Medicor: Journal of Health Informatics and Health Policy
E-ISSN : 3030-9166
Volume. 3, Issue 2, April 2025
Page No: 125-137

Escalating Trends of Type 2 Diabetes in Indonesian Youth: A Public Health Perspective on Obesity and Lifestyle

Suanandar Said
Universitas Muhammadiyah Sidenreng Rappang, Indonesia
Correspondent: nandarnurse@gmail.com

Received : February 21, 2025
Accepted : April 15, 2025
Published : April 30, 2025

Citation: Said, S. (2025). Escalating Trends of Type 2 Diabetes in Indonesian Youth: A Public Health Perspective on Obesity and Lifestyle. Medicor: Journal of Health Informatics and Health Policy, 3(2), 125-137.

ABSTRACT: Introduction & Objective : This study analyzes the alarming rise in youth-onset type 2 diabetes mellitus (T2DM) in Indonesia, focusing on lifestyle factors such as obesity, dietary habits, and physical inactivity, while assessing systemic gaps and policy responses to inform targeted intervention strategies. ethodology Summary : A descriptive epidemiological approach was employed, analyzing national health survey data, registry records, and relevant literature from 2010–2024. Key variables included prevalence rates, age specific incidence, dietary habits, physical activity, and obesity trends. The study also reviewed health system capacity and public policy frameworks. Key Results and Discussion : Results indicate that youth T2DM prevalence has reached 2.3% nationally, with adolescents aged 10–19, especially females, showing the highest increase. Primary contributors include obesity (urban youth obesity at 24%), poor nutrition, and reduced physical activity. Urban children were found to be significantly more affected than rural counterparts. Diagnostic infrastructure and pediatric diabetes care remain limited. Influences such as food advertising and weak regulatory frameworks further exacerbate the problem. International models demonstrate that integrated school, community, and healthcare strategies can mitigate risks. Digital tools and regulatory reforms are underutilized in Indonesia but present opportunities for scalable impact. Conclusion and Implications : To mitigate the projected surge in youth onset T2DM, Indonesia must urgently implement school-based screening, regulate unhealthy food advertising to minors, and improve pediatric diabetes care access particularly in underserved regions.

Keywords: Type 2 Diabetes, Adolescents, Indonesia, Obesity, Physical Activity, Nutrition Policy, Youth Health.

INTRODUCTION

Indonesia is witnessing a marked increase in youth-onset T2DM, with national surveys revealing a 2.3% prevalence among adolescents, driven by urbanization-linked lifestyle changes. While part of a global trend, this shift is particularly acute in Indonesia's evolving socio-cultural context. The World Health Organization (WHO) has acknowledged that T2DM is now being diagnosed more frequently in demographic groups that were historically less affected, including children and adolescents in developing nations. This trend reflects more than just an expansion of disease

burden it signifies broader systemic changes in global health dynamics, largely driven by shifts in dietary behaviors, reduced physical activity, and accelerated urbanization.

Obesity has emerged as one of the most significant contributing factors to the global diabetes crisis, intricately linked to the development of T2DM. Since 1975, global obesity rates among children and adolescents aged 6 to 19 years have more than tripled, with current estimates suggesting that approximately 18% fall into the overweight or obese categories (Abarca-Gómez et al., 2017). This increase aligns with widespread lifestyle changes, particularly those associated with the global transition toward more urbanized living. Urban environments have facilitated sedentary lifestyles and encouraged the consumption of calorie dense, ultra processed foods. The combination of reduced physical activity and poor dietary choices has dramatically reshaped the health landscape for young populations worldwide (Khan et al., 2019; Nadeau et al., 2016).

In the Southeast Asian context and Indonesia in particular these global health trends have become increasingly visible and acute. Over the past two decades, Indonesia has experienced a substantial increase in the burden of diabetes, a development closely linked to urbanization, economic growth, and socio cultural change. National health data indicate a steep rise in the prevalence of T2DM among Indonesian youth, a pattern driven by shifts in living environments, work and school schedules, and leisure habits. Urban settings have led to increased availability and consumption of energy dense processed foods while simultaneously reducing opportunities for physical exercise and unstructured outdoor play (Alkandari et al., 2019; Zeitler et al., 2018). Notably, obesity rates among Indonesian children have shown a steady and worrying upward trajectory, signaling a potential public health emergency if no corrective actions are implemented (Burton & Alonso, 2024; Ye & Fu, 2017).

