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Risk factor analysis of type 2 diabetes mellitus in rural areas: A systematic review

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Abstract

Background: Type 2 diabetes mellitus (DM) prevalence continues to increase in rural areas, which is of particular concern due to limited access to health services in these areas.
Purpose: To identify various risk factors for the incidence of type 2 DM in rural areas for the development of effective prevention programs.
Method: *Systematic review* is based on PRISMA guidelines. Searches were conducted in Scopus, Science Direct, and SINTA for 2020-2025 articles. Data were extracted and analyzed narratively based on the type of risk factors that were found.
Results: Out of 856 articles, 20 studies met the inclusion criteria. Dominant risk factors identified included obesity (OR range 2.15-3.05), family history of DM (OR range 2.13-4.46), and low physical activity (OR range 2.94-7.43). Additional risk factors include hypertension, unhealthy food environment, and unhealthy diet. Several studies reported an increased incidence of type 2 DM in younger populations in rural areas.
Conclusion: Obesity, family history of DM, and low physical activity are the dominant risk factors for type 2 DM in rural areas. These factors are important targets for health policy interventions, especially given the increasing incidence in younger populations in rural areas.

Keywords: Diabetes; Risk Factors; Rural Area.

INTRODUCTION

Type 2 diabetes mellitus (DM) is a global health challenge where the prevalence continues to increase significantly, not only in urban areas but also in rural areas (Motala, Mbanya, Ramaiya, Pirie, & Ekoru, 2022). This metabolic disease is characterized by hyperglycemia due to impaired insulin secretion, insulin action, or both, which results in various long-term complications including microvascular and macrovascular damage (Gherbon, Frandes, Nicula-Neagu, Timar, & Timar, 2023). The increasing prevalence of type 2 DM in rural areas is of particular concern given the limited access to health services, diagnostic facilities, and comprehensive management in these areas (Jeffries-Stokes, Stokes, McDonald, Evans, Anderson, & Robinson, 2020). Recent data shows that the prevalence rate in urban areas, indicates a shift in disease patterns that were previously dominant in urban areas (Wang, Liu, Qiao, Xue, Liu, Zhang, & Li, 2020).

Various risk factors have been identified to contribute to the incidence of type 2 DM, but their characteristics may differ between urban and rural areas. Lifestyle factors such as unhealthy diet, low physical activities, and smoking are known to have a significant association with the incidence of type 2 DM (Issaka, Paradies, Cameron, & Stevenson, 2024; Jati et al., 2023; Taja, Ndoen, & Ndun, 2024). In addition, anthropometric factors such as obesity, waist circumference, and visceral adiposity index also show a strong correlation with the risk of type 2 DM (Yu, Yi, Chen, Hou, Liu, Xu, & Song, 2022; Ruiz-

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Alejos, Carrillo-Larco, Miranda, Gilman, Smeeth, & Bernabé-Ortiz, 2020). In rural areas, rapid nutrition transitions, changes in food consumption patterns, and the adoption of sedentary lifestyles have contributed to the increase in cases of type 2 DM (Yu et al., 2022). The increased frequency of eating outside the home even in rural areas has also shown a significant association with an increased risk of type 2 DM (Wang et al., 2020).

Interestingly, some studies have shown that built environment factors also affect the risk of type 2 DM in rural areas (Feyissa, Wood, Vakil, Namara, Coffee, Alsharrah, & Versace, 2024). even though the mechanism may be different in urban areas. This systematic review aims to identify various risk factors for the incidence of type 2 DM in rural areas, which will provide scientific evidence as a basis for developing more effective prevention and control programs for type 2 DM that are appropriate to the context of rural areas. To provide recommendations for the development of type 2 DM prevention programs specific to rural areas.

RESEARCH METHOD

This systematic review was conducted based on PRISMA (Preferred Reporting Items for Systematic Reviews) guidelines. A literature search was conducted on electronic databases including Scopus, Science Direct, and SINTA for articles published from January 2020 to 2025. The search strategy used the following keyword combinations: “type 2 diabetes mellitus” OR “T2DM” OR “type 2 diabetes” and “rural” OR “rural area” OR “rural population” AND “risk factors” OR “determinants” OR “predictors” and “cross-sectional” OR “case-control” OR “cohort” OR “longitudinal”.

The search was limited to English and Indonesian language articles. References of relevant articles were also searched to identify additional studies that may have been missed in the main database search. The inclusion criteria for the selected studies were: (1) observational research design (cross-sectional, case-control, or cohort); (2) the study sample came from the population in rural areas; (3) the main outcome was the incidence of type 2 diabetes mellitus; (4) provided data on risk factors for type 2 DM such as body mass index, obesity, low physical activity, family history, unhealthy diet, smoking habits, or other risk factors; (5) presented association measures in the form of ratios or data that allowed calculation with 95% confidence intervals. Studies were excluded if: (1) did not separate data between rural and urban populations; (2) focused on gestational diabetes or type 1 diabetes; (3) did not provide sufficient data for extraction or analysis.

The study selection process was conducted in two stages: first, screening of titles and abstracts to identify potentially relevant articles; second, full-text review of articles that passed the first stage to determine final eligibility. This process was conducted by two researchers independently to minimize bias, with discussions to reach consensus in case of disagreement.

Data from studies that met the inclusion criteria were extracted using a standardized data extraction form. Extracted information included: (1) study characteristics (authors, year of publication, country, study design); (2) sample characteristics (sample size, age, sex, rural definition); (3) case definition of type 2 DM; (4) risk factors studied; (5) association measures with 95% confidence intervals; and (6) adjusted variables. For studies that reported results based on multiple statistical models, data from the most comprehensive model with the most adjustments were selected for analysis.

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RESEARCH RESULTS

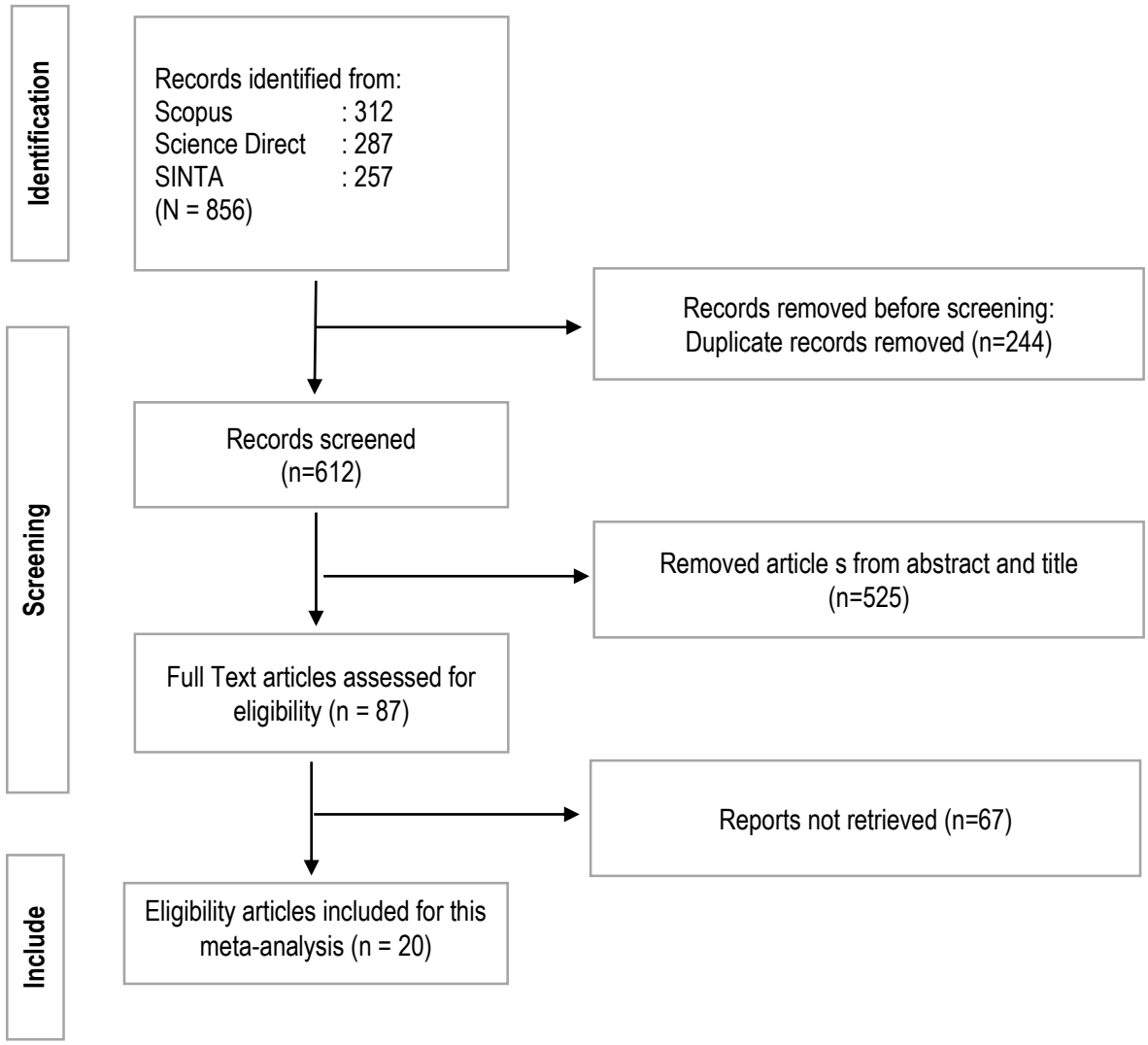


Figure Flow Prism Diagram

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Table Summary of Review Articles

(Author, Year) (Country)	Purpose	Method	Results
(Feyissa et al., 2024) (Australia)	To systematically review longitudinal studies examining the relationship between incident type 2 diabetes mellitus (T2DM) and built environment factors.	Longitudinal studies	Konsistensi dalam sifat hubungan antara fitur lingkungan binaan yang berkaitan dengan DM tipe 2. Kami mengamati hubungan terbalik atau "protektif" yang signifikan secara statistik antara DM tipe 2 dan lingkungan aksesibilitas pejalan kaki serta lingkungan makanan sehat.
(Homsana et al., 2024) (Laos)	To estimate the prevalence and explore determinants of SLD in rural southern Lao PDR for lean and non-lean populations.	cross-sectional community-based study	SLD prevalence is notably high among Laotian adults in rural areas, particularly in females and in non-lean individuals. Lean individuals with OV infection exhibited lower SLD prevalence. SLD was more prevalent in individuals with T2DM, independent of BMI. SLD adds to the burden of infection-related liver morbidity in Lao PDR.
(Issaka et al., 2024) (Australia)	To use systematic and meta-analytic methods to examine the strength of associations between modifiable risk factors and T2DM in Africa.	A systematic search of literature	Obesity defined by BMI and central obesity, but not behavioral risk factors were most strongly associated with T2DM in African populations, emphasizing the need for obesity prevention to limit the rise of T2DM.
(Muhammad et al., 2024) (Pakistan)	To provide a comprehensive picture of diabetic retinopathy in Pakistan by evaluating how diabetes affects blindness and visual impairment in people with the disease.	Quantitative and qualitative analysis.	This study highlights the significant impact of Type 2 Diabetes Mellitus (T2DM) on visual acuity in Pakistan, highlighting the complexity of diabetic retinopathy, its varying degrees of impairment and associated factors emphasizing the need for targeted interventions to alleviate this burden.

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(Author, Year) (Country)	Purpose	Method	Results
(Nanditha et al., 2024) (India)	To study the prevalence of T2DM and its associated risk factors among the younger (20–39 years) and older individuals (≥40 years) at two time points using the population data of 2006 and 2016.	Epidemiological surveys	Increase in rates of obesity and dyslipidemia was also higher in the younger than in the older individuals. In 10 years, incidence of T2DM increased by 120% (1.1% vs. 0.5%, $p < 0.0001$) and 150% (5% vs. 2%, $p < 0.0001$) in the younger and older individuals, respectively.
(Taja et al., 2024) (Indonesia)	To know the association between family history, smoking behaviors, and physical activity with the incidence of type 2 diabetes mellitus in the elderly in the Sikumana Community Health Center working area in 2021	Research was a quantitative study	Relationship between family history (p=0.009) and physical activity (p=0.001) with the incidence of diabetes mellitus in the elderly in the working area of the Sikumana Health Center, while smoking habits (p=0.483) there is no relationship with the incidence of diabetes mellitus in the elderly in the working area of the Sikumana Health Center.
(Gherbon et al., 2023) (Romania)	To study the effects of COVID-19 lockdown on glycemic control in people with type 2 diabetes mellitus (T2DM).	A retrospective observational study (case-control)	This study have demonstrated that in people with T2DM, the COVID-19 lockdown determines better glycemic control among patients treated with OAD compared to those treated with insulin therapy.
(Jabbar et al., 2023) (India)	To find the prevalence of type 2 diabetes and its precursors in South Indian adult youth (18–30 years age) of Thiruvananthapuram district.	A cross-sectional study	The prevalence of diabetes and prediabetes in South Indian young adults was 0.48% and 2.4%, respectively, while the prevalence of overweight, obesity and abdominal obesity was 28.2%, 16.1% and 28.4%, respectively, with 27.1% of participants showing clinical features of insulin resistance and 35.1% having a family history of diabetes.

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(Author, Year) (Country)	Purpose	Method	Results
(Jati et al., 2023) (Indonesia)	To assess the risk factors for Type 2 Diabetes Mellitus in the working area of the Kemaraya Public Health Center, Kendari City, in 2023, namely physical activty.	A case control design	This study revealed that physical activity (p value= 0.000, OR= 7.429; CI: 2.625-21.018), were significantly associated with Type 2 Diabetes Mellitus.
(Maimaitituerxun et al., 2023) (China)	To develop and validate a nomogram-based model to detect mild cognitive impairment (MCI) in T2DM patients.	A retrospective observational study	A total of 496 patients were included in this study. The prevalence of MCI in T2DM patients was 34.1% (95% confidence interval [CI]: 29.9%–38.3%). Age, marital status, household income, diabetes duration, diabetic retinopathy, anxiety, and depression were independently associated with MCI. Nomogram based on these factors had an area under the curve of 0.849 (95% CI: 0.815– 0.883), and the threshold probability ranged from 35.0% to 85.0%
(Parera et al., 2023) (Indonesia)	To analyze the risk factors associated with the incidence of Type 2 Diabetes Mellitus.	Analytical observational research	A significant relationship between family history (p-value = 0.002; OR=4,462), hypertension (p-value=0.004; OR=4.063) and physical activity (p-value=0.029; OR=2.941) with the incidence of Type 2 DM and there was no significant relationship between smoking (p-value = 0.640) with the incidence of Type 2 DM at the Oesapa Health Center in Kupang City.
(Al-Mohaithef et al., 2022) (Arab Saudi)	To identify high-risk patients for diabetic foot ulcers (DFUs) in Egypt.	A cross-sectional study	Studies show that 47.9% of diabetic patients are at risk of developing DFU. Advanced age, male gender, illiteracy, having type 2 diabetes and a longer duration of diabetes, undergoing insulin therapy, uncontrolled glucose levels, and smoking were the most common risk factors identified in our study.

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(Author, Year) (Country)	Purpose	Method	Results
(Yu et al., 2022) (China)	To demonstrate the association of VAI and its longitudinal transition patterns with type 2 diabetes mellitus (T2DM) in middle-aged and older Chinese.	Health and Retirement Longitudinal Study	This study demonstrated the significant associations of baseline VAI and its transitions with the risk of new-onset T2DM. Early prevention efforts are needed to control the development of T2DM in Chinese with high-VAI levels.
(Gebang, 2021) (Indonesia)	To know the relationship between physical activity factors and the incidence of type 2 diabetes mellitus in sikka regency, east nusa tenggara province	Observational analytic research	The results of the bivariate analysis showed that there was a relationship between age factors, family history (OR: 2.13; 95% CI: 1.05-4.31; p-value: 0.02), obesity (OR: 2.15; 95% CI: 0.99-4.69; p-value: 0.03), physical activity (OR: 5.02; 95% CI: 2.35-10.84; p-value: 0.00) with the incidence of type 2 diabetes mellitus, while gender and occupation factors had no relationship with the incidence of type 2 diabetes mellitus.
(Xue, et al., 2021) (China)	To investigate whether dietary patterns were associated with the risk of type 2 diabetes mellitus (T2DM) or pre-diabetes in adults of rural area in Henan	Cross-sectional study	The prevalence of pre-diabetes and T2DM in rural Henan was 6.8% and 9.4%, respectively, with three dietary patterns identified (meat diet, grain-nut-egg diet, and vegetable-staple-fruit diet), of which the vegetable-staple-fruit diet could reduce the risk of pre diabetes by 32.7% and T2DM by 41.8%, while the grain-nut-egg diet could also reduce the risk of T2DM by 15.5% with a U-shaped relationship pattern.
(Lintang et al., 2019) (Indonesia)	To determine the relationship between the duration of type 2 diabetes mellitus and the incidence of peripheral artery disease in type 2 diabetes mellitus patients at the Kedaton Community Health Center, Bandar Lampung City.	Correlative analytic research	A strong relationship between the duration of type 2 diabetes mellitus and the incidence of peripheral artery disease in type 2 diabetes mellitus patients at the Kedaton Community Health Center in Bandar Lampung City.

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(Author, Year) (Country)	Purpose	Method	Results
(Ruiz-Alejos et al., 2020) (Peru)	To determine the association between excess body fat, assessed by skinfold thickness, and the incidence of type 2 diabetes mellitus (T2DM) and hypertension (HT).	The prospective cohort study	The study found a strong association between the thickness of the subscapular region skinfold and the risk of developing type 2 diabetes and hypertension, even after controlling for body mass index. subscapular skinfold thickness proved to be the strongest anthropometric marker for predicting the risk of both conditions, with a high population attributable fraction (PAF).
(Wang et al., 2020) (China)	To explore the dose–response relationship between AFHs and T2DM in a Chinese population.	Cross-sectional study	A relationship between the frequency of AFHs and T2DM was observed in the rural Chinese population. An excessive frequency of AFHs was likely to increase the prevalence of T2DM. Meanwhile, BMI partially mediates the effects of the frequency of AFHs on T2DM.

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DISCUSSION

Based on the results of a systematic review of 20 studies that met the inclusion criteria, several major risk factors for the incidence of type 2 DM in rural areas can be identified and discussed comprehensively. Obesity has consistently emerged as the dominant risk factor for type 2 DM in rural areas in various studies and different geographical contexts. These findings are in line with the biological understanding of the pathophysiology of type 2 DM, where obesity contributes to insulin resistance through increased free fatty acids, inflammatory adipocytokines and oxidative stress (Yu et al., 2022). Interestingly, several studies in this review found that body fat distribution, specifically visceral adiposity, may be more important than general obesity in predicting the risk of type 2 DM (Ruiz-Alejos et al., 2020; Jabbar, Nair, Chellamma, Jayakumar, Ramesh, Gomez, & Vijayakumar, 2023). This suggests that specific anthropometric measurements such as waist circumference, waist-hip ratio, or visceral adiposity index may be more informative for type 2 DM risk assessment than BMI alone, especially in rural populations who may have different body composition from urban populations.

The increasing prevalence of obesity in rural areas reflects the nutritional transition and lifestyle changes occurring even in rural areas (Xue et al., 2021). This transition is characterized by a shift from a traditional diet rich in fiber and low in fat to a "western" diet high in calories, high in saturated fat and low in fiber. Changes in activity patterns from physically intensive work such as manual farming to more sedentary work also contribute to the increase in obesity in rural areas (Motala et al., 2022).

The significant contribution of family history to the risk of type 2 DM in rural areas indicates the importance of genetic factors in the development of this disease. Individuals with a positive family history of type 2 DM have a 2-5 fold risk of developing the same condition (Taja et al., 2024; Parera, Hinga, & Riwu, 2023). Genetic factors can affect pancreatic beta cell function, insulin sensitivity, glucose metabolism, and body fat distribution. Although genetic factors cannot be modified, early detection in individuals with a positive family history can help in the timely implementation of prevention strategies (Nanditha, Susairaj, Satheesh, Raghavan, Snehalatha, & Ramachandran, 2024).

Interestingly, some studies suggest that genetic factors may interact with environmental factors in rural areas in a different way than urban areas. For example, genetic predisposition to insulin resistance may be exacerbated by specific dietary patterns in rural areas or limited food availability (Homsana, Southisavath, Kling, Hattendorf, Vorasane, Paris, & Probst-Hensch, 2024). These findings emphasize the importance of considering gene-environment interactions in the development of prevention strategies for type 2 DM in rural areas.

Low physical activity has consistently emerged as an important risk factor for type 2 DM in rural areas, with some studies even reporting ORs of more than 5 (Jati et al., 2023; Gebang, 2021). These findings may seem counterintuitive given the traditional view that rural life is more physically active with agricultural and manual activities. However, modernization of agriculture, mechanization, and changes in employment from agriculture to services and industry have contributed to the decline in physical activity levels in rural areas (Motala et al., 2022). In addition, structural factors such as limited public transportation, long distances between destinations, lack of sports facilities, and unsupportive infrastructure (such as pedestrian or bicycle paths) may hinder physical activity in rural areas (Feyissa et al., 2024). These infrastructure limitations emphasize the importance of considering the specific context of rural areas in designing interventions to increase physical activity.

Diet is an important modifiable risk factor for type 2 DM in rural areas. Several studies in this review suggest that a traditional diet high in vegetables, fruits, and whole grains is protective against type 2 DM (Xue et al., 2021). In contrast, increased consumption of ultra-processed foods, fast foods, and high-calorie foods in rural areas contributes to an increased risk of type 2 DM (Wang et al., 2020). The nutrition transition in rural areas is characterized by a shift from local food production and consumption to greater reliance on processed and imported foods. The increasing frequency of eating out even in rural areas, as reported by Wang et al. (2020), reflects the social and economic changes taking place in rural communities. This suggests that food-based interventions for the prevention of type 2 DM in rural areas need to consider not only the

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availability and affordability of healthy foods, but also changing social norms and food preferences.

The findings of Feyissa et al. (2024) on the influence of the built environment on the risk of type 2 DM provide a new perspective in understanding the determinants of type 2 DM in rural areas. Green space-rich and pedestrian-friendly neighbourhoods may reduce the risk of type 2 DM through increased physical activity and mental well-being. In contrast, unhealthy food environments, characterized by high availability of ultra-processed foods and limited access to fresh and nutritious foods, increase the risk of type 2 DM. The social context of rural areas, such as limited access to health services, lack of health education, and geographic isolation, also plays a role in increasing the risk of type 2 DM. low awareness of risk factors and symptoms of type 2 DM can delay diagnosis and early intervention (Jeffries-Stokes et al., 2020). This suggests the importance of a holistic approach to type 2 DM prevention in rural areas that considers the social determinants of health.

The finding of an increasing incidence of type 2 DM in younger populations in rural areas is alarming and has important implications for health policy (Nanditha et al., 2024; Jabbar et al., 2023). The onset of type 2 DM at a younger age is associated with an increased risk of microvascular and macrovascular complications, reduced quality of life, and decreased economic productivity. Several factors contribute to this trend including increased childhood and adolescent obesity, unhealthy diet, low physical activity, and obesogenic environmental factors. These findings emphasize the importance of preventive interventions that start at an early age and are tailored to the context of rural areas.

CONCLUSION

This study reveals that risk factors for the incidence of type 2 DM in rural areas have a consistent pattern in various studies. Obesity, family history of DM, and low physical activity are consistently associated with an increased risk of developing type 2 DM in rural areas. These risk factors are important intervention targets for health policy makers in developing appropriate prevention strategies. In addition, this study highlights the importance of concerted efforts to address the rapid nutrition transition in rural areas, especially given the increasing incidence of type 2 DM in younger populations.

Although the risk factors for type 2 DM in rural areas are similar to urban areas, the specific context of rural areas such as limited access to health services, lack of infrastructure for physical activity, and changes in food consumption patterns need to be considered in the development of prevention strategies. A comprehensive approach, involving various sectors and stakeholders, is needed to address the increasing burden of type 2 DM in rural areas. This systematic review has contains few limitations. First, heterogeneity in the definition of "rural" between studies may affect the comparability of findings. Second, most of the included studies used cross-sectional or case-control designs, which cannot definitively establish causal relationships. Third, variations in the definition and measurement of risk factors between studies may affect effect estimates. Nonetheless, the consistency of findings across studies and different geographical contexts strengthens the conclusions of this review.

REFERENCES

Al-Mohaithef, M., Abdelmohsen, S. A., Algameel, M., & Abdelwahed, A. Y. (2022). Screening for identification of patients at high risk for diabetes-related foot ulcers: a cross-sectional study. *Journal of International Medical Research*, *50*(3), 03000605221087815.

Feyissa, T. R., Wood, S. M., Vakil, K., Namara, K. M., Coffee, N. T., Alsharrah, S., & Versace, V. L. (2024). The built environment and its association with type 2 diabetes mellitus incidence: A systematic review and meta-analysis of longitudinal studies. *Social Science & Medicine*, *361*, 117372.

Gebang, A. A. (2021). Hubungan faktor aktivitas fisik dengan kejadian penyakit diabetes melitus tipe 2 di Kabupaten Sikka Provinsi Nusa Tenggara Timur Tahun 2021.

Gherbon, A., Frandes, M., Nicula-Neagu, M., Timar, R., & Timar, B. (2023). The implications of the pandemic with Covid-19 in the glycemic control of people with type 2 diabetes. *Diabetes, Metabolic Syndrome and Obesity*, 4109-4118.

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Homsana, A., Southisavath, P., Kling, K., Hattendorf, J., Vorasane, S., Paris, D. H., & Probst-Hensch, N. (2024). Steatotic liver disease among lean and non-lean individuals in Southern Lao PDR: a cross-sectional study of risk factors. *Annals of Medicine*, *56*(1), 2329133.

Issaka, A., Paradies, Y., Cameron, A. J., & Stevenson, C. (2024). The association between body weight indices, behavioral factors, and type 2 diabetes mellitus in Africa: a systematic review and meta-analysis of population-based epidemiological studies. *Nutrition, Metabolism and Cardiovascular Diseases*, *34*(1), 1-18.

Jabbar, P. K., Nair, A., Chellamma, J., Jayakumar, R. V., Ramesh, J., Gomez, R., & Vijayakumar, K. (2023). Type 2 diabetes and precursors in community dwelling Asian Indian adult youth. *Indian Journal of Endocrinology and Metabolism*, *27*(4), 307-314.

Jati, R. A., Muchtar, F., & Salsabila, S. (2023). Faktor Risiko Aktivitas Fisik Pada Kejadian Diabetes Melitus Tipe 2 di Wilayah Kerja Puskesmas Kemaraya Kota Kendari Tahun 2023. *KOLONI*, *2*(2), 328-334.

Jeffries-Stokes, C. A., Stokes, A. M., McDonald, L., Evans, S., Anderson, L., & Robinson, P. M. (2020). Risk factors for renal disease and diabetes in remote Australia–findings from The Western Desert Kidney Health Project. *Rural and Remote Health*, *20*(2), 27-38.

Lintang S, A. A., Mutiara, H., & Falamy, R. (2019). Hubungan Antara Lama Menderita Diabetes Melitus Tipe 2 Dengan Kejadian Peripheral Arterial Disease Pada Pasien Diabetes Melitus Tipe 2 Di Puskesmas Kedaton Kota Bandar Lampung. *MEDULA, medicalprofession journal of lampung university*, *9*(2), 379-384.

Maimaitituerxun, R., Chen, W., Xiang, J., Xie, Y., Kaminga, A. C., Wu, X. Y., & Dai, W. (2023). 使用列线图筛查 2 型糖尿病轻度认知障碍. *Journal of Diabetes*, *15*(5), 448-458.

Motala, A. A., Mbanya, J. C., Ramaiya, K., Pirie, F. J., & Ekoru, K. (2022). Type 2 diabetes mellitus in sub-Saharan Africa: challenges and opportunities. *Nature Reviews Endocrinology*, *18*(4), 219-229.

Muhammad Junaid, M. J., Fawad Ahmed, F. A., Ziaur Rehman, Z. R., Irfan Ali, I. A., & Tayyaba Arshad, T. A. (2024, November). The Impact of Type 2 Diabetes Mellitus Duration on Diminishing Visual Acuity in Pakistan. In *Medical Forum Monthly* (Vol. 35, No. 11).

Nanditha, A., Susairaj, P., Satheesh, K., Raghavan, A., Snehalatha, C., & Ramachandran, A. (2024). The rising prevalence of type 2 diabetes among the youth in southern India—An ancillary analysis of the Secular TRends in DiabEtes in India (STRiDE-I) study. *Journal of Diabetes*, *16*(7), e13576.

Parera, Y. F., Hinga, I. A. T., & Riwu, Y. R. (2023). Analisis Faktor Risiko Yang Berhubungan dengan Kejadian Diabetes Melitus Tipe 2 di Wilayah Kerja Puskesmas Oesapa Kota Kupang Tahun 2023. *Sehatmas: Jurnal Ilmiah Kesehatan Masyarakat*, *2*(4), 991-1000.

Ruiz-Alejos, A., Carrillo-Larco, R. M., Miranda, J. J., Gilman, R. H., Smeeth, L., & Bernabé-Ortiz, A. (2020). Skinfold thickness and the incidence of type 2 diabetes mellitus and hypertension: an analysis of the PERU MIGRANT study. *Public health nutrition*, *23*(1), 63-71.

Taja, L. E. C., Ndoen, H. I., & Ndun, H. J. (2024). Hubungan Genetik, Kebiasaan Merokok, dan Aktivitas Fisik dengan Kejadian Diabetes Melitus Tipe 2 pada Lansia di Wilayah Kerja Puskesmas Sikumana Tahun 2021. *SEHATMAS: Jurnal Ilmiah Kesehatan Masyarakat*, *3*(3), 515-521.

Wang, B., Liu, L., Qiao, D., Xue, Y., Liu, X., Zhang, D., & Li, X. (2020). The association between frequency of away-from home meals and type 2 diabetes mellitus in rural Chinese adults: the Henan Rural Cohort Study. *European Journal of Nutrition*, *59*(8), 3815-3825.

Xue, Y., Liu, C., Wang, B., Mao, Z., Yu, S., Wang, Y., & Li, X. (2021). The association between dietary patterns with type 2 diabetes mellitus and pre-diabetes in the Henan rural cohort study. *Public Health Nutrition*, *24*(16), 5443-5452.

Yu, J., Yi, Q., Chen, G., Hou, L., Liu, Q., Xu, Y., & Song, P. (2022). The visceral adiposity index and risk of type 2 diabetes mellitus in China: a national cohort analysis. *Diabetes/metabolism research and reviews*, *38*(3), e3507.

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