



The Influence of Physical Activity, Smoking Habits on Prediabetes and Diabetes at Age 18-24 Years

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective and Background: Diabetes mellitus is a chronic degenerative metabolic disorder characterized by elevated blood glucose levels (hyperglycemia) due to impairments in insulin secretion, insulin action, or both. The prevalence of diabetes mellitus is increasing globally, and modifiable risk factors such as physical activity and smoking are known to contribute to its development. While physical activity is recognized as a protective factor against diabetes, smoking has been identified as a risk factor that may interfere with glucose metabolism, possibly through mechanisms involving oxidative stress and the activation of the sympathetic nervous system. This study aimed to explore the association between physical activity and smoking habits with the risk of diabetes mellitus among individuals aged 18-24 years.

Methods: This descriptive quantitative analysis used secondary data to examine the relationship between physical activity, smoking habits, and the risk of diabetes mellitus. Data were collected

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from a sample of individuals aged 18-24 years to assess their physical activity levels and smoking behaviors.

Results: The analysis revealed no significant evidence of an association between physical activity habits, smoking habits, and the risk of developing diabetes mellitus in individuals aged 18-24 years. These findings suggest that, within this age group, neither physical activity nor smoking were found to have a measurable impact on the risk of diabetes mellitus based on the data analyzed.

Keywords: Diabetes mellitus; physical activity; smoking; diabetes risk; young adults-18-24 years

1. INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic condition characterized by elevated blood glucose levels caused by disruptions in insulin production, function, or both. Insulin, a vital hormone, regulates blood sugar by enabling the body to utilize glucose as a source of energy (Shi et al. 2013). In diabetes mellitus, impaired insulin function results in the accumulation of Blood glucose levels, which, if not properly managed, May lead to severe complications affecting the kidneys, eyes, nerves, and blood vessels (Nanjar et al. 2023). Diabetes is primarily categorized into two types: Type 1 Diabetes Mellitus and Type 2 Diabetes Mellitus. 2. DM type 1 occurs from autoimmune damage to insulin-producing cells in the pancreas, requiring external insulin intake throughout life. Diabetes Mellitus type 2 occurs due to insulin resistance, so the body cannot respond to insulin effectively, related to routine factors such as excess weight, Insufficient physical activity, and poor diet (Ciarambino et al. 2022).

According to data from the World Health Organization (WHO), approximately 422 million people worldwide are affected by diabetes., with the prevalence rate continuing to increase (Walicka et al. 2024). Most cases are type 2 diabetes, the majority of which can be prevented through lifestyle modifications, including adopting a healthy diet., regular exercise, and avoiding cigarettes. Diabetes causes health risks and contributes to around 1.5 million deaths per year (Walicka et al. 2024, Ismail et al. 2021).

Smoking is the activity of burning tobacco that has been processed into cigarettes, where the smoke produced will be inhaled. Meanwhile, a smoker is an individual who inhales cigarette smoke, either directly or indirectly. Inhaling cigarette smoke directly means that the individual is actively smoking cigarettes. Meanwhile, inhaling cigarette smoke indirectly occurs when someone does not smoke but is in an environment where other people smoke, so that

they are exposed to and inhale cigarette smoke from their surroundings (Kanaley et al. 2022, Mukharjee et al. 2020).

The World Health Organization (WHO) states that physical activity namely movements carried out by skeletal muscles that require the use of energy (Ichwan et al. 2022). This definition includes all types of movement, whether during leisure time, commuting (walking or cycling), at work, or in household activities. Physical activity includes moderate to vigorous intensity activities, both of which provide health benefits. Common examples include walking, cycling, sports, and play, which can be done at a variety of skill levels and enjoyed by everyone (Charreire et al. 2021).

Doing physical activity regularly is crucial for overall health and well-being. It helps in preventing diseases. Chronic conditions like heart disease, diabetes, various types of cancer, as well as the risk of mental health issues, can be reduced (Li et al. 2022). Conversely, low physical activity contributes to the rise in NCDs, which burdens health systems globally (Ichwan et al. 2022). WHO emphasizes that increasing physical activity worldwide will support the achievement of targets to reduce NCDs and contribute to the Sustainable Development Goals. This initiative requires commitment and resources from governments, collaboration between sectors, and continued support from WHO to promote active lifestyles worldwide (Saleem et al. 2022).

With significant health effects, diabetes is a major concern in the prevention and management of non-communicable diseases. Increasing understanding, early identification, and effective management of diabetes are crucial steps in reducing the health impacts of this disease in society. The results of a study by H. Syarippudin in 2021 showed that smoking is associated with diabetes mellitus (Luther et al. 2022). A study conducted by Cicilia L and colleagues in 2018 found a connection between physical activity and the occurrence of diabetes

mellitus among outpatients at the Internal Medicine Polyclinic of Bitung Regional Hospital (Cicilia et al. 2018). The purpose of this study is to explore the connection between physical activity, smoking habits, and the risk of diabetes mellitus in individuals aged 18-24.

2. METHODS

This study aimed to analyze the characteristics of how physical activity and smoking habits influenced the risk of Diabetes Mellitus (DM) in individuals aged 18 to 24, using a descriptive approach (Ali et al. 2023). The data used in this study were obtained from secondary sources, specifically the CDC Diabetes Health Indicators dataset, which was retrieved from the UCI Machine Learning Repository. This dataset included various indicators that affected the development of Diabetes Mellitus. The sample size for this study consisted of 5,974 individuals from the age group of 18-24, as outlined in the dataset. Of these, 1,223 individuals were identified as having prediabetes or diabetes, while 4,751 individuals did not. Data collection focused on indicators related to physical activity, smoking habits, and the DM risk status within this age group. The collected data were analyzed using descriptive analysis methods, with an emphasis on descriptive statistics related to physical activity levels, smoking behaviors, and their association with the risk of DM in this age range. Statistical techniques, such as chi-square tests, were used to assess the relationship between smoking habits, physical activity, and the incidence of prediabetes or diabetes. The results were presented in table format, aiming to provide a comprehensive overview of how physical activity and smoking habits contributed to the risk of Diabetes Mellitus in individuals aged 18-24 years. These tables highlighted the relationship between these factors and offered valuable insights for diabetes prevention and management strategies in this young adult population (Benhlina and Tirari 2024).

3. RESULTS

Based on the data obtained, information was obtained regarding the relationship between smoking behavior and prediabetes/diabetes status. The following are the results of the analysis:

1. Smoking Behavior in Individuals with Prediabetes/Diabetes of the total sample of individuals with prediabetes/diabetes, 7

people (33.3%) were recorded as smokers, while 14 people (66.7%) were recorded as non-smokers.

2. Smoking Behavior in Individuals Without Prediabetes/Diabetes of the total sample of individuals without prediabetes/diabetes, 1216 people (21.7%) were recorded as smokers, while 4385 people (78.3%) were recorded as non-smokers.

From the Statistical Analysis, the p value obtained from this analysis was 0.192, no significant differences were found in smoking behavior and individuals with prediabetes/diabetes and individuals without prediabetes/diabetes.

Based on the analysis conducted, no significant difference was found in smoking behavior between individuals with prediabetes/diabetes and those without prediabetes/diabetes, with a p-value of 0.192. Although there was a difference in the percentage of smokers between the two groups, this difference was not substantial enough to indicate a statistically significant relationship. This suggests that smoking does not play a significant role in distinguishing prediabetes/diabetes status in the studied population. However, smoking remains an important risk factor for various health conditions, including diabetes, and should be addressed in efforts to prevent and manage diabetes. Further research with a larger sample size and control over other variables is needed to gain a clearer understanding of this relationship.

Based on data regarding physical activity and prediabetes/diabetes status as follows:

- a) Physical Activity in Individuals with Prediabetes/Diabetes: Of the total sample of individuals with prediabetes/diabetes, 19 people (90.5%) did physical activity, while 2 people (9.5%) did not do physical activity.
- b) Physical Activity in Individuals Without Prediabetes/Diabetes: of the total sample of individuals without prediabetes/diabetes, 4869 people (86.9%) did physical activity, while 732 people (13.1%) did not do physical activity.

From the results of the statistical analysis, the P value obtained from this analysis was 1,000, which means that no significant differences were found in the physical activity of groups of individuals with and without prediabetes/diabetes.

Table 1. Chi square analysis of smoking behavior with the incidence of prediabetes, diabetes

Behavior	Prediabetes, DM		No		P Value
	n	%	n	%	
Smoke	1216	21.70%	7	33.30%	0.192
Do not smoke	4385	78.30%	14	66.70%	

Table 2. Chi square analysis of physical activity with the incidence of pre-diabetes and diabetes

Physical activity	Prediabetes, DM		No		P Value
	n	%	n	%	
Physical activity	4869	86.9 %	19	90.5 %	1,000
No	732	13.1 %	2	9.5 %	

4. DISCUSSION

The analysis results revealed that the percentage of smokers in the group of individuals with prediabetes or diabetes. (33.3%) was greater than that in the group of individuals without prediabetes or diabetes. (21.7%). However, statistically, this difference was not significant because the P value was 0.192. This results indicates that there is no significant association between smoking behavior and the prediabetes/diabetes status in the sample population (Dominguez et al. 2021). (Kanaley et al.

2022) Other factors that should be further considered include additional risk factors, such as diet and genetics, which may influence prediabetes/diabetes. While smoking is commonly linked to a higher risk of insulin resistance and diabetes complications, other factors also play a significant role (Alam et al. 2021).

Insulin resistance occurs when skeletal muscle or fat cells become less responsive to insulin, leading to reduced glucose uptake by these cells. This condition can result in hyperinsulinemia and a further decline in insulin sensitivity (Liu et al. 2020). Smoking is linked to insulin resistance in a dose-dependent manner, meaning the more a person smokes, the greater the risk. Smoking directly increases the likelihood of developing insulin resistance, mainly by activating certain hormones, and may also contribute indirectly through its impact on abdominal obesity. Nicotine could play a key role in this potential mechanism (Ashra et al. 2015).

Given the rising prevalence of prediabetes and diabetes, along with the link between smoking and insulin resistance, reducing or quitting smoking could be an effective strategy for

individuals at risk or diagnosed with insulin resistance. As such, smoking cessation or reduction could be a valuable part of any diabetes prevention or treatment plan (La Sala and Pontiroli 2020).

From the results of the analysis obtained from the percentage of individuals who do physical activity in the group with prediabetes/diabetes (90.5%) is slightly higher than the group without prediabetes/diabetes (86.9%). However, a P value of 1.000 indicates that this difference is not statistically significant. Some things to note in the interpretation of these results are the P value of 1,000, namely that there was no significant relationship between physical activity and prediabetes/diabetes status in the sample population so that in the sample taken, both individuals with and without prediabetes/diabetes have similar levels of physical activity. Although there is no significant relationship, physical activity remains an important factor in the prevention and management of diabetes. Physical activity helps improve insulin sensitivity and reduces the risk of complications in individuals with diabetes (Adams 2020).

Physical activity is essential for metabolic health, particularly in managing insulin resistance and related disorders such as type 2 diabetes mellitus (T2DM). Research consistently shows a significant connection between physical activity levels and insulin sensitivity. Regular exercise programs have been proven to significantly enhance glycemic control, making exercise a recommended therapeutic approach to reduce insulin resistance. Consistent participation in exercise programs has been shown to significantly improve glycemic control, establishing exercise as a recommended therapeutic method to lower insulin resistance on the other hand, physical activity and exercise can

help preserve and restore the function of pancreatic islet cells, thereby improving peripheral insulin sensitivity (Adams 2020). Exercise interventions promote β -cell proliferation by boosting circulating growth factor levels, highlighting its critical role in supporting pancreatic health and regulating glucose metabolism. Furthermore, a sedentary lifestyle contributes to elevated levels of oxidative stress and ceramide production, both of which disrupt insulin signaling and hinder glucose metabolism. Regular exercise triggers an anti-inflammatory response, boosts antioxidant defenses, and supports mitochondrial function, all of which contribute to improved insulin sensitivity and enhanced metabolic efficiency. Promoting an active lifestyle and regular exercise is crucial for preventing and managing insulin resistance and other related metabolic disorders, ultimately fostering overall health and well-being (Nédó and Paulik 2012).

5. CONCLUSION

In theory, both physical activity and smoking are known to affect the risk of diabetes, the results of this study did not reveal a statistically significant association between the two factors and the risk of diabetes. This may be influenced by the study design, inadequate measurement of variables, or limited sample characteristics. As a next step, conducting more in-depth research with more precise designs and measurements is needed to confirm these findings and better understand the influence of the two factors on the risk of diabetes.

Overall, although no significant relationship was found between physical activity and smoking habits with prediabetes/diabetes status, physical activity and reducing smoking habits are major factors in maintaining Overall health and reducing the risk of chronic diseases and their prevention.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The authors hereby state that no generative AI tools such as large language models (ChatGPT, COPILOT, etc.) or text-to-image generators were utilized in the creation or editing of this work.

DATA AVAILABILITY

All relevant data are included in the paper and its supporting information files. This study aims to inform researchers identify The Influence of

Physical Activity, Smoking Habits on Prediabetes and Diabetes at Age 18-24 Years.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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