 diabetes is significantly associated to dietary sugars, physical inactivity, and unequal access to health care. Thus, dietary sugars, physical inactivity, and unequal access to health care have been documented as major risk factors for type 2 diabetes.

Keywords: Diabetes Mellitus, Dietary Sugar, Physical Inactivity, Unequal Care.

INTRODUCTION

Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycemia due to deficiency in insulin secretion and/or insulin action, leading to disturbance of carbohydrate, protein and fat metabolism (WHO, 2022; GDB, 2021). According to International Diabetes Federation report in 2021, the number of people living with diabetes is approximately 536.6 million which is expected to reach 783.2 million by 2045 (Sun *et al.,* 2021). Report showed that the number of people living with diabetes increased from 200 million in 1990 to 830 million in 2022 worldwide (WHO, 2024). This resulted to increase in the prevalence rate of diabetes from 6.8 % in 1990 to 14.1% in 2022 worldwide (WHO, 2024). Low and middle income countries recorded the highest prevalence rate of diabetes than high income countries. In African, the prevalence rate of diabetes has increased from 6.4 % in 1990 to 10.5 % in 2022 (WHO, 2024). In 2022, more than 54 million people were living with diabetes in African region (WHO, 2024). It has been reported that only 26.1 % of people diagnosed with diabetes in Africa receive treatments (WHO, 2024). It has been predicted that diabetes will be the 7th leading cause of death in 2030 (NCD, 2024).

Type 2 diabetes which is due to insufficient insulin secretion and resistance, accounts for over 90 % of all diabetes cases worldwide (Safiri *et al.,* 2022). The prevalence and mortalities due to type 2 diabetes were approximately 437.9 million and 1.5 million, respectively (Safiri *et al.,* 2022). Physical inactivity has been documented as a major modifiable risk factor for type 2 diabetes (ElSayed *et al.,* 2023). In 2016, it was reported that about 27.5 % of the global population demonstrated insufficient physical activity (Guthold *et al.,* 2018). Physical inactivity and diets increase the risk of dying from non-communicable diseases including diabetes (Carbone *et al.,* 2019). Energy and nutrient intake, lifestyle and health systems have changed, shifting the prevalence of diabetes from once being a disease of the rich to become more prevalent in Low and Middle Income Countries (Zheng *et al.,* 2018). The onset of type 2 diabetes can be treated or prevented by medications, through consumption of nutrients rich diet, and regular physical activity. Diabetes if remains untreated can leads to blindness, kidney failure, heart attacks, stroke and lower limb amputation (GDB, 2021).

The comprehensive and systematic review on how sugar inactivity and unequal access shape global prevalence of diabetes will significantly help for management and control of diabetes mellitus and its complications. This review paper helps to understand the associations between the diet, physical inactivity, and etiology of diabetes mellitus. This review aims at consolidating and reviewing the evidence on the overall effect of high sugar consumption, physical inactivity, and care disparities on the global prevalence of diabetes mellitus. The study extracts global epidemiological data to examine changes in burden of diabetes mellitus attributable to diet and physical inactivity from 2016 – 2024.

METHODOLOGY

Study Design

This systematic review was designed to explore and document the evidence on the association between excessive sugar consumption, physical inactivity, lack of access to quality healthcare and prevalence of diabetes according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.

Data Source

The relevant literatures were comprehensively searched through five electronic databases: PubMed, ScienceDirect, MDPI, Scopus, and Web of Science. The methodology involves identification of multiple relevant data sources on the effect of diet and physical inactivity on diabetes mellitus globally from 1990 to 2019, by country, study design, and sample size. The data were identified through systematic reviews of published studies, government/organizational websites, reports, and GBD collaborator datasets.

Search Strategy

Experimental, qualitative, and observational studies were the scope of this systematic review paper. The internet search for this review included relevant keywords and phrases such as diabetes prevalence, sugar intake and diabetes, physical activity and diabetes, and health inequalities, and diabetes among others. The Boolean terms AND and OR were used to enhance the specificity of the search.

Inclusion Criteria

The relevant studies published from 2000 to 2026 were used in this review paper. The focus was on type 2 diabetes mellitus. The literatures used analysed consumption of sugar and/or lack of physical activity. Healthcare, meta-analysis, systematic reviews, and observational studies were included. The literatures include regional or worldwide researches.

Exclusion Criteria

Commentaries and case studies; articles published in other languages than the English; unclearly reported methodology or insufficient data; irrelevant findings were not used.

