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Review Article (Pages: 1-10)

The Prevalence of Type 2 Diabetes (T2D) among Iranian Children and Adolescents: A Literature Review

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Abstract

Background: Type 2 diabetes (T2D) mellitus is becoming a notable health concern among children and adolescents in Iran. This study aims to review the prevalence of T2D among Iranian children and adolescents and identify risk factors based on existing literature.

Materials and Methods: In this review, a systematic search was conducted across multiple databases, including PubMed, Scopus, Web of Science, EMBASE, CINAHL, and Google Scholar, from inception to December 2024. Two independent researchers performed the search, study selection, and data extraction.

Results: The global incidence of Type 2 Diabetes among youth has significantly increased from 1990 to 2021, rising from 56.02 to 123.86 per 100,000 with an average annual percentage change of 3.01%. Type 2 Diabetes prevalence is lower in Iranian children, with approximately 1% developing pre-diabetes or T2D annually, compared to adults at about 10.8%. Among overweight children, the prevalence of impaired fasting glucose (IFG) is reported as 4.61%, while the prevalence of T2D is 0.1%. T2D in children and adolescents is influenced by both modifiable and non-modifiable risk factors, including high Body Mass Index (BMI), elevated fasting plasma glucose levels, lifestyle factors such as sedentary behavior and unhealthy diets, genetic predisposition, family history, and biological differences. Geographic and demographic variations also contribute to these disparities, with urban children generally having higher rates of obesity compared to their rural counterparts.

Conclusion: Unlike the rising global incidence of Type 2 Diabetes, Iranian children and adolescents have a notably lower rate, with about 1% developing pre-diabetes or T2D annually. Lifestyle factors, genetic predispositions, and regional differences are key risk factors. Understanding these factors is crucial for developing effective prevention strategies.

Key Words: Adolescents, Children, Iran, Type 2 Diabetes, Prevalence.

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1- INTRODUCTION

Type 2 diabetes (T2D) is a progressive metabolic disorder characterized by insulin resistance and impaired insulin secretion, ultimately leading to chronic hyperglycemia. It poses a major global health threat because of serious long-term complications, including cardiovascular disease, nephropathy, neuropathy, and retinopathy (1–3). The rising prevalence of T2D among children and adolescents is particularly alarming; North America reports the highest rates of youth-onset T2D, whereas Europe shows comparatively lower prevalence (4). Findings from the Global Burden of Disease Study also highlight a steady increase in the incidence of T2D among adolescents and young adults aged 10–24 years between 1990 and 2021 (5).

In Iran, the trend of increasing T2D prevalence is further complicated by rising sedentary behavior and childhood obesity. Adolescent obesity rates have escalated from 13.3% to 24% within a decade (6). The COVID-19 pandemic has exacerbated these lifestyle-related risk factors, contributing to decreased physical activity and compromised dietary habits (7, 8). Systemic reviews have estimated the overall prevalence of T2D in Iran to be approximately 10.8% in adults, with notable variations across age groups and regions (9). However, there is a paucity of specific data on T2D prevalence within the Iranian pediatric population, hindering the development of targeted interventions.

Understanding the prevalence of T2D in Iranian children is crucial due to the aggressive clinical course of youth-onset T2D, characterized by rapid β-cell function decline and increased risk of complications like cardiovascular disease and nephropathy (10, 11). Projections indicate a potential doubling or quadrupling of T2D cases in youth by 2050, emphasizing the urgency of this issue (1). Given the cultural and regional variations within Iran, localized studies are essential to develop culturally sensitive and effective interventions (12, 13). Therefore, this study aimed to evaluate the prevalence of T2D and risk factors among Iranian children and adolescents, utilizing existing literature to bridge the current knowledge gap and inform the development of targeted prevention and management strategies (14).

2- MATERIALS AND METHODS

This study employed a narrative review approach to evaluate the prevalence and risk factors of Type 2 Diabetes Mellitus in Iranian children and adolescents, utilizing existing literature.

2-1. Search Strategy

A systematic search was conducted across multiple electronic databases, including PubMed, Scopus, Web of Science, EMBASE, CINAHL, and Google Scholar, from database inception up to December 2024. Both English and Persian language publications were included to ensure a comprehensive capture of relevant studies. Additionally, gray literature was explored to minimize publication bias. Search terms focused on "children," "adolescents," "type 2 diabetes," "T2D," "prevalence," and "risk factors," combined with "Iran".