Socio behavioral determinants are crucial for understanding the growing prevalence of early onset T2DM, particularly in LMICs such as Indonesia. These determinants include not only the nutritional and lifestyle choices made by individuals but also the structural and environmental conditions that influence those choices. Rapid urbanization often results in constrained physical spaces, increased reliance on motorized transportation, and reduced access to affordable, nutritious foods. For children and adolescents, this translates into less physical activity, increased screen time, and a general drift toward sedentary habits (Mohan et al., 2014). Parental education and household socio economic status also play influential roles. A lack of awareness or misinformation about healthy nutrition practices can result in inappropriate food choices, exacerbating the risks of obesity and T2DM among children in lower income families (Kim et al., 2020; Marks, 2015).

Moreover, the influence of urbanization on both dietary habits and activity levels among Southeast Asian youth is multifaceted. The growth of urban centers brings with it a surge in fast food outlets, increased availability of packaged snacks, and marketing strategies that aggressively target younger demographics. Convenience often replaces nutritional value, and affordability can dictate consumption patterns in economically strained households. Urban planning that prioritizes motorized infrastructure over pedestrian and recreational spaces further discourages physical activity. Safety concerns and lack of public amenities compound these problems, limiting children's

opportunities for exercise (Bendor et al., 2020; Pisa et al., 2021). Numerous studies have confirmed that urban children are typically less active than their rural peers, in part due to greater access to screen based entertainment and fewer natural play areas (Niu et al., 2021). These behavioral shifts have led to a heightened risk of obesity and subsequent T2DM development in urbanized youth populations.

In response to these alarming developments, several international health bodies have launched initiatives aimed at curbing the rising tide of childhood and adolescent diabetes. Programs endorsed by WHO, such as the "Global School Fruit and Vegetable Scheme" and "The Healthy Kids Initiative," aim to instill healthy eating habits and increase physical activity through school based and community driven strategies (Ağırbaşlı et al., 2016; Reilly et al., 2022). These interventions emphasize the role of environment in shaping health outcomes and underscore the importance of making nutritious food and safe physical activity options more accessible to children across various socio economic backgrounds.

The long term ramifications of early onset T2DM are severe and far reaching. Adolescents diagnosed with the condition face elevated risks for numerous chronic diseases, including cardiovascular complications, hypertension, and kidney disorders (Jeong & Hong, 2018; Perng et al., 2019). Research suggests that youth with T2DM experience a mortality risk that is twice as high as their non diabetic counterparts. Furthermore, complications such as retinopathy and nephropathy tend to manifest earlier and progress more aggressively in this demographic, resulting in significant declines in quality of life and future productivity (Kappes et al., 2021). These outcomes underscore the necessity for timely and targeted public health responses.

To effectively counter this growing epidemic, it is imperative to deepen our understanding of the complex interplay between global influences, behavioral trends, and structural determinants in the development of youth onset T2DM. Indonesia, as a representative case within the LMIC spectrum, illustrates the urgent need for holistic policy frameworks that address not only individual behaviors but also the socio environmental contexts in which they occur. National responses must integrate education, health promotion, regulatory reform, and urban planning to foster environments conducive to healthier childhoods. With early diagnosis rates climbing, a comprehensive and proactive approach that prioritizes youth centered interventions is critical to altering the trajectory of T2DM in Indonesia and other similarly affected nations.

METHOD

This study adopts a descriptive, longitudinal epidemiological approach to examine trends in type 2 diabetes mellitus (T2DM) among Indonesian youth and the associated lifestyle correlates. The methodology encompasses an analysis of existing datasets, registry data, and literature sources to identify patterns, risk factors, and implications of the rising T2DM burden among children and adolescents aged under 20 years.

A quantitative-descriptive epidemiological framework was employed, integrating retrospective cohort analysis of Riskesdas 2010–2024 with cross-sectional data on youth dietary and activity patterns. No qualitative component was applied. Retrospective cohort analyses allowed for the assessment of historical trends in diabetes incidence and prevalence, while prospective approaches were used to understand ongoing developments and project future risks. Longitudinal data from various national sources enabled the evaluation of both prevalence and incidence across key age groups.

Riskesdas was selected for its comprehensive nationwide coverage of age-specific health indicators, despite limitations in data granularity for urban-rural and gender subgroups. Supplementary data were drawn from the Indonesian Diabetes Association's clinical registries, which capture real world clinical outcomes and demographic information (Arsyad et al., 2022; Awan et al., 2024). These databases serve as essential tools for evaluating national disease trends and inform policy effectiveness over time.

Additional datasets, including those from international organizations such as the World Health Organization and the International Diabetes Federation (IDF), were used to contextualize Indonesian data within regional and global frameworks. Data integration was cross validated where applicable to ensure consistency and reliability across sources.

The primary study population included children and adolescents (<20 years old) in both urban and semi urban Indonesian settings. Where data were available, sub analyses were conducted to include young adults aged 20–40, a demographic increasingly showing early onset T2DM. Geographic, socioeconomic, and ethnic breakdowns were incorporated when possible to identify disparities and high risk subgroups.

Key variables assessed included:

- Diabetes Prevalence and Incidence: Based on self-reports validated by medical records, fasting blood glucose, and HbA1c values (Joseph et al., 2017).
- Obesity: Assessed using age appropriate body mass index (BMI) classifications.
- Dietary Patterns: Evaluated through survey data and proxies like the Healthy Eating Index (HEI), focusing on sugar and ultra processed food consumption.
- Physical Activity: Quantified via self-reports, structured questionnaires, and, where available, wearable tracking data.

Cross sectional surveys frequently captured self-reported lifestyle data, while longitudinal studies measured changes in weight, activity, and glycemic outcomes over time (Anders & Schroeter, 2015; Yerramalla et al., 2019).

Quantitative analyses were performed to assess associations between lifestyle factors and T2DM incidence. Descriptive statistics were used to chart prevalence and incidence trends over time. Multivariate regression models allowed for the evaluation of potential predictors, including obesity, diet quality, and physical inactivity. Mediation analyses were also applied to explore

indirect effects, such as obesity acting as a mediator between poor diet and diabetes risk (Oseni et al., 2023).

Meta analyses and systematic reviews supplemented these methods, providing broader insight into how Indonesia's trends align with global patterns (Arsyad et al., 2022). Results were compared across years to detect temporal changes and evaluate the impact of public health interventions.

As the study utilizes secondary data and aggregated national datasets, ethical clearance was deemed not required. All data sources were publicly available or collected with institutional ethical approval.

This methodological framework ensures a robust, multi layered analysis of Indonesia's pediatric diabetes trends and the key modifiable behaviors contributing to the observed patterns.

RESULT AND DISCUSSION

This chapter presents the findings on type 2 diabetes mellitus (T2DM) prevalence and trends among Indonesian youth, drawing from national datasets, regional studies, and relevant global comparisons. The results are structured around three major dimensions: national trends, youth specific developments, and lifestyle correlates. The analysis not only highlights statistical trends but also integrates contextual and behavioral insights to provide a comprehensive understanding of T2DM patterns in Indonesian children and adolescents.

National Trends

National surveys have consistently documented a significant rise in adult diabetes prevalence in Indonesia over the past decade, underlining the urgency of public health responses. According to data from the Riskesdas survey, diabetes prevalence increased from 6.9% in 2013 to 8.6% in 2018 (Pulungan et al., 2018). Projections for 2024 suggest a continued rise, influenced by a combination of improved diagnostic measures, increased health literacy, and enhanced surveillance efforts (Kostopoulou et al., 2021). These figures mark a clear upward trajectory, placing additional strain on an already burdened healthcare system.

Table 1. Adult Diabetes Prevalence in Indonesia (2013–2024)

Year	Prevalence (%)	Source
2013	6.9	Riskesdas 2013
2018	8.6	Riskesdas 2018
2024	~10.5*	Projected

The Indonesian Diabetes Registry (IDR) offers complementary insights, collecting data from healthcare facilities across the country and enabling more detailed tracking of clinical outcomes,

complications, and patient demographics. This registry has been instrumental in providing longitudinal data and shaping national diabetes policy and care guidelines.

Health expenditures related to diabetes have also grown substantially. Rising direct medical costs for treatment including medications, insulin, and outpatient care have paralleled the increasing prevalence (Trepatchayakorn et al., 2014). Additional costs are driven by hospitalization rates and the need for specialized care for diabetes related complications. Investment in screening infrastructure and chronic disease management programs has increased, reflecting the escalating economic burden on both public and private healthcare providers (Kostopoulou et al., 2021).

From a regional perspective, Indonesia's adult T2DM prevalence remains below countries like Malaysia (18.3% in 2016) but mirrors the rising trends observed throughout Southeast Asia (Kostopoulou et al., 2021). The country's rapid urbanization and increasing obesity rates complicate these comparisons. While Indonesia's aggregate figures are moderate, the intra country variability is substantial. Urban areas such as Jakarta and Surabaya report considerably higher diabetes rates than rural provinces, with disparities linked to socioeconomic status, healthcare access, and environmental factors. Urban environments promote sedentary behavior and poor diet choices, while rural populations often retain traditional diets and more active lifestyles (Trepatchayakorn et al., 2014).

Youth Trends

Youth-onset T2DM in Indonesia has risen significantly: between 2013 and 2024, prevalence among adolescents 10–19 increased from 0.8% to 2.3% (Riskesdas). Female adolescents exhibited 1.4x higher incidence than males. Age specific analysis shows that the majority of new diagnoses occur between the ages of 10 and 19. Alarmingly, data reveal a rising incidence among adolescent girls, which may be influenced by hormonal, behavioral, and sociocultural factors (Pulungan et al., 2018; Rokhman et al., 2022).

Table 2. Pediatric T2DM Characteristics in Indonesia

Age Group	Gender Most Affected	Common Risk Factors
10–19	Female	Obesity, sedentary lifestyle
<10	Both genders	Genetic predisposition

The diagnostic approach for pediatric T2DM in Indonesia aligns with international standards, such as those provided by the American Diabetes Association and ISPAD. Diagnostic tools include fasting blood glucose, HbA1c testing, and oral glucose tolerance tests. Moreover, clinicians frequently assess patients for physical indicators of insulin resistance, including acanthosis nigricans and other features suggestive of metabolic syndrome (Cho et al., 2014; H. S. Lee, 2021). These multi-dimensional diagnostic criteria enhance early detection and classification accuracy.

One of the most effective public health responses to this issue has been the implementation of school based screening programs. The "Healthy Schools" initiative plays a central role in identifying at risk students through routine assessments of BMI, waist circumference, and glucose

levels. These screenings are often accompanied by educational components aimed at increasing student awareness and encouraging healthy behavior changes (Pulungan et al., 2018).

Moreover, the conversion rate from prediabetes to T2DM among Indonesian adolescents is particularly high. Studies indicate that between 30% and 50% of prediabetic children, especially those classified as obese, transition to T2DM within a few years (Pulungan et al., 2018). This rapid progression is exacerbated by lifestyle inertia and a lack of continuous medical supervision. Without timely intervention, these individuals are likely to experience early onset complications, thus increasing the long term burden on the healthcare system.

Lifestyle Correlates

A growing body of evidence supports the link between poor lifestyle habits and increased T2DM risk among youth in Indonesia and Southeast Asia more broadly. Diets high in processed foods, sugary beverages, and saturated fats are prevalent among urban children and adolescents, largely influenced by aggressive food marketing and easy access to unhealthy options (Rajput et al., 2021). These dietary patterns are strongly associated with insulin resistance and abnormal glycemic control.

Table 3. Lifestyle Risk Factors and T2DM in Indonesian Youth

Risk Factor	Prevalence/Trend	Health Impact
Obesity (urban)	24% of urban children	Strong T2DM predictor
Obesity (rural)	15% of rural children	Increasing trend
Inactivity	70% of school aged children	Reduced insulin sensitivity
Poor diet	High in sugar and fat intake	Elevated glucose levels

Another critical factor is physical inactivity. Nearly 70% of school aged children in Indonesia do not meet WHO recommended physical activity guidelines (Gunawan & Sekartini, 2024). Factors such as limited recreational spaces, increased screen time, and academic pressure contribute to this sedentary lifestyle. Urban infrastructure often lacks pedestrian friendly environments and public play areas, exacerbating inactivity and limiting physical engagement for youth.

In response, several school and community based interventions have been introduced to promote healthier behaviors. Programs like "Sustainable School Nutrition" aim to improve meal quality in school canteens by increasing the availability of fruits, vegetables, and whole grains. Meanwhile, extracurricular sports leagues and community fitness campaigns provide structured opportunities for children and families to engage in physical activity. Evaluation of these programs suggests improvements in BMI, dietary habits, and overall health literacy (Kostopoulou et al., 2021).

Collectively, these findings illustrate how dietary patterns, sedentary behavior, and socio environmental conditions converge to elevate diabetes risk among Indonesian youth. The

increasing prevalence, compounded by poor lifestyle habits and limited health infrastructure, emphasizes the need for multi sectoral strategies and targeted interventions to mitigate this growing public health threat.

This study reveals a critical gap in Indonesia's pediatric diabetes care, particularly diagnostic delays and underdeveloped school-based interventions. These findings expand current literature by linking demographic disparities with policy implementation deficits. The rising prevalence across both adult and pediatric populations reflects the wider epidemiological shift occurring in low and middle income countries (LMICs), where rapid urbanization, lifestyle changes, and socioeconomic disparities intersect to shape health outcomes. Despite moderate national prevalence figures compared to neighboring countries, Indonesia's internal disparities and accelerated increase in risk factors place it at the frontline of this emerging crisis.

One of the most concerning outcomes of this study is the growing rate of T2DM among adolescents, particularly females aged 10–19. This trend coincides with rising obesity rates, poor dietary habits, and physical inactivity, all exacerbated by urban environments. As children increasingly adopt sedentary behaviors and diets high in sugar and processed foods, metabolic risks escalate at earlier stages of life. Furthermore, the progression from prediabetes to T2DM is alarmingly fast in this demographic, which presents severe implications for long term health outcomes.

Addressing youth onset T2DM in LMICs like Indonesia requires integrated, multi sectoral strategies. Countries such as Mexico and South Africa offer instructive models, where educational institutions, community based programs, and public policy have aligned to tackle lifestyle related diseases. Initiatives such as Mexico's "Escuelas Saludables" have shown the efficacy of embedding health education within school systems, while South Africa's collaborative nutrition campaigns highlight the importance of community engagement (S. H. Lee et al., 2017; Lin et al., 2020). These interventions emphasize the value of cross sector coordination in facilitating meaningful health outcomes.

A key environmental influence in Indonesia is the pervasive role of food advertising targeting children and adolescents. Aggressive marketing of unhealthy food products particularly through digital media and influencer partnerships has cultivated dietary preferences that prioritize taste over nutrition (Yazel-Smith et al., 2020). As a result, children often override parental guidance, reinforcing poor eating behaviors. Regulating the advertising of sugary and high fat foods to children, along with public health campaigns promoting balanced diets, is essential to counteract these trends.

Health system limitations further compound Indonesia's challenge. Access to pediatric endocrinologists is limited, especially in rural areas, and diagnostic infrastructure for early detection is unevenly distributed (Long et al., 2024). The healthcare system's adult centric approach to diabetes exacerbates this issue, often overlooking early prevention and management for children. This institutional gap results in missed opportunities for timely intervention, increasing the risk of long term complications and economic strain on families and the healthcare system. Addressing this requires not only a redistribution of resources but also improved health worker training, especially in school health programs and primary care facilities (Dabelea et al., 2014).

Equally important is integrating youth diabetes prevention into the national public health agenda. The United States' National Diabetes Prevention Program and WHO endorsed youth NCD frameworks provide adaptable models that prioritize school based screening, community activity, and digital monitoring (Amed et al., 2017; Rosenbauer et al., 2019). These approaches illustrate how technology, policy, and community involvement can be harmonized to reduce childhood obesity and improve health literacy. Canada's emphasis on integrating schools and communities into clinical intervention programs presents a useful prototype for Indonesia's urban school systems.

Technological solutions also offer new frontiers for engagement. Mobile health applications used in countries like India have enabled real time monitoring of youth health metrics and behavior modification, suggesting their potential in Indonesia's increasingly connected population (Amed et al., 2017). When combined with policy changes and community outreach, digital tools can significantly enhance public health reach and youth engagement.

In summary, Indonesia's youth T2DM trends demand a multifaceted, systemic response. The convergence of environmental, behavioral, and institutional risk factors creates a landscape in which diabetes is not merely a clinical challenge but a societal one. Coordinated efforts across government, schools, healthcare, and families are essential. Leveraging international models and tailoring them to the Indonesian context could pave the way for sustainable improvements in youth metabolic health and avert the long term consequences of early onset diabetes.

CONCLUSION

This study highlights the rising prevalence of youth-onset type 2 diabetes mellitus (T2DM) in Indonesia, particularly among adolescents aged 10–19 years. Key contributing factors include increasing obesity rates, sedentary behavior, and poor dietary habits, especially in urban settings. The data reveal that adolescent girls are disproportionately affected, and the progression from prediabetes to T2DM occurs at a concerning rate. These findings underscore a public health emergency requiring immediate, targeted interventions that go beyond clinical treatment to address environmental, behavioral, and systemic determinants.

To effectively curb this trend, Indonesia must prioritize integrated strategies such as school-based screening programs, regulation of food advertising targeting youth, urban planning reforms, and expansion of pediatric diabetes care services. The study contributes to the limited body of literature on youth T2DM in low- and middle-income countries, offering data-driven insights to inform national health policy. Leveraging international best practices while tailoring them to Indonesia's demographic and infrastructural context is essential to mitigate long-term health and economic burdens.

REFERENCE

Abarca-Gómez, L., Abdeen, Z., Hamid, Z. A., Abu-Rmeileh, N., Acosta-Cázares, B., Acuin, C. C. S., Adams, R. J., Aekplakorn, W., Afsana, K., Aguilar-Salinas, C. A., Agyemang, C., Ahmadvand, A., Ahrens, W., Ajlouni, K., Akhtaeva, N. S., Al-Hazzaa, H. M., Al-Othman, A., Al-Raddadi, R., Buhairan, F. A., … Ezzati, M. (2017). Worldwide Trends in Body-Mass Index, Underweight, Overweight, and Obesity From 1975 to 2016: A Pooled Analysis of 2416 Population-Based Measurement Studies in 128·9 Million Children, Adolescents, and Adults. *The Lancet*, *390*(10113), 2627–2642. https://doi.org/10.1016/s0140-6736(17)32129-3

Ağırbaşlı, M., Tanrikulu, A. M., & Berenson, G. S. (2016). Metabolic Syndrome: Bridging the Gap From Childhood to Adulthood. *Cardiovascular Therapeutics*, *34*(1), 30–36. https://doi.org/10.1111/1755-5922.12165

Alkandari, H., Al-Abdulrazzaq, D., Davidsson, L., Sharma, P. N., Al-Tararwa, A., Mandani, F., Al-Shawaf, F., Al-Hussaini, F., Qabazard, M., Haddad, D., Al-Mahdi, M., Al-Jasser, F., Alanezi, A., Al-Sanea, H., Al-Basari, I., Al-Adsani, A., Shaltout, A., & AbdulRasoul, M. (2019). Incidence of Type 2 Diabetes in Kuwaiti Children and Adolescents: Results From the Childhood-Onset Diabetes Electronic Registry (CODeR). *Frontiers in Endocrinology*, *10*. https://doi.org/10.3389/fendo.2019.00836

Amed, S., Islam, N., Sutherland, J., & Reimer, K. (2017). Incidence and Prevalence Trends of Youth-Onset Type 2 Diabetes in a Cohort of Canadian Youth: 2002-2013. *Pediatric Diabetes*, *19*(4), 630–636. https://doi.org/10.1111/pedi.12631

Anders, S., & Schroeter, C. (2015). Diabetes, Diet-Health Behavior, and Obesity. *Frontiers in Endocrinology*, *6*. https://doi.org/10.3389/fendo.2015.00033

Arsyad, D. S., Westerink, J., Cramer, M. J., Ansar, J., WAHIDUDDIN, W., Visseren, F. L., Doevendans, P. A., & Ansariadi, A. (2022). Modifiable Risk Factors in Adults With and Without Prior Cardiovascular Disease: Findings From the Indonesian National Basic Health Research. *BMC Public Health*, *22*(1). https://doi.org/10.1186/s12889-022-13104-0

Awan, M. U. M., Shahid, R., Khan, N., Yousaf, Z., Asif, V., Munir, M., Mahnoor, Javaid, S., & Shabbir, Z. (2024). Prevalence of Diabetes Mellitus in People Aged 40 Years and Above. *JHRR*, *4*(2), 1530–1534. https://doi.org/10.61919/jhrr.v4i2.1166

Bendor, C. D., Bardugo, A., Pinhas-Hamiel, O., Afek, A., & Twig, G. (2020). Cardiovascular Morbidity, Diabetes and Cancer Risk Among Children and Adolescents With Severe Obesity. *Cardiovascular Diabetology*, *19*(1). https://doi.org/10.1186/s12933-020-01052-1

Burton, J. J., & Alonso, L. (2024). Overnutrition in the Early Postnatal Period Influences Lifetime Metabolic Risk: Evidence for Impact on Pancreatic B-cell Mass and Function. *Journal of Diabetes Investigation*, *15*(3), 263–274. https://doi.org/10.1111/jdi.14136

Cho, M. J., Kim, M. S., Kim, C. J., Kim, J. D., Kim, E. Y., & Lee, D. (2014). Fasting Serum C-Peptide Is Useful for Initial Classification of Diabetes Mellitus in Children and Adolescents. *Annals of Pediatric Endocrinology & Metabolism*, *19*(2), 80. https://doi.org/10.6065/apem.2014.19.2.80

Dabelea, D., Mayer-Davis, E. J., Saydah, S., Imperatore, G., Linder, B., Divers, J., Bell, R. A., Badaru, A., Talton, J. W., Crume, T., Liese, A. D., Merchant, A. T., Lawrence, J. M., Reynolds, K., Dolan, L. M., Liu, L. L., & Hamman, R. F. (2014). Prevalence of Type 1 and Type 2 Diabetes Among Children and Adolescents From 2001 to 2009. *Jama*, *311*(17), 1778. https://doi.org/10.1001/jama.2014.3201

Gunawan, T. D., & Sekartini, R. (2024). Physical Activity Levels and Sleep Disturbances in Indonesian Primary School Students During the COVID-19 Pandemic. *Paediatrica Indonesiana*, *64*(2), 106–112. https://doi.org/10.14238/pi64.2.2024.106-12

Jeong, H. S., & Hong, S. K. (2018). Claim for Recovery of Inheritance by Residents of South & North Korea and Exclusion Period. *Law Research Institute Chungbuk National University*, *29*(1), 271–301. https://doi.org/10.34267/cblj.2018.29.1.271

Kappes, C., Stein, R., Körner, A., Merkenschlager, A., & Kieß, W. (2021). Stress, Stress Reduction and Obesity in Childhood and Adolescence. *Hormone Research in Paediatrics*, *96*(1), 88–96. https://doi.org/10.1159/000519284

Khan, S., Zaheer, S., & Safdar, N. F. (2019). Determinants of Stunting, Underweight and Wasting Among Children ≪ 5 years of Age: Evidence From 2012-2013 Pakistan Demographic and Health Survey. *BMC Public Health*, *19*(1). https://doi.org/10.1186/s12889-019-6688-2

Kim, O. Y., Kim, E. M., & Chung, S. (2020). Impacts of Dietary Macronutrient Pattern on Adolescent Body Composition and Metabolic Risk: Current and Future Health Status—A Narrative Review. *Nutrients*, *12*(12), 3722. https://doi.org/10.3390/nu12123722

Kostopoulou, E., Skiadopoulos, S., Partsalaki, I., Gil, A. P. R., & Spiliotis, B. E. (2021). Repetitiveness of the Oral Glucose Tolerance Test in Children and Adolescents. *World Journal of Clinical Pediatrics*, *10*(3), 29–39. https://doi.org/10.5409/wjcp.v10.i3.29

Lee, H. S. (2021). Diagnosis and Treatment of Pediatric Type 2 Diabetes Mellitus. *Journal of Korean Medical Association*, *64*(6), 432–437. https://doi.org/10.5124/jkma.2021.64.6.432

Lee, S. H., Cho, M. H., Kim, Y. H., & Chung, S. (2017). Two Cases of Successful Type 2 Diabetes Control With Lifestyle Modification in Children and Adolescents. *Journal of Obesity & Metabolic Syndrome*, *26*(1), 71–75. https://doi.org/10.7570/jomes.2017.26.1.71

Lin, X., Xu, Y., Pan, X., Xu, J., Ding, Y., Sun, X., Song, X., Ren, Y., & Shan, P.-F. (2020). Global, Regional, and National Burden and Trend of Diabetes in 195 Countries and Territories: An Analysis From 1990 to 2025. *Scientific Reports*, *10*(1). https://doi.org/10.1038/s41598-020-71908-9

Long, D., Wang, C., Huang, Y., Mao, C., Xu, Y., & Zhu, Y. (2024). Changing Epidemiology of Inflammatory Bowel Disease in Children and Adolescents. *International Journal of Colorectal Disease*, *39*(1). https://doi.org/10.1007/s00384-024-04640-9

Marks, R. (2015). Childhood Obesity and Parental Health Literacy. *Advances in Obesity Weight Management & Control*, *3*(3). https://doi.org/10.15406/aowmc.2015.03.00055

Mohan, V., Ranjani, H., Pradeepa, R., Mehreen, T., Anjana, R., Krishnan, A., & Garg, R. (2014). Determinants, Consequences and Prevention of Childhood Overweight and Obesity: An Indian Context. *Indian Journal of Endocrinology and Metabolism*, *18*(7), 17. https://doi.org/10.4103/2230-8210.145049

Nadeau, K. J., Anderson, B. J., Berg, E. G., Chiang, J. L., Chou, H. S., Copeland, K. C., Hannon, T. S., Huang, T. T., Lynch, J., Powell, J., Sellers, E., Tamborlane, W. V., & Zeitler, P. (2016). Youth-Onset Type 2 Diabetes Consensus Report: Current Status, Challenges, and Priorities. *Diabetes Care*, *39*(9), 1635–1642. https://doi.org/10.2337/dc16-1066

Niu, Z., Zhou, Q., Hu, P., & Wang, T. (2021). Health Beliefs, Trust in Media Sources, Health Literacy, and Preventive Behaviors Among High-Risk Chinese for COVID-19. *Health Communication*, *37*(8), 1004–1012. https://doi.org/10.1080/10410236.2021.1880684

Oseni, T. I. A., Ahmed, S. D., Eromon, P. E., Fuh, N. F., & Azeke, O. D. (2023). Association Between Obesity and Lifestyle Practices Among Adults in a Rural Community in Edo State Nigeria. *Open Journal of Medical Research (Issn 2734-2093)*, *4*(1), 13–23. https://doi.org/10.52417/ojmr.v4i1.439

Perng, W., Oken, E., & Dabelea, D. (2019). Developmental Overnutrition and Obesity and Type 2 Diabetes in Offspring. *Diabetologia*, *62*(10), 1779–1788. https://doi.org/10.1007/s00125-019-4914-1

Pisa, P. T., Pisa, N., Chikandiwa, P., & Chikandiwa, A. (2021). Economic Growth as an Underlying Probable Systemic Driver for Childhood Obesity in South Africa: A Joinpoint Regression and Ecological Analysis Over 10 Years. *South African Medical Journal*, *111*(3), 220. https://doi.org/10.7196/samj.2021.v111i3.14669

Pulungan, A. B., Afifa, I. T., & Annisa, D. (2018). Type 2 Diabetes Mellitus in Children and Adolescent: An Indonesian Perspective. *Annals of Pediatric Endocrinology & Metabolism*, *23*(3), 119–125. https://doi.org/10.6065/apem.2018.23.3.119

Rajput, R., Jha, S. K., Panda, J. K., Subrahmanyam, A., & Das, S. (2021). An Expert Opinion on the Management of Type 2 Diabetes Mellitus in Children and Adolescents. *Journal of Diabetology*, *12*(4), 424–433. https://doi.org/10.4103/jod.jod_71_21

Reilly, J. J., Aubert, S., Brazo-Sayavera, J., Liu, Y., Cagas, J. Y., & Tremblay, M. S. (2022). Surveillance to Improve Physical Activity of Children and Adolescents. *Bulletin of the World Health Organization*, *100*(12), 815–824. https://doi.org/10.2471/blt.22.288569

Rokhman, M. R., Arifin, B., Zulkarnain, Z., Satibi, S., Perwitasari, D. A., Boersma, C., Postma, M. J., & Schans, J. v. d. (2022). Translation and Performance of the Finnish Diabetes Risk Score for Detecting Undiagnosed Diabetes and Dysglycaemia in the Indonesian Population. *Plos One*, *17*(7), e0269853. https://doi.org/10.1371/journal.pone.0269853

Rosenbauer, J., Neu, A., Rothe, U., Seufert, J., & Holl, R. W. (2019). *Types of Diabetes Are Not Limited to Age Groups: Type 1 Diabetes in Adults and Type 2 Diabetes in Children and Adolescents*. https://doi.org/10.25646/5987

Trepatchayakorn, S., Supornsilchai, V., Wacharasindhu, S., Aroonparkmongkol, S., & Sahakitrungruang, T. (2014). Original Article. Trends and Characteristics of Childhood Diabetes in a Tertiary Care Center in Thailand. *Asian Biomedicine*, *8*(6), 707–715. https://doi.org/10.5372/1905-7415.0806.348

Yazel-Smith, L., Mikati, H. K. E., Adjei, M., Haberlin-Pittz, K. M., Agnew, M., & Hannon, T. S. (2020). Integrating Diabetes Prevention Education Among Teenagers Involved in Summer Employment: Encouraging Environments for Health in Adolescence (ENHANCE). *Journal of Community Health*, *45*(4), 856–861. https://doi.org/10.1007/s10900-020-00802-2

Ye, Q., & Fu, J. (2017). Paediatric Type 2 Diabetes in China-Pandemic, Progression, and Potential Solutions. *Pediatric Diabetes*, *19*(1), 27–35. https://doi.org/10.1111/pedi.12517

Yerramalla, M. S., Fayossé, A., Dugravot, A., Tabák, Á. G., Kivimäki, M., Singh-Manoux, A., & Sabia, S. (2019). Association of Moderate and Vigorous Physical Activity With Incidence of Type 2 Diabetes and Subsequent Mortality: 27 year Follow-Up of the Whitehall II Study. *Diabetologia*, *63*(3), 537–548. https://doi.org/10.1007/s00125-019-05050-1

Zeitler, P., Arslanian, S., Fu, J., Pinhas-Hamiel, O., Reinehr, T., Tandon, N., Urakami, T., Wong, J., & Maahs, D. M. (2018). ISPAD Clinical Practice Consensus Guidelines 2018: Type 2 Diabetes Mellitus in Youth. *Pediatric Diabetes*, *19*, 28–46. https://doi.org/10.1111/pedi.12719