Data Analysis

The findings of the selected relevant studies were analyzed through a narrative synthesis approach to find out the significant trends and associations of dietary sugars, physical inactivity, and unequal access to health care with diabetes prevalence.

RESULTS

Study Selection (PRISMA)

A total of 4,512 records were identified from the PubMed, ScienceDirect, MDPI, Scopus, and Web of Science databases. A total of 3689 records were screened after removing the duplicates records (823). At screening 3,545 records were excluded resulting to 144 records for retrieval and eligibility assessment. After the assessment, records with wrong intervention (38), wrong study design (45), and wrong outcome (34) were detected resulting to a total of 27 records included in the review. The extracted data include authors, year of publication, study site, study design, sample size, and key findings.

Characteristics of Included Studies

Table 1: Characteristics of the included studies (N = 27)

ID	Author	Year	Country	Study Design	Sample size	Key findings
SO1	Imamura *et al.*,	2016	USA	Meta analysis	17 cohorts	SSB intake increases diabetes risk
SO2	Hu *et al.*,	2016	Global	Cohort	80000	Diet strongly linked to T2DM
SO3	Ding *et al.*,	2016	Global	Systematic review	Multiple	Physical inactivity is a key risk factor
SO4	Afshun *et al.*,	2017	Global	Systematic analysis	195 countries	Poor diet contribute to diabetes burden
SO5	Cho *et al.*,	2018	Global	Cross sectioninal	Global	Rising global diabetes prevalence
SO6	Zheng *et al.*,	2018	Global	Review	Multi data set	Lifestyle factors drive diabetes
SO7	Pattern *et al.*,	2018	Global	Cohort	63,000+	Sedentary behaviour
SO8	Malik *et al.*,	2019	Global	Review	Multiple	Sugary beverages increase diabetes risk
SO9	Saeedi *et al.*,	2019	Global	Epidemiological	Global	Diabetes prevalence rising worldwide
SO10	GBD study	2019	Global	Epidemiological	Global	Life style factors major contributors

SO11	Jayed *et al*.,	2020	Global	Meta analysis	Multiple	Sugar intake linked to T2DM
SO12	Alhanawi *et al*.,	2020	Saudi Arabia	Cross sectional	10,000+	Socio-economic inequality linked to diabetes prevalence
SO13	Khan *et al*.,	2021	Global	Systematic review	Multiple studies	Urbanization and life style changes increases risk of diabetes.
SO14	Lee *et al*.,	2021	South korea	Cohort	120,000+	Sydentry life style increases incidence
SO15	Brown *et al*.,	2021	USA	Cross sectionsl	15,000+	Diet and inactivity linked to diabetes
SO16	WHO Report	2022	Global	Global	Global data	Inequality in healthcare access worsen diabetes
SO17	Zhang *et al*.,	2022	China	Cohort study	100,000	Physical inactivity significantly associated with diabetes incidence
SO18	Gracia *et al*.,	2020	Spain	Cross sectional	8000+	Diet quality affect diabetes risk
SO19	Ahmed *et al*.,	2022	Nigeria	Cross sectional	5000+	Poor healthcare access increases burden
SO20	GBD Study	2023	Global	Epidemiological study	Global	Diabetes burden increasing in LMICs
SO21	Osei *et al*.,	2023	Ghana	Cross sectional	4500+	Urban life style linked to diabetes
SO22	Kumar *et al*.,	2023	India	Cohort	70,000+	Physical inactivity increases risk
SO23	Silva *et al*.,	2023	Brazil	Cross sectional	9000+	Socio economic factors influence diabetes
SO24	O'Connor *et al*.,	2024	Global	Systematic review	Multiple	Combined lifestyle factors increase diabetes risk
SO25	Hassan *et al*.,	2024	Egypt	Cross-sectional	6,000+	Poor access delays diagnosis
SO26	Wang *et al*.,	2024	Chins	Cohort	110,000	Sugar intake increases diabetes intake
SO27	Johnson *et al*.,	2024	USA	Cohort	9	

DISCUSSION

The results for the current review were derived from systematic reviews and meta-analyses of observational as well as intervention studies, which provide the highest scientific evidence. These results are further supported by systematic reviews and meta-analyses of prospective cohort studies, which showed no association of total sugars and fructose but a small inverse association of sucrose intake (50–78g/d) with T2DM incidence. High sugar consumption, physical inactivity, and unequal access to care remain the major consequences in global diabetes, with high prevalence. Report showed that 240 million individuals live with undiagnosed diabetes, with almost half of all adults with diabetes were unaware of the disease worldwide (Magliano and Boyko, 2021). It is estimated that 537 million (10.5%) individuals (those aged 20–79 years) worldwide are currently on treatment of diabetes (Magliano and Boyko, 2021; Laraeni *et al.,* 2021). In 2021, about 537 million people are living with diabetes, making up 10.5 % of the global population (Magliano and Boyko, 2021). It is predicted that the prevalence of diabetes will increase to 643 million (11.3%) by 2030 and 783 million (12.2%) by 2045 (Magliano and Boyko, 2021; Ong *et al.,* 2023).

