KESANS: International Journal of Health and Science
2808-7178 / 2808-7380
http://kesans.rifainstitute.com/index.php/kesans/index

Behavioral and Cardiometabolic Factors Associated with Prediabetes Among Adolescents

[1]Nurul Anggini*, [2] Ilham, [3] Ummi Kalsum
[1]Faculty of Medicine and Health Sciences, Universitas Jambi, Indonesia*; email: nurulanggini21@gmail.com
[2]Faculty of Medicine and Health Sciences, Universitas Jambi, Indonesia; email: ilham_bugis@unja.ac.id
[3]Faculty of Medicine and Health Sciences, Universitas Jambi, Indonesia; email: ummi2103@unja.ac.id
*Correspondence

Article Information
Submitted: **12 June 2026**
Accepted: **28 June 2026**
Publish: **03 July 2026**

Keyword: Adolescents; Prediabetes; Obesity; Physical Activity; Dietary Patterns; Systematic Literature Review;

Abstract
Introduction: *Prediabetes among adolescents is an emerging public health problem due to its increasing prevalence and potential progression to type 2 diabetes mellitus. Various behavioral and cardiometabolic factors have been reported to contribute to the development of prediabetes; however, existing evidence remains fragmented.* ***Objective:*** *This study aimed to systematically review and synthesize current evidence regarding dietary, behavioral, obesity-related, and cardiometabolic factors associated with prediabetes among adolescents.* ***Method:*** *A Systematic Literature Review (SLR) was conducted following the PRISMA 2020 guidelines. Literature searches were performed in PubMed, Scopus, ScienceDirect, and Google Scholar for studies published between 2021 and 2026. Eligible studies included original research involving adolescents aged 10–19 years and reporting factors associated with prediabetes, obesity, overweight, or related metabolic disorders. The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist.* ***Results and Discussion:*** *A total of 11 studies met the eligibility criteria and were included in the review. The findings identified unhealthy dietary patterns, low physical activity, sedentary behavior, obesity, cardiometabolic abnormalities, and sugar-sweetened beverage consumption as factors associated with prediabetes among adolescents. Obesity emerged as the most consistent predictor of prediabetes, while behavioral factors such as junk food consumption, prolonged screen time, and inadequate physical activity contributed indirectly through increased obesity risk.* ***Conclusion:*** *Prediabetes among adolescents is influenced by multiple behavioral and cardiometabolic factors, with obesity serving as the primary intermediary determinant. Comprehensive interventions focusing on healthy dietary behaviors, physical activity promotion, obesity prevention, and early metabolic screening are essential to reduce the future burden of prediabetes and type 2 diabetes mellitus among adolescents.*

How to Cite **Nurul Anggini, Ilham, Ummi Kalsum/Behavioral and Cardiometabolic Factors Associated with Prediabetes Among Adolescents/Vol. 5, No. 9, 2026**
DOI https://doi.org/10.54543/kesans.v5i9.670
e-ISSN/p-ISSN **2808-7178 / 2808-7380**
Published by **CV. Rifainstitut/KESANS: International Journal of Health and Science**

Introduction

Prediabetes and obesity among adolescents have emerged as major public health concerns worldwide due to their increasing pbrevalence and long-term health consequences. Adolescence is a critical developmental period characterized by rapid physical, psychological, and behavioral changes that influence future health trajectories. The widespread adoption of unhealthy dietary habits, sedentary lifestyles, prolonged screen time, and reduced physical activity has substantially contributed to the increasing burden of metabolic disorders among young populations. According to the World Health Organization (WHO, 2023), the prevalence of overweight and obesity among children and adolescents aged 5–19 years has increased dramatically over the past four decades, rising from approximately 8% in 1990 to more than 20% globally. Obesity during adolescence is strongly associated with insulin resistance, impaired glucose metabolism, and an increased risk of developing prediabetes and type 2 diabetes mellitus later in life.

Prediabetes is an intermediate metabolic state in which blood glucose levels are higher than normal but remain below the diagnostic threshold for diabetes mellitus. According to the American Diabetes Association (ADA), prediabetes is defined as fasting plasma glucose of 100–125 mg/dL, HbA1c of 5.7–6.4%, or a 2-hour plasma glucose level of 140–199 mg/dL during an oral glucose tolerance test (ElSayed et al., 2024). The condition is primarily characterized by insulin resistance, in which peripheral tissues become less responsive to insulin, together with progressive pancreatic β-cell dysfunction that limits the body's ability to maintain normal glucose homeostasis. Although prediabetes is potentially reversible, persistent insulin resistance and declining β-cell function substantially increase the risk of progression to type 2 diabetes mellitus and cardiovascular disease if appropriate preventive interventions are not implemented (ElSayed et al., 2024; WHO, 2023).

Recent evidence indicates that the prevalence of prediabetes among adolescents continues to increase worldwide. This trend has been associated with unhealthy dietary patterns, excessive consumption of sugar-sweetened beverages, low levels of physical activity, prolonged sedentary behavior, and obesity (Lariwu et al., 2024; Osei et al., 2026). In Indonesia, rapid urbanization, increased availability of fast food, expansion of food delivery services, and technology-driven lifestyle changes have further encouraged unhealthy eating behaviors and physical inactivity among adolescents, raising concerns regarding the future burden of non-communicable diseases.

Several studies have investigated individual determinants associated with obesity and prediabetes among adolescents. Previous studies reported significant associations between junk food consumption and obesity (Indraguna et al., 2024; Widhawati et al., 2026), unhealthy dietary patterns and overweight (Yana et al., 2025), sugar-sweetened beverage consumption and prediabetes (Siregar et al., 2021), and obesity and prediabetes risk (Sridahrianti et al., 2025). Other studies have highlighted the contribution of physical inactivity, sedentary behavior, and cardiometabolic abnormalities to the development of metabolic disorders among adolescents (Horner et al., 2025; Liu et al., 2021). However, existing evidence remains fragmented because most studies have examined these determinants separately and focused on single outcomes such as obesity, overweight, or prediabetes. Consequently, there is limited comprehensive evidence synthesizing the combined influence of behavioral and cardiometabolic factors on prediabetes risk among adolescents.

Therefore, a systematic literature review is needed to integrate current evidence regarding the relationships between dietary behaviors, physical activity, obesity, and cardiometabolic factors associated with prediabetes among adolescents. The findings of this review are expected to provide evidence-based recommendations for healthcare professionals, educators, public health practitioners, and policymakers to develop comprehensive prevention strategies, promote healthy lifestyles, and support early metabolic screening among adolescents at increased risk of prediabetes.

Method

Study Design

This study employed a Systematic Literature Review (SLR) design to identify, evaluate, and synthesize scientific evidence regarding the roles of dietary patterns, physical activity, obesity, and other metabolic risk factors associated with prediabetes among adolescents. The review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021) to ensure transparency and methodological rigor.

Search Strategy

A comprehensive literature search was conducted using four electronic databases: PubMed, ScienceDirect, Scopus, and Google Scholar. The search was performed between January and March 2026 and included studies published from January 2021 to March 2026. The search strategy combined Medical Subject Headings (MeSH) terms and free-text keywords using Boolean operators as follows:

("prediabetes" OR "impaired fasting glucose" OR "type 2 diabetes risk")
AND
("adolescent" OR "teenager" OR "youth")
AND
("diet" OR "junk food" OR "fast food" OR "sugar-sweetened beverage" OR "physical activity" OR "obesity" OR "sedentary lifestyle").

Manual searches of reference lists from eligible studies were also conducted to identify additional relevant publications.

Eligibility Criteria: The eligibility criteria were determined using the PICOS framework (Table 1).

