November 2023

TOBACCO AND DIABETES

- *Type 2 diabetes is a major causal factor for severe health conditions, such as blindness, kidney failure, heart attacks, stroke and lower-limb amputation. Quitting tobacco use is a crucial step in reducing the risk of experiencing these health complications.*
- *Quitting smoking lowers the risk of developing type 2 diabetes by 30–40% and improves the management of this chronic condition. Over 95% of diabetes cases are of this type.*
- *Tobacco use substantially elevates the risks of developing cardiovascular disease, which is a critical complication for people with type 2 diabetes.*
- *Smoking worsens diabetic neuropathy and foot ulcers and delays wound healing. Quitting smoking decreases the person's risk of such complications, leading to better long-term health outcomes.*
- *Smoking damages retinal blood vessels, increasing the risk of diabetic retinopathy and vision loss in people with type 2 diabetes. Quitting tobacco helps protect your eyesight and reduces the risk of these complications.*
- *Tobacco use and exposure to second-hand smoke can bring on the onset of type 2 diabetes at earlier age. Governments should protect their populations by making all indoor public places smoke-free.*

What is diabetes?

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces *(1)*. Insulin is a hormone that regulates blood glucose *(1)*. Hyperglycaemia, also called raised blood glucose or raised blood sugar, is a common effect of uncontrolled diabetes and, over time, leads to serious damage to many of the body's systems, especially the nerves and blood vessels *(1)*. Type 2 diabetes affects how your body uses sugar (glucose) for energy. It stops the body from using insulin properly, which can lead to high levels of blood sugar if not treated. Type 2 diabetes is largely preventable and, in some cases, potentially reversible, if identified and managed early in the disease course *(2)*. Type 1 diabetes is characterized by deficient insulin production and requires daily administration of insulin. Gestational diabetes is hyperglycaemia with blood glucose values above normal but below those diagnostic of diabetes. Gestational diabetes occurs during pregnancy. Other forms of diabetes also exist *(1,2)*. More than 95% of people with diabetes have type 2 diabetes and this type will therefore be the predominant focus of this report *(1,2)*.

Tobacco definitions

Smoked tobacco products: any product made or derived from tobacco which generates smoke. Examples include manufactured cigarettes, roll-your-own tobacco, cigars, shisha (also known as waterpipe), kreteks and bidis.

Second-hand smoke (SHS): the smoke emitted from the burning end of a cigarette or other tobacco products, usually in combination with the smoke exhaled by the smoker. The terms "passive smoking" or "involuntary smoking" are also often used to describe exposure to SHS.

Smokeless tobacco: any product that consists of cut, ground, powdered or other tobacco that is intended to be placed in the oral or nasal cavity. Examples include snuff, chewing tobacco, gutka, mishri and snus.

Electronic nicotine delivery system (ENDS) (also known as e-cigarette): a device that heats a liquid to create an aerosol that is inhaled by the user, which typically contains nicotine and toxic substances that are harmful to both users and non-users who are exposed to the aerosols second-hand; the liquid is often flavoured.

Heated tobacco products (HTPs): tobacco products that produce aerosols containing nicotine and toxic chemicals when tobacco is heated or when a device containing tobacco is activated. These aerosols are inhaled by users during a process of sucking or smoking involving a device. They contain the highly addictive substance nicotine, as well as non-tobacco additives, and are often flavoured.

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Health impact of type 2 diabetes

Diabetes is one of the four major types of noncommunicable diseases and the ninth leading cause of death globally *(3)*. The International Diabetes Federation (IDF) estimates that 537 million people had diabetes in 2021, a number that is projected to continue to increase in the coming years *(1,4)*. The risk of developing type 2 diabetes, like that of many other chronic health conditions, is linked to personal and environmental factors, but also has links to risk factors such as tobacco use, unhealthy diet and physical inactivity *(2)*. Particularly noteworthy is that 58.9 million diabetes-related disability-adjusted life-years (DALYs), or 76.5% of DALYs associated with type 2 diabetes, were attributed to various risk factors, with tobacco use accounting for 12.1% of them *(2)*. It is crucial to recognize that type 2 diabetes is a major causal factor for several debilitating conditions, including blindness, kidney failure, heart attacks, stroke and lower-limb amputation *(1)*.

WHO definition: disability-adjusted life-years

One DALY represents the loss of the equivalent of one year of full health. DALYs for a disease or health condition are the sum of the years of life lost to due to premature mortality (YLLs) and the years lived with a disability (YLDs) due to prevalent cases of the disease or health condition in a population.

Source: (5)

Pathophysiology of tobacco use and the development of type 2 diabetes

Pancreatic β cells (beta cells) are found in the pancreas and are responsible for the synthesis and secretion of insulin *(6)*. There is a steadily growing amount of evidence from clinical and epidemiological studies highlighting the role of tobacco in the development and exacerbation of type 2 diabetes and diabetes-related health complications *(7,8)*. Extensive evidence indicates that smoking cigarettes significantly raises the risk of developing type 2 diabetes – by 30–40% compared with individuals who do not smoke *(7)*. Research indicates that nicotine, one of the highly toxic components of tobacco smoke, impairs the function and mass of β cells *(6,9)*, which in turn affects the production of insulin and the regulation of glucose production, playing an important role in the onset of type 2 diabetes *(6)*. Evidence suggests that nicotine induces insulin resistance through activation of oxidative stress *(10,11)*. Acute impairment in glucose tolerance and increased insulin resistance have been observed in both non-smokers and smokers following the consumption of three cigarettes *(10)*.

Tobacco smoking and type 2 diabetes-related complications

Smoking intensity (defined as the number of cigarettes/day) and smoking modality (i.e. active or exposed to second-hand smoke (SHS)) plays a role in the risk of developing diabetes-related health complications. Tobacco use is a significant risk factor for cardiovascular disease, which is a crucial complication of type 2 diabetes, is linked to the early onset of microvascular complications and may aggravate complications due to type 2 diabetes *(7)*.

Nephropathy is another severe complication and a major cause of end-stage renal failure. Tobacco use has been confirmed as an independent risk factor for the onset and progression of diabetic nephropathy and kidney failure in people with type 2 diabetes *(12)*.

Tobacco use can contribute to nerve damage, leading to diabetic neuropathy *(13)*. It can also result in poor blood circulation and nerve damage in the feet, increasing the risk of foot ulcers, infections and, in severe cases, amputations *(14)*. Both tobacco use and type 2 diabetes can negatively impact oral health and impair the body's ability to heal wounds. When combined, they can significantly delay the healing process, thereby increasing the risk of infections and other complications *(14,15)*. Furthermore, smoking can damage the blood vessels in the retina, potentially leading to diabetic retinopathy and thereby causing vision loss in people with type 2 diabetes *(14,16)*.

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SHS and type 2 diabetes

There are more than 7000 chemical components of tobacco smoke, of which at least 69 are known to cause cancer and hundreds are harmful to health even to those who are not actively smoking *(17,18)*. Approximately 1.3 million of the over 8.7 million tobacco deaths each year *(18,19)* are attributed to SHS *(20)*, also known as passive smoking or exposure to environmental tobacco smoke. Various systematic reviews show a significant association between exposure to SHS and increased risk of type 2 diabetes *(20,21,22,23)*. Many of the complications associated with type 2 diabetes have also been found to develop via the inhalation of SHS *(22,23)*.

Smokeless tobacco and type 2 diabetes

There is evidence to suggest that heavy use or high consumption of smokeless tobacco increases the risk of developing type 2 diabetes *(24,25,26)*. This is consistent with the fact that smokeless tobacco use leads to nicotine addiction *(27,28)*, and nicotine included in smokeless tobacco contributes to the development of type 2 diabetes and allied health conditions.

New and emerging nicotine and tobacco products and type 2 diabetes

Electronic nicotine delivery systems: despite the limited available evidence, research indicates that e-cigarette use is associated with enhanced glucose intolerance and an elevated risk of developing type 2 diabetes *(29,30)*.

Heated tobacco products: owing to their novelty, research surrounding these products and type 2 diabetes is still emerging, however early studies suggest that they increase the risk of type 2 diabetes *(31)*. Studies of second-hand emissions from heated tobacco products suggest that they expose both users and bystanders to some of the same chemicals found in cigarette smoke, although at lower levels for bystanders *(32)*. Given that SHS might have implications on effective glycaemic control *(31)*, it is necessary to further investigate the effects of SHS and heated tobacco products on type 2 diabetes *(32)*.

Smoking cessation and type 2 diabetes

There has been ample research on the impact of smoking cessation on type 2 diabetes and its complications. Overall, research has found that smoking cessation is associated with a reduced risk of cardiovascular disease and mortality among smokers with type 2 diabetes, and also reduces the long-term risk of developing type 2 diabetes in the first place, despite a short-term weight gain *(33,34)*. Health benefits increase with longer duration of quitting *(35)*.

Impact of selected tobacco control interventions on type 2 diabetes

Limited literature exists on the effectiveness of tobacco control interventions and smoking cessation methods for people with type 2 diabetes. However, a systematic review of six studies found some promising outcomes. Interventions for people with type 2 diabetes lasting 1–5 months involving an educational component (pharmacist-led behavioural and pharmacological support) demonstrated strong evidence for positive effects on quitting tobacco use *(35)*. The involvement of pharmacists in delivering smoking cessation interventions within a health-care setting also appeared beneficial *(36)*. This aligns with the recommendation of the United States National Diabetes Education Program *(36)*, which emphasizes interdisciplinary collaboration among health-care professionals to implement evidence-based strategies for behaviour change in diabetes management *(36)*.

Despite limited data, it is important for people with type 2 diabetes to avoid tobacco use as part of their diabetes management. Qualitative research undertaken among smokers with type 2 diabetes has revealed that misconceptions surrounding smoking cessation, including concerns about post-cessation weight gain, the influence of smoking peers and

the psychological aspect of addiction, have resulted in negative attitudes towards smoking cessation. These findings strongly emphasize the imperative for comprehensive, personalized interventions, encompassing both behavioural and pharmacological interventions, to increase the success rates of smoking cessation *(37)*.

Research indicates a notable increase in the risk of suboptimal glycaemic control among tobacco users, emphasizing the positive impact of tobacco cessation on glycaemic management. Raising awareness is paramount in educating people with type 2 diabetes about the gravity and ramifications of smoking, particularly its adverse effects on their glycaemic status *(38,39)*. The World Health Organization (WHO) HEARTS-D programme emphasizes this recommendation *(40)*. While specific guidelines for smoking cessation in this population are lacking, the observation of general principles based on patient motivation, behavioural interventions and pharmacological treatments is advised. These interventions should be at least as intensive as those for the general population, while considering the unique characteristics of the disease and the individual *(41)*.

Population-level and health systems interventions

Population-level interventions to combat tobacco-linked diabetes morbidity are essential. WHO offers tools for the implementation of the WHO Framework Convention on Tobacco Control (WHO FCTC) through the MPOWER measures to reduce the demand for tobacco *(42,43)*, and the Global Diabetes Compact, which will invest in training of health-care workers in diabetes prevention and management and promote better integration of diabetes care at primary health care level. WHO tracks the status of the MPOWER demand reduction measures in the biennial WHO report on the global tobacco epidemic *(18,44)*. In 2017, the World Health Assembly also endorsed a set of WHO "best buys" and other recommended interventions for governments to implement for the prevention and control of noncommunicable diseases *(45)*. These "best buys" have recently been updated and include seven tobacco control interventions in total, which highlight the association between tobacco use and the elevated risk of developing type 2 diabetes *(46)*. The implementation of effective tobacco control measures is proven to reduce tobacco use as well as tobacco use related morbidity and mortality *(42)*. Reducing tobacco use will help in achieving not only Global Diabetes Compact targets, but also United Nations Sustainable Development Goal 3.4 (to reduce premature mortality from noncommunicable diseases by one third through prevention, treatment and promotion of mental health and well-being by 2030). Preventing type 2 diabetes morbidity and mortality linked to tobacco use requires a comprehensive, multisectoral approach. Health-care providers and organizations should raise awareness about the harm caused by tobacco use and exposure to SHS in relation to type 2 diabetes, as well as the benefits of quitting tobacco.

WHO recommends the following population-level and pharmacological interventions to ensure access to comprehensive cessation support:

- **brief advice:** advice on how to stop using tobacco, usually taking only a few minutes, and given to all tobacco users during the course of a routine consultation or interaction with a health professional *(44)*;
- **toll-free quit lines:** a telephone counselling service that can provide both proactive and reactive telephone counselling *(47)*;
- **mCessation and chatbots:** a two-way messaging system based on the mCessation content library, which guides tobacco users through a six-month text message quit-support programme; WHO has also developed chatbots in partnership with WhatsApp, WeChat and Viber to give tobacco users the best advice on how to quit tobacco *(48)*; and
- **pharmacological interventions:** nicotine replacement therapy, bupropion and varenicline should be provided to all tobacco users who want to quit *(41,49)*.

Further links

- WHO FCTC *(43)*
- WHO No Tobacco Unit (TFI) *(50)*
- MPOWER *(42)*
- Global Diabetes Compact *(51)*
- WHO quitting toolkit *(48)*

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Authors

Rebekka Aarsand, Bianca Hemmingsen, Leah Soweid, Simone St Claire, Edouard Tursan D'Espaignet, Frank Hu, Kerstin Schotte, Dongbo Fu, Ranti Fayokun, Vinayak M Prasad, Beatriz Yáñez Jiménez, Philip Riley

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Contributor to development and review: Miyuki Hasegawa[1]

[1] Intern, WHO Prevention of Noncommunicable Diseases Department

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