Association between Dietary Load and Diabetes Mellitus

Dietary sugars are sugars consisting of monosaccharides and disaccharides added to foods during processing and preparation or naturally present in foods such as honey, syrups, and fruit juices (Fidler *et al.,* 2017). Dietary sugars have been shown to increase the risk of diabetes. High sugar and unhealthy diets including sugar-sweetened beverages are the major contributors to Type 2 diabetes. Studies showed that 13 – 30 % of Type 2 diabetes cases are linked to consumption of sugary drinks. Dietary sugars have been documented to induce a stronger postprandial glycemic response resulting to increase insulin secretion (Meike *et al.,* 2022). Study showed that glucose and maltose cause a rapid increase in postprandial glycemia which is significant risk factor for the development of type 2 diabetes (Zeevi *et al.,* 2015; Foster-Powell *et al.,* 2002). Research also indicated that sucrose and fructose have a medium to low glycemic index due to which contribute less to high blood glucose (Foster-Powell *et al.,* 2002). However, it has been reported that consumption of sugar-sweetened beverages was associated with high incidence of type 2 diabetes (Imamura *et al.,* 2015).

Association between Physical Inactivity and Diabetes Mellitus

The number of deaths due to type 2 diabetes associated with physical inactivity has been increased worldwide. The association between physical inactivity and type 2 diabetes has been reported in many studies. Physical activity prevents type 2 diabetes through many physiological and biochemical processes (Medina-Contreras *et al.,* 2017; Narendran *et al.,* 2015). Physical activity can increase the uptake of skeletal muscle

glucose to reduce blood sugar levels (Piercy *et al.,* 2018). It also enhances the release of adiponectin from adipose tissue, improving insulin sensitivity and mitigating insulin resistance (ElSayed *et al.,* 2023b). Regular physical activity aids weight control, reduces abdominal adiposity, and improves insulin sensitivity, decreasing the risk of type 2 diabetes (ElSayed *et al.,* 2023b). According to World Health Organization, regular physical activity is recommended for at least 30 minutes in a day to combat diabetic trend. However, physical activity for at least 150 minutes per week has been recommended for individuals with type 2 diabetes (Mendes *et al.,* 2016). Several researches have shown that physical inactivity is notably higher among illiterate and lower income individuals (Gupta *et al.,* 2012). Study showed that workers with low level of education were found to have approximately eight times less physical activity compared to the highly educated workers (Reddy *et al.,* 2007). Individuals with higher socioeconomic status engage more in leisure time physical activities than those with lower socioeconomic backgrounds due to lack of resources for such activities (Stalsberg *et al.,* 2018).

Association between Unequal Access to Care and Diabetes Mellitus

Inadequate access to conventional treatment remains a major barrier in low-income countries. Access to healthcare services remains unequal, influencing timely interventions and significant health outcomes (Al-Rubeaan *et al.,* 2015). Access to health services by individuals with diabetes is affected by income, socioeconomic conditions, and overall health status (Krishnan and Nagarajan, 2021). Study revealed that diabetic patients with lower education and income levels experience reduced access to care, preventive services, and effective diabetes management (Ali *et al.,* 2016). Socioeconomic inequality in access to healthcare among diabetic patients has been observed in England (Barnard *et al.,* 2020). Study in Tehran indicated that utilization of health services is more concentrated among privileged groups indicating socioeconomic inequality in outpatient health services (Tapager *et al.,* 2022; SetarehForozan *et al.,* 2019). Mulyanto *et al*., (2019) found socioeconomic inequality in the utilization of pharmaceutical and outpatient services in Indonesia. Unequal access to health care services may increase the risk of diabetes complications (Gesuita *et al.,* 2018).

CONCLUSION

Based on the findings of the relevant studies reviewed, the prevalence and incident risk of type 2 diabetes is significantly associated to dietary sugars, physical inactivity, and unequal access to health care. High physical inactivity has substantially increase burden of diabetes mellitus worldwide. Thus, dietary sugars, physical inactivity, and unequal access to health care have been documented as major risk factors for type 2 diabetes.

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