Table 1
PICOS Framework

Component	Criteria
Population	Adolescents aged 10–19 years
Exposure	Dietary patterns, junk food consumption, sugar-sweetened beverages, physical inactivity, sedentary lifestyle, obesity, cardiometabolic risk factors
Comparison	Not applicable
Outcome	Prediabetes, impaired glucose regulation, obesity, overweight, or metabolic risk factors associated with prediabetes
Study Design	Cross-sectional, case-control, and cohort studies

The inclusion criteria were:
1. Original research articles.
2. Published between 2021 and 2026.
3. Involving adolescents aged 10–19 years.
4. Reporting factors associated with prediabetes, obesity, or metabolic disorders.
5. Available in full text.
6. Published in English or Indonesian.

The exclusion criteria were:
1. Review articles, systematic reviews, and meta-analyses.
2. Editorials, conference abstracts, and commentaries.
3. Studies involving adult or elderly populations.
4. Duplicate publications.
5. Studies with irrelevant outcomes.

Study Selection

All records identified from the database search were imported into reference management software. Duplicate records were removed before screening. The study selection process consisted of three stages:
1. Title screening.
2. Abstract screening.
3. Full-text assessment.

The screening process was performed independently by the reviewers. Any disagreements were resolved through discussion until consensus was reached. The selection process followed the PRISMA 2020 flow diagram. A total of 156 records were identified from database searches. After removing duplicates, 138 articles remained for screening. Following title and abstract screening, 24 articles underwent full-text assessment. Ultimately, 11 studies met all eligibility criteria and were included in the final review.

Data Extraction

Data extraction was conducted using a standardized extraction form developed by the researchers. The extracted information included:
- Author and publication year
- Country
- Study design
- Sample size
- Characteristics of participants
- Investigated risk factors
- Statistical findings (OR, AOR, RR, or p-value)
- Main conclusions

The extracted data were cross-checked by all reviewers to ensure accuracy and consistency.

Quality Assessment

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist appropriate to each study design.

Each study was evaluated based on criteria related to sampling methods, measurement validity, confounding factors, statistical analysis, and reporting quality.

Studies were categorized as:

- High quality (≥75%)
- Moderate quality (50–74%)
- Low quality (<50%)

Only studies classified as moderate and high quality were included in the final synthesis.

Data Synthesis

Due to heterogeneity in study populations, outcome measurements, and analytical methods, a meta-analysis was not performed. Therefore, findings were synthesized narratively. The included studies were grouped according to major themes:

1. Dietary patterns and junk food consumption.
2. Physical activity and sedentary lifestyle.
3. Obesity and cardiometabolic risk factors.
4. Sugar-sweetened beverage consumption and prediabetes.

A comparative analysis was conducted to identify consistent patterns, dominant risk factors, and contextual differences across studies.

Result and Discussion

1. Result

Study Selection

The study selection process followed the PRISMA 2020 guidelines. A total of 156 records were identified through database searches from PubMed, Scopus, ScienceDirect, and Google Scholar. After removing 18 duplicate records, 138 articles remained for title and abstract screening. A total of 114 studies were excluded because they did not meet the inclusion criteria. Subsequently, 24 full-text articles were assessed for eligibility. Thirteen articles were excluded due to inappropriate study populations, irrelevant outcomes, review designs, or insufficient data. Finally, 11 studies met all eligibility criteria and were included in the systematic review. The detailed selection process is presented in Figure 1.