2-2. Eligibility criteria

Eligibility criteria for this review were defined to include population-based studies conducted among Iranian children or adolescents aged 18 years or younger (15), focusing on Type 2 Diabetes Mellitus prevalence and/or associated risk or predisposing factors in the Iranian population. Additionally, only original research published in English or Persian languages up to December 2024 was considered.

2-3. Exclusion criteria

Exclusion criteria were applied to ensure the relevance and quality of included

studies. These excluded studies focused on type 1 diabetes, adult populations, and those merging T2D data with other diabetes types. Furthermore, studies on diabetes among individuals with co-morbidities, interventional studies like RCTs, and non-original publications such as case series, reviews, and editorials were not included.

2-4. Data extraction

Data from the selected studies were extracted and organized using a researcher-developed data extraction form. This form captured information on study design, participant characteristics, prevalence rates, and identified risk factors.

2-5. Review process

Two independent researchers conducted the search, study selection, and data extraction processes. Discrepancies were resolved through discussion and consensus, or by consulting a third reviewer.

2-6. Ethical considerations

As this study involved a review of publicly available literature, ethical committee approval was not required. However, adherence to copyright regulations and transparent documentation of sources were maintained throughout the review process.

3- RESULTS

Type 2 diabetes mellitus has emerged as a major global health challenge, with its prevalence and incidence surging dramatically over recent decades. This trend is particularly concerning among younger populations, where lifestyle changes, obesity, and socioeconomic factors play significant roles. Globally, the incidence of T2D among youth increased from 56.02 to 123.86 per 100,000 from 1990 to 2021, with an average annual percentage change of 3.01% (5). In Iran, the prevalence of T2D in children is significantly lower than in adults, with approximately 1% of adolescents developing pre-diabetes or T2D annually (16). The overall prevalence of T2D in Iranian adults is estimated at about 10.8% (9). The following sections explore the global prevalence rate of T2D, its prevalence among Iranian children and adolescents, and the risk factors contributing to its development in this demographic.

3-1. Global Prevalence Rate

The global incidence of T2D among youth has surged significantly from 1990 to 2021. The incidence rose from 56.02 to 123.86 per 100,000, with an average annual percentage change of 3.01%. This increase is linked to lifestyle changes, obesity, and socioeconomic factors, particularly in low and middle SDI regions. The trend highlights the need for targeted interventions to address the growing health challenge of early-onset T2D (5).

3-2. Prevalence of Type 2 Diabetes in Iranian Children and Adolescents

- **Prevalence rate:** The prevalence of Type 2 Diabetes (T2D) among Iranian children is notably lower than in adults, reflecting distinct differences in risk factors and health outcomes across age groups. While the overall prevalence of T2D in Iranian adults is estimated at approximately 10.8% (9), studies indicate that the incidence among adolescents is significantly lower, with about 1% developing pre-diabetes or T2D each year (16). This disparity underscores the importance of understanding age-specific risk factors and implementing targeted interventions to address the growing burden of T2D in both adult and adolescent populations.
- **Incidence rate**: In a cohort of Iranian adolescents aged 10-19, the incidence

of pre-diabetes/Type 2 Diabetes (T2D) was found to be 9.61 per 1000 person-years (16). This incidence rate corresponds to approximately 1% of Iranian adolescents developing pre-diabetes or T2D annually, highlighting the need for tailored strategies to manage and prevent T2D in this demographic.

3-3. Prevalence of impaired fasting glucose (IFG) and T2D in Overweight Iranian Children

A study conducted by Moadab et al. (2010) focused on the prevalence of impaired fasting glucose (IFG) and Type 2 Diabetes (T2D) in a population-based sample of overweight/obese children in Iran. The study found that 4.61% of the participants had IFG, while only 0.1% had T2D (17). This study highlights that although T2D is relatively rare in Iranian obese children, IFG is more common, indicating a need for preventive measures and regular screening of fasting plasma glucose.

3-4. Prevalence of Type 2 Diabetes in Iranian Adults

Based on an updated systematic review and meta-analysis, the overall prevalence of T2D in Iranian adults is estimated to be approximately 10.8%. This figure reflects a comprehensive overview of the condition's impact across different demographics. Specifically, men have a prevalence of around 10.8%, while women have a slightly higher prevalence of about 13.4%. The prevalence of diabetes is notably higher in the 55-64 age group, reaching approximately 21.7%. Geographically, certain provinces such as Khuzestan, