THE ASSOCIATION BETWEEN DIETARY PATTERNS AND TYPE 2 DIABETES MELLITUS AMONG INDONESIAN URBAN WORKERS

Risti Rosmiati[1], Nila Reswari Haryana[2], Hardi Firmansyah[3], Rasita Purba[4]
[1,2,3,4]Universitas Negeri Medan, Medan, Indonesia
Corresponding email: ristirosmiati@unimed.ac.id

Abstract The prevalence of type 2 diabetes mellitus (T2DM) has become a major global health concern, including in Indonesia. Urbanization and lifestyle changes, such as dietary patterns, contribute to its rise. This study analyzed the association between dietary patterns and T2DM risk among Indonesian urban workers. Major dietary patterns were derived using principal component analysis from a 17-item food frequency completed by urban workers in the Indonesia Family Life Survey (IFLS) wave 5. The association between these dietary patterns and the risk of T2DM was assessed using logistic regression analysis, adjusting for potential confounding variables. A total of 8545 urban workers were included in the study. Four major dietary patterns were identified: Western, prudent, modern, and traditional. After adjusting for age, sex, nutritional status, physical activity, and smoking status, it was found that individuals with the highest Western dietary pattern had higher odds (OR 2.483, 95% CI 1.636 – 3.767) of T2DM than those in the lowest quartile. The prudent dietary pattern revealed lower odds (OR 0.203, 95% CI 0.130 – 0.317) for T2DM among those in the highest quartile compared with the lowest quartile. This study highlights the association between specific dietary patterns and the risk of developing T2DM among Indonesian urban workers.

Keywords: Dietary Pattern; Principal Component Analysis; Urban Workers

INTRODUCTION

Type 2 diabetes mellitus (T2DM) prevalence has increased alarmingly over the past few decades, becoming a serious global public health concern (Amiri, 2016; Khan et al., 2020; Zimmet et al., 2014) . The multiple impacts of the disease on individuals, societies, and healthcare systems underscore the urgency of understanding its determinants and risk factors (Berbudi et al., 2020; Cannon et al., 2018; Einarson et al., 2018; Faselis et al., 2020; Seuring et al., 2015) . Indonesia, where a confluence of urbanization and altering lifestyle patterns has elevated T2DM to the forefront of public health concerns, is one of the nation's grappling with this escalating health crisis. As urbanization accelerates, altering dietary practices and lifestyle behaviors, it is crucial to decipher the complex relationship between dietary patterns and T2DM risk, particularly among the urban working population of Indonesia (Gassasse et al., 2017; Jannasch et al., 2017; Sami et al., 2017; Senadheera et al., 2016).

T2DM's emergence as a global epidemic is the result of complex interactions between genetic predisposition, environmental factors, and lifestyle choices. Urbanization, which is characterized by rapid migration to cities and the adoption of urban lifestyles, has been widely linked to the rising incidence of T2DM. The transition from traditional agrarian settings to urban environments is frequently accompanied by changes in dietary habits, levels of physical activity, and socioeconomic conditions. Among these modifications, dietary patterns are the most influential in terms of T2DM risk (Gassasse et al., 2017; Jannasch et al., 2017).

Indonesia, a heterogeneous archipelagic nation undergoing rapid urbanization, exemplifies the profound effect of changing lifestyles on the prevalence of T2DM (Kurniawan et al., 2022; Tahapary et al., 2016) . Diets characterized by increased consumption of refined carbohydrates, added sugars, and saturated fats – hallmarks of the global nutrition transition – have gradually replaced the traditional Indonesian diet, which was based on rice and various locally sourced ingredients. Combined with decreased physical activity due to sedentary occupations, these dietary changes have contributed to the rising prevalence of T2DM in Indonesia (Amarta et al., 2021; Yu et al., 2021).

This study aims to illuminate the complex relationship between dietary patterns and T2DM risk among urban Indonesian workers. The urban workforce is a significant demographic subgroup that faces unique challenges, including time constraints, limited access to nutritious foods, and high levels of stress (Li et al., 2019; Oyewole & Atinmo, 2015; Tayama et al., 2016). Investigating the association between dietary patterns and the risk of T2DM in this population could inform the development of targeted intervention strategies.

This research contributes to the expanding body of knowledge on the epidemiology of T2DM and its underlying determinants by analyzing the association between dietary patterns and T2DM risk among urban workers in Indonesia. This study's findings may be useful for public health policymakers, healthcare practitioners, and nutritionists who wish to design interventions based on scientific evidence to reduce the risk of T2DM in urban areas. In addition, the results may contribute to the formulation of culturally-tailored dietary recommendations for the prevention and management of T2DM, taking into account the diverse culinary traditions of Indonesia.

The confluence of urbanization and shifting dietary patterns has heightened the importance of understanding the complex associations between diet and T2DM risk. This study examines the relationship between dietary patterns and T2DM risk among urban Indonesian workers in an effort to close this knowledge gap. This investigation has the potential to inform targeted interventions that could ultimately halt the T2DM epidemic, not only in Indonesia but also in other urbanizing societies around the world.

METHOD

This cross-sectional study utilized data from the fifth wave of the Indonesia Family Life Survey (IFLS), a longitudinal survey designed to investigate the health, socioeconomic, and demographic characteristics of Indonesian households (Strauss et al., 2016). The study population consisted of urban workers residing in various Indonesian urban centers between the ages of 19 and 64.

Dietary information was collected through a validated 17-item food frequency questionnaire (FFQ), which encompassed a broad spectrum of food items commonly consumed in Indonesia. Participants were required to report their average frequency of consumption for each food item over a specified period. The FFQ was administered through face-to-face interviews by trained surveyors, ensuring accuracy and consistency of responses.

Principal component analysis (PCA), a widely used data reduction technique, was employed to identify major dietary patterns among the participants (Zhao et al., 2021). The 17 food items from the FFQ were used as variables in the PCA. The obtained dietary patterns were labeled based on the type of foods with the highest loadings in each pattern,

and these patterns were subsequently used as independent variables in the subsequent analysis.

The outcome variable of interest was the presence or absence of T2DM. Self-reported T2DM status was obtained from participants' responses during the survey. Participants were classified into two groups: those with T2DM and those without T2DM. Confounding variables included age, gender, body mass index (BMI), physical activity level, and smoking status.

Descriptive statistics are presented as frequencies and means [standard deviations (SDs)]. Logistic regression analysis was performed to assess the association between derived dietary patterns and the risk of T2DM. The dietary patterns identified through PCA were entered as independent variables, while adjusting for potential confounding variables. The odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were calculated to quantify the strength and direction of the associations. To ensure the robustness of the findings, a sensitivity analysis was conducted by excluding participants with missing data or extreme dietary consumption patterns. This analysis aimed to assess the potential impact of missing or outlier data on the observed associations. Statistical analysis was conducted using SPSS V.27.0.

RESULTS AND DISCUSSION

A total of 8545 urban workers (19-64 years) participated in the study. Characteristic of participants presents in Table 1.

Table 1: Characteristics of participants

No.	Characteristic	n	%
1	Age, (mean±SD)	38.7±11	
2	Sex		
	Male	4,844	56.7
	Female	3,701	43.3
3	Nutritional status		
	Severely underweight	100	1.2
	Underweight	589	6.9
	Normal	4,654	54.5
	Overweight	1,272	14.9
	Obese	1,930	22.6
4	Physical activity		
	Inactive	7,794	91.2
	Active	750	8.8
5	Smoking status		
	Yes	3,722	43.6
	No	4,823	56.4

The average age of urban workers was 38.7 years. More than fifty percent of the participants were men. Approximately 37.5% of participants were considered overweight and obese. The majority of participants were physically inactive, and more than half were non-smokers.

The identification of four distinct dietary patterns — Western, prudent, modern, and

traditional — reflects the complexity of this population's dietary habits. A western pattern characterized by a high intake of processed foods and sugary beverages; a prudent pattern characterized by fruits and vegetables; a modern pattern characterized by the consumption of instant noodles, fried snacks, and eggs; and a traditional pattern characterized by the consumption of rice, vegetables, and fish. By adjusting for key confounding variables such as age, sex, nutritional status, physical activity, and smoking status, we meticulously controlled for potential sources of bias that could have affected the observed associations.

As shown in Table 2, adjusted logistic regression models revealed a statistically significant relationship between Western and prudent dietary patterns and type 2 diabetes. The findings regarding the Western dietary pattern reveal a compelling link between dietary choices and the risk of type 2 diabetes. The significantly elevated odds ratio (OR) of 2.483 with a 95 percent confidence interval (CI) of 1.636 – 3.767 indicates a strong and statistically significant association between a Western diet and an increased risk of developing T2DM. This result is consistent with previous research suggesting that diets high in processed foods, refined sugars, and unhealthy fats can contribute to insulin resistance and impaired glucose metabolism, thereby promoting the development of T2DM (Jannasch et al., 2017; Sami et al., 2017; Senadheera et al., 2016).

Table 2: Logistic regression analysis on the relationship between dietary patterns and type 2 diabetes mellitus

No.	Variables	OR	95%CI
1	Western dietary pattern		
	1st Quartile	Ref.	
	2nd Quartile	1.620*	1.059-2.477
	3rd Quartile	1.864**	1.220-2.843
	4th Quartile	2.483**	1.636-3.767
2	Prudent dietary pattern		
	1st Quartile	Ref.	
	2nd Quartile	0.597**	0.406-0.878
	3rd Quartile	0.399**	0.266-0.596
	4th Quartile	0.203**	0.130-0.317
3	Modern dietary pattern		
	1st Quartile	Ref.	
	2nd Quartile	1.150	0.766–1.728
	3rd Quartile	1.047	0.695–1.576
	4th Quartile	0.944	0.619–1.439
4	Traditional dietary pattern		
	1st Quartile	Ref.	
	2nd Quartile	0.956	0.643–1.422
	3rd Quartile	0.666	0.437–1.017
	4th Quartile	0.580	0.381–0.882

In contrast, the prudent dietary pattern demonstrates a promising inverse association with T2DM risk. The remarkably low odds ratio of 0.203 (95 percent confidence interval: 0.130 – 0.317) indicates a robust protective effect associated with a healthy diet. This diet, which is frequently characterized by a higher consumption of whole grains, fruits, vegetables, lean proteins, and healthy fats, is consistent with dietary guidelines for the

prevention of T2DM. The findings highlight the potential advantages of nutrient-dense, well-balanced diets for promoting metabolic health and reducing the risk of T2DM (Alkhatib et al., 2017; Cena & Calder, 2020; Schulze et al., 2018; Simmons et al., 2017; Uusitupa et al., 2019).

In addition, the focus of the study on urban workers in Indonesia adds a new dimension to the existing literature on T2DM risk factors. Urbanization is frequently associated with changes in dietary patterns, such as increased consumption of processed foods and sedentary lifestyles, both of which can contribute to the increase in prevalence of type 2 diabetes (Gassasse et al., 2017; Kurniawan et al., 2022; Tahapary et al., 2016) . By focusing on this population, the study contributes to a more thorough understanding of how dietary patterns influence T2DM risk in a particular context.

This study provides valuable evidence of the association between distinct dietary patterns and the risk of type 2 diabetes in urban Indonesian workers. Dietary choices play a crucial role in determining T2DM risk, as demonstrated by the study's significant associations. These findings highlight the significance of promoting healthier eating habits, such as those aligned with the prudent dietary pattern, in order to reduce the growing burden of T2DM in urban populations. Further research could investigate the mechanisms underlying these associations and identify potential avenues for targeted interventions to promote metabolic health in populations at risk.

CONCLUSION

Four major dietary patterns were identified: Western, prudent, modern, and traditional. After adjusting for age, sex, nutritional status, physical activity, and smoking status, it was found that individuals with the highest Western dietary pattern had higher odds (OR 2.483, 95% CI 1.636 – 3.767) of T2DM than those in the lowest quartile. The prudent dietary pattern revealed lower odds (OR 0.203, 95% CI 0.130 – 0.317) for T2DM among those in the highest quartile compared with the lowest quartile. This study highlights the association between specific dietary patterns and the risk of developing T2DM among Indonesian urban workers.

REFERENCES
Alkhatib, A., Tsang, C., Tiss, A., Bahorun, T., Arefanian, H., Barake, R., Khadir, A., & Tuomilehto, J. (2017). Functional foods and lifestyle approaches for diabetes prevention and management. *Nutrients*, *9*(12), 1310.
Amarta, O. R., Chalidyanto, D., & Laksono, A. D. (2021). Ecological Analysis of Diabetes Mellitusin Indonesia. *Indian Journal of Forensic Medicine & Toxicology*, *15*(3), 3897–3904.
Amiri, M. (2016). Diabetes mellitus type 2; an international challenge. *Ann Res Dial*, *1*(1), e04.
Berbudi, A., Rahmadika, N., Tjahjadi, A. I., & Ruslami, R. (2020). Type 2 diabetes and its impact on the immune system. *Current Diabetes Reviews*, *16*(5), 442–449.
Cannon, A., Handelsman, Y., Heile, M., & Shannon, M. (2018). Burden of illness in type 2 diabetes mellitus. *Journal of Managed Care & Specialty Pharmacy*, *24*(9-a Suppl), S5–S13.
Cena, H., & Calder, P. C. (2020). Defining a healthy diet: evidence for the role of contemporary dietary patterns in health and disease. *Nutrients*, *12*(2), 334.

Einarson, T. R., Acs, A., Ludwig, C., & Panton, U. H. (2018). Economic burden of cardiovascular disease in type 2 diabetes: a systematic review. *Value in Health*, *21*(7), 881–890.

Faselis, C., Katsimardou, A., Imprialos, K., Deligkaris, P., Kallistratos, M., & Dimitriadis, K. (2020). Microvascular complications of type 2 diabetes mellitus. *Current Vascular Pharmacology*, *18*(2), 117–124.

Gassasse, Z., Smith, D., Finer, S., & Gallo, V. (2017). Association between urbanisation and type 2 diabetes: an ecological study. *BMJ Global Health*, *2*(4), e000473.

Jannasch, F., Kröger, J., & Schulze, M. B. (2017). Dietary patterns and type 2 diabetes: a systematic literature review and meta-analysis of prospective studies. *The Journal of Nutrition*, *147*(6), 1174–1182.

Khan, M. A. B., Hashim, M. J., King, J. K., Govender, R. D., Mustafa, H., & Al Kaabi, J. (2020). Epidemiology of type 2 diabetes–global burden of disease and forecasted trends. *Journal of Epidemiology and Global Health*, *10*(1), 107.

Kurniawan, F., Manurung, M. D., Harbuwono, D. S., Yunir, E., Tsonaka, R., Pradnjaparamita, T., Vidiawati, D., Anggunadi, A., Soewondo, P., & Yazdanbakhsh, M. (2022). Urbanization and Unfavorable Changes in Metabolic Profiles: A Prospective Cohort Study of Indonesian Young Adults. *Nutrients*, *14*(16), 3326.

Li, W., Sun, F., Li, Y., & Durkin, D. W. (2019). Work stress and depressive symptoms in Chinese migrant workers: the moderating role of community factors. *Journal of Immigrant and Minority Health*, *21*, 1248–1256.

Oyewole, O. E., & Atinmo, T. (2015). Nutrition transition and chronic diseases in Nigeria. *Proceedings of the Nutrition Society*, *74*(4), 460–465.

Sami, W., Ansari, T., Butt, N. S., & Ab Hamid, M. R. (2017). Effect of diet on type 2 diabetes mellitus: A review. *International Journal of Health Sciences*, *11*(2), 65.

Schulze, M. B., Martínez-González, M. A., Fung, T. T., Lichtenstein, A. H., & Forouhi, N. G. (2018). Food based dietary patterns and chronic disease prevention. *Bmj*, *361*.

Senadheera, S. P. A. S., Ekanayake, S., & Wanigatunge, C. (2016). Dietary habits of type 2 diabetes patients: variety and frequency of food intake. *Journal of Nutrition and Metabolism*, *2016*.

Seuring, T., Archangelidi, O., & Suhrcke, M. (2015). The economic costs of type 2 diabetes: a global systematic review. *Pharmacoeconomics*, *33*, 811–831.

Simmons, D., Devlieger, R., Van Assche, A., Jans, G., Galjaard, S., Corcoy, R., Adelantado, J. M., Dunne, F., Desoye, G., & Harreiter, J. (2017). Effect of physical activity and/or healthy eating on GDM risk: the DALI lifestyle study. *The Journal of Clinical Endocrinology & Metabolism*, *102*(3), 903–913.

Strauss, J., Witoelar, F., & Sikoki, B. (2016). *The fifth wave of the Indonesia family life survey: overview and field report* (Vol. 1). Rand Santa Monica, CA, USA.

Tahapary, D., Kurniawan, F., Sartono, E., Djuardi, Y., Supali, T., Yazdanbakhsh, M., Soewondo, P., & Harbuwono, D. (2016). The effect of urbanization on adiposity and insulin resistance among Indonesian. *Endocrine Abstracts*, *41*.

Tayama, J., Li, J., & Munakata, M. (2016). Working long hours is associated with higher prevalence of diabetes in urban male Chinese workers: The rosai karoshi study. *Stress and Health*, *32*(1), 84–87.

Uusitupa, M., Khan, T. A., Viguiliouk, E., Kahleova, H., Rivellese, A. A., Hermansen, K., Pfeiffer, A., Thanopoulou, A., Salas-Salvadó, J., & Schwab, U. (2019). Prevention of type 2

diabetes by lifestyle changes: a systematic review and meta-analysis. *Nutrients*, *11*(11), 2611.

Yu, M., Zhan, X., Yang, Z., & Huang, Y. (2021). Measuring the global, regional, and national burden of type 2 diabetes and the attributable risk factors in all 194 countries. *Journal of Diabetes*, *13*(8), 613–639.

Zhao, J., Li, Z., Gao, Q., Zhao, H., Chen, S., Huang, L., Wang, W., & Wang, T. (2021). A review of statistical methods for dietary pattern analysis. *Nutrition Journal*, *20*(1), 1–18.

Zimmet, P. Z., Magliano, D. J., Herman, W. H., & Shaw, J. E. (2014). Diabetes: a 21st century challenge. *The Lancet Diabetes & Endocrinology*, *2*(1), 56–64.