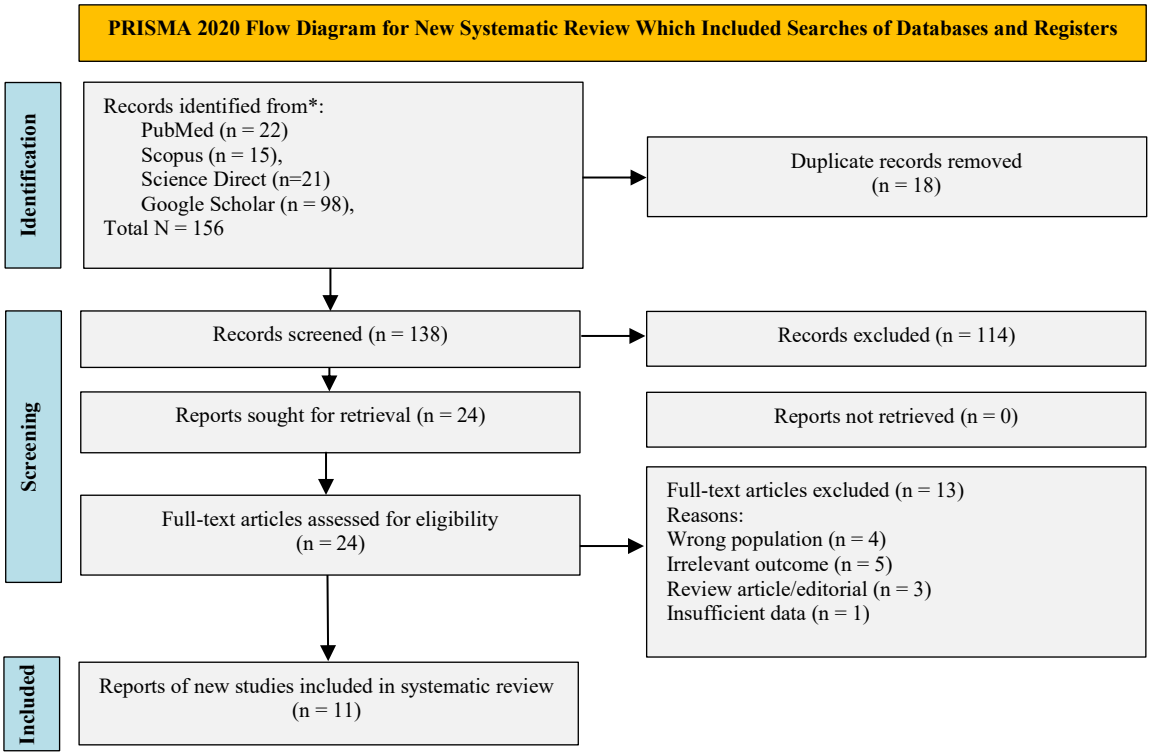

Figure 1. PRISMA Flow Diagram

Characteristics of Included Studies

The characteristics of the included studies are presented in Table 1. The studies were published between 2021 and 2026 and were conducted in Indonesia, the United States, India, and Denmark. Eight studies employed cross-sectional designs, two used case-control approaches, and one study used a cohort design. Sample sizes ranged from 34 to 5,633 participants. The included studies examined several factors associated with metabolic disorders and prediabetes among adolescents, including dietary patterns, junk food consumption, sugar-sweetened beverage intake, physical activity, sedentary lifestyle, obesity, and cardiometabolic risk factors.

Table 2
Characteristics of Included Studies

No	Author (Year)	Country	Design	Sample	Risk Factors	Main Findings
1	Widhawati (2026)	Indonesia	Cross-sectional	70	Junk food, physical activity	Junk food and low physical activity were associated with obesity ($p<0.001$).
2	Indraguna (2024)	Indonesia	Cross-sectional	70	Junk food consumption	Junk food consumption was associated with obesity ($p=0.018$).
3	Yana (2025)	Indonesia	Cross-sectional	127	Diet, physical activity	Diet and physical activity were associated with overweight ($p<0.05$).
4	Liu (2021)	USA	Cross-sectional	5,633	Cardiometabolic risk factors	Cardiometabolic risk clusters increased prediabetes risk (OR=1.32–12.20).
5	Grace (2021)	India	Case-control	220	Dietary habits	Fast food and sweets consumption were

No	Author (Year)	Country	Design	Sample	Risk Factors	Main Findings
						associated with obesity ($p<0.05$).
6	Lariwu (2024)	Indonesia	Case-control	316	Obesity, physical activity, sweet beverages	Obesity was the strongest predictor of prediabetes (OR=6.029).
7	Osei (2026)	USA	Cross-sectional	1,998	WHtR, BMI, age, sex	WHtR was the strongest predictor of prediabetes/T2DM (AOR=146.42).
8	Horner (2025)	Denmark	Cohort	>1,000	Screen time	Longer screen time increased cardiometabolic risk.
9	Herlianty (2025)	Indonesia	Cross-sectional	34	Obesity	Obesity was significantly associated with prediabetes ($p<0.001$).
10	Ayu (2023)	Indonesia	Cross-sectional	117	Fiber intake, junk food, sleep duration	Fiber intake and junk food consumption were associated with overweight.
11	Siregar et al. (2021)	Indonesia	Cross-sectional	140	Sweetened beverages	Sweetened beverage consumption increased prediabetes risk (OR=4.333).

Dietary Patterns and Junk Food Consumption

Four studies identified unhealthy dietary patterns as significant contributors to obesity and metabolic disorders among adolescents. Widhawati (2026) reported that frequent junk food consumption significantly increased the likelihood of obesity (OR = 42.095; $p < 0.001$). Similarly, Indraguna (2024) found a significant relationship between junk food consumption and obesity among school-aged children ($p = 0.018$).

Grace (2021) demonstrated that frequent consumption of fast food, sweet snacks, and unrestricted access to snacks significantly increased the risk of obesity among adolescents. In addition, Ayu (2023) reported that inadequate fiber intake and frequent junk food consumption were significantly associated with overweight status among high school students. Overall, the evidence suggests that unhealthy dietary patterns characterized by high consumption of energy-dense foods and low fiber intake contribute substantially to obesity and metabolic abnormalities among adolescents.

Physical Activity and Sedentary Lifestyle

Three studies highlighted the role of physical inactivity and sedentary behavior in the development of metabolic disorders among adolescents. Widhawati (2026) found that low physical activity was strongly associated with obesity (OR = 133.714; $p < 0.001$). Similarly, Yana (2025) reported a significant association between physical activity patterns and overweight among adolescents ($p = 0.001$). Furthermore, Horner (2025) observed that each additional hour of screen time was associated with higher cardiometabolic risk scores among children and adolescents. These findings indicate that sedentary behaviors contribute to energy imbalance and increased susceptibility to metabolic disorders.

Obesity and Cardiometabolic Risk Factors

Obesity was identified as the most consistently reported determinant of prediabetes. Lariwu (2024) found that obesity was the strongest predictor of prediabetes among high school students (OR = 6.029). Similarly, Herlianty (2025) demonstrated a significant association between obesity and prediabetes among adolescents (p = 0.000).

Liu (2021) reported that clusters of cardiometabolic risk factors, including abdominal obesity, elevated triglycerides, hypertension, and low HDL cholesterol, significantly increased the risk of prediabetes. Likewise, Osei (2026) identified waist-to-height ratio as the strongest independent predictor of prediabetes and type 2 diabetes mellitus among adolescents.These findings suggest that obesity and cardiometabolic abnormalities play a central role in the progression from normal glucose metabolism to prediabetes during adolescence.

Sugar-Sweetened Beverage Consumption and Prediabetes

Two studies consistently identified sugar-sweetened beverage consumption as a significant predictor of prediabetes. Siregar et al. (2021) reported that adolescents consuming more than 12 grams of sugar-sweetened beverages per day had significantly higher odds of developing prediabetes (OR = 4.333; p = 0.01). Similarly, Lariwu (2024) found that sweetened beverage consumption was one of the major contributors to prediabetes among adolescents. The evidence indicates that excessive sugar intake through beverages may contribute to impaired glucose regulation and increase the risk of developing prediabetes.

Summary of Major Findings

Across the included studies, obesity emerged as the most consistent predictor of prediabetes among adolescents. Evidence from Lariwu (2024), Herlianty (2025), Liu (2021), and Osei (2026) demonstrated that obesity and cardiometabolic abnormalities substantially increased the risk of impaired glucose regulation. Behavioral factors, including frequent junk food consumption, low physical activity, prolonged screen time, and excessive consumption of sugar-sweetened beverages, were consistently associated with obesity and subsequently contributed to prediabetes risk. These findings suggest that obesity acts as an intermediary pathway linking unhealthy lifestyle behaviors to the development of prediabetes among adolescents:

1. Unhealthy dietary patterns, particularly frequent consumption of junk food and fast food.
2. Low levels of physical activity and increased sedentary behavior.
3. Obesity and cardiometabolic abnormalities as the strongest predictors of prediabetes.
4. High consumption of sugar-sweetened beverages.

Among these factors, obesity emerged as the most consistent predictor of prediabetes, followed by unhealthy dietary habits and insufficient physical activity.

Quality Assessment

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist. The results are presented in Table 2.

Table 3
Quality Assessment of Included Studies Using JBI Checklist

No	Author (Year)	Study Design	JBI Items	Score	Percentage (%)	Quality
1	Widhawati (2026)	Cross-sectional	8	8	100	High
2	Indraguna (2024)	Cross-sectional	8	7	87.5	High
3	Yana (2025)	Cross-sectional	8	7	87.5	High
4	Liu (2021)	Cross-sectional	8	8	100	High
5	Grace (2021)	Case-control	10	9	90	High
6	Lariwu (2024)	Case-control	10	9	90	High
7	Osei (2026)	Cross-sectional	8	8	100	High
8	Horner (2025)	Cohort	11	10	90.9	High
9	Herlianty (2025)	Cross-sectional	8	7	87.5	High
10	Ayu (2023)	Cross-sectional	8	6	75	High
11	Siregar et al. (2021)	Cross-sectional	8	6	75	High

All eleven studies were classified as high quality. No studies were categorized as low quality. Overall, the methodological quality of the included evidence was considered satisfactory, supporting the reliability of the findings presented in this review.

2. Discussion

Main Findings of the Review

This systematic review identified obesity as the most consistent determinant of prediabetes among adolescents. Across the included studies, obesity and cardiometabolic abnormalities were repeatedly associated with impaired glucose regulation and increased risk of prediabetes. In addition, unhealthy dietary patterns, low physical activity, sedentary behavior, and sugar-sweetened beverage consumption were consistently linked to obesity and metabolic disorders. These findings suggest that behavioral and metabolic factors interact and contribute to the development of prediabetes among adolescents.

Obesity and Cardiometabolic Risk Factors

Among all identified determinants, obesity emerged as the strongest and most consistent predictor of prediabetes. Lariwu et al. (2024) reported that obesity increased the risk of prediabetes by more than six times among adolescents. This finding is biologically plausible because excessive visceral adiposity promotes chronic low-grade inflammation through increased secretion of inflammatory cytokines, leading to insulin resistance and impaired pancreatic β-cell function. Similarly, Herlianty (2025) found a significant association between obesity and prediabetes, while Liu et al. (2021) demonstrated that clusters of cardiometabolic abnormalities, including abdominal obesity, hypertension, elevated triglycerides, and low HDL cholesterol, substantially increased prediabetes risk. Furthermore, Osei et al. (2026) identified waist-to-height ratio as the strongest independent predictor of prediabetes and type 2 diabetes mellitus among adolescents.

The association between obesity and prediabetes is biologically plausible. Excess adipose tissue, particularly visceral fat, promotes insulin resistance through chronic inflammation and metabolic dysregulation. As insulin sensitivity decreases, glucose metabolism becomes impaired, increasing the likelihood of developing prediabetes. These findings support previous evidence indicating that obesity is a critical intermediary factor linking unhealthy lifestyle behaviors to impaired glucose regulation and future diabetes risk.

Dietary Patterns and Junk Food Consumption

This review found that unhealthy dietary patterns were consistently associated with obesity and metabolic disorders among adolescents. Studies conducted by Widhawati (2026), Indraguna (2024), Grace et al. (2021), and Ayu (2023) demonstrated that frequent consumption of junk food, fast food, sweet snacks, and low-fiber diets significantly increased the risk of overweight and obesity.

Poor dietary habits contribute to excessive caloric intake, weight gain, and metabolic imbalance. Frequent consumption of energy-dense foods rich in saturated fat, refined carbohydrates, and added sugars promotes adiposity and increases the likelihood of insulin resistance. Although these dietary factors may not directly cause prediabetes, they contribute substantially to obesity, which subsequently increases the risk of impaired glucose metabolism. Therefore, unhealthy dietary behavior can be considered an upstream determinant of prediabetes among adolescents.

Physical Activity and Sedentary Lifestyle

Low levels of physical activity and prolonged sedentary behavior were also identified as important determinants of metabolic risk among adolescents. Widhawati (2026) reported a strong association between low physical activity and obesity, while Yana (2025) found that insufficient physical activity significantly increased the likelihood of overweight among adolescents. In addition, Horner et al. (2025) observed that longer screen time was associated with higher cardiometabolic risk scores.

Physical activity plays a fundamental role in maintaining energy balance, improving insulin sensitivity, and regulating glucose metabolism. Conversely, sedentary behavior reduces energy expenditure and promotes fat accumulation. The increasing use of smartphones, online gaming, and digital media has contributed to a decline in physical activity among adolescents worldwide. Consequently, promoting active lifestyles and reducing screen time should be prioritized as part of comprehensive strategies to prevent obesity and prediabetes.

Sugar-Sweetened Beverage Consumption and Prediabetes

Consumption of sugar-sweetened beverages emerged as one of the behavioral factors most directly associated with prediabetes. Siregar et al. (2021) reported that adolescents consuming high amounts of sugar-sweetened beverages had more than four times greater odds of developing prediabetes. Similarly, Lariwu et al. (2024) identified sweetened beverage consumption as a significant contributor to prediabetes risk.

Sugar-sweetened beverages contain large amounts of rapidly absorbable free sugars that produce repeated postprandial glucose spikes and compensatory hyperinsulinemia. Chronic exposure to this metabolic stress may gradually reduce insulin sensitivity and accelerate pancreatic β-cell dysfunction, ultimately impairing glucose homeostasis. In addition, unlike solid foods, liquid calories produce relatively weak satiety signals,

resulting in greater total energy intake, weight gain, and increased adiposity. Consequently, excessive consumption of sugar-sweetened beverages contributes both directly to impaired glucose regulation and indirectly through obesity, which has consistently been identified as the strongest predictor of prediabetes among adolescents. Therefore, reducing sugar-sweetened beverage consumption should be considered an essential component of adolescent diabetes prevention programs.

Public Health Implications

The findings of this review highlight the multifactorial nature of prediabetes among adolescents. Obesity appears to function as an intermediary pathway through which unhealthy dietary habits, physical inactivity, sedentary behavior, and excessive sugar consumption influence glucose metabolism. Consequently, prevention efforts should adopt an integrated approach targeting multiple risk factors simultaneously.

Schools should strengthen nutrition education programs, promote healthy food environments, and encourage regular physical activity. Families should support healthy eating behaviors and limit the availability of junk food and sugar-sweetened beverages at home. Healthcare providers should conduct routine screening for obesity and metabolic risk factors among adolescents, particularly those with a family history of diabetes. At the policy level, governments should implement regulations that limit unhealthy food marketing directed toward adolescents and promote public awareness regarding healthy lifestyle behaviors.

Strengths and Limitations

This review provides a comprehensive synthesis of current evidence regarding behavioral and cardiometabolic determinants of prediabetes among adolescents. By integrating findings from multiple countries and study settings, the review offers valuable insights into modifiable risk factors that can be targeted through public health interventions.

However, several limitations should be acknowledged. Most included studies used cross-sectional designs, limiting causal inference. Differences in study populations, measurement methods, and outcome definitions may also have contributed to heterogeneity across studies. Additionally, only articles published in English and Indonesian were included, potentially introducing language bias. Future longitudinal and prospective studies are needed to clarify causal pathways linking lifestyle behaviors, obesity, and prediabetes among adolescents. Most included studies were conducted in Indonesia, which may limit the generalizability of the findings to other populations.

Conclusion

This systematic literature review identified obesity as the most consistent determinant associated with prediabetes among adolescents. Unhealthy dietary patterns, low physical activity, sedentary behavior, and excessive consumption of sugar-sweetened beverages contribute to obesity, which subsequently increases the risk of insulin resistance and impaired glucose metabolism leading to prediabetes. These findings emphasize that behavioral and cardiometabolic factors interact throughout adolescence and should be addressed simultaneously rather than individually.

The review highlights the importance of implementing comprehensive prevention strategies that integrate nutrition education, promotion of regular physical activity, obesity prevention, and reduction of sugar-sweetened beverage consumption. Routine

metabolic screening should be prioritized for adolescents with obesity or overweight, unhealthy lifestyle behaviors, or a family history of diabetes to facilitate early detection and timely intervention. Collaboration among schools, families, healthcare providers, and policymakers is essential to establish supportive environments that encourage healthy behaviors and reduce the future burden of prediabetes and type 2 diabetes mellitus among adolescents.

Reference

Ayu, T. P., Simanungkalit, S. F., Fauziyah, A., & Wahyuningsih, U. (2023). Hubungan Asupan Serat, Kebiasaan Konsumsi Junk Food, dan Durasi Tidur dengan Gizi Lebih pada Remaja. *Jurnal Kesehatan*, *14*(3). https://doi.org/10.26630/jk.v14i3.3942

ElSayed, N. A., Aleppo, G., Bannuru, R. R., Bruemmer, D., Collins, B. S., Ekhlaspour, L., Hilliard, M. E., Johnson, E. L., Khunti, K., Lingvay, I., Matfin, G., McCoy, R. G., Perry, M. Lou, Pilla, S. J., Polsky, S., Prahalad, P., Pratley, R. E., Segal, A. R., Seley, J. J., … Gabbay, R. A. (2024). American Diabetes Association Professional Practice Committee; 6. Glycemic Goals and Hypoglycemia: Standards of Care in Diabetes—2024. *Diabetes Care*, *47*(Supplement_1).

Grace, G. A., Edward, S., & Gopalakrishnan, S. (2021). Dietary habits and obesity among adolescent school children: A case control study in an urban area of kancheepuram district. *Indian Journal of Community Medicine*, *46*(4), 637–640. https://doi.org/10.4103/ijcm.IJCM_1013_20

Indraguna, K. C., Aisyah, I., & Hudaya, A. P. (2024). Hubungan Tingkat Konsumsi Junk Food dengan Obesitas pada Anak Usia Sekolah. *Jurnal Keperawatan Florence Nightingale*, *7*(1), 191–196. https://doi.org/10.52774/jkfn.v7i1.169

Karlina Lariwu, C., Pondaa, A., Prisilia Sarayar, C., Enggune, M., Lontaan, M., & Fitria Tumiwa, F. (2024). *Early Detection Of Prediabetic and Risk Factors in Tomohon City High School Students*.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, n71. https://doi.org/10.1136/bmj.n71

Peprah Osei, E. (2026). Prevalence and predictors of prediabetes/type 2 diabetes mellitus among adolescents in the United States: NHANES (2021–2023). *PLOS Global Public Health*, *6*(2 February). https://doi.org/10.1371/journal.pgph.0005596

Siregar, S., Sunanda Putra, E., Keperawatan, J., Kemenkes Jambi, P., Studi Diploma Tiga Teknologi Laboratorium Medis, P., Analis Kesehatan, J., Unggulan IPTEK, P., & Studi Diploma Tiga Keperawatan, P. (2021). Interaksi konsumsi minuman manis dengan risiko prediabetes pada remaja Kota Jambi. *Riset Informasi Kesehatan*, *10*(2). https://doi.org/10.30644/rik.v8i2.538

WHO. (2023). World Health Organization. Obesity and overweight. *WHO*.

Yana, S., Rahmah Alamsyah, P., & Ayu Lestari, L. (2025). The Relationship between Diet and Physical Activity Patterns with the Incidence of Overweight in Adolescents at SMK Minhajut Thulab Al Amin. *PROFESIONAL HEALTH JOURNAL*, *7*(1), 140–146. https://doi.org/10.54832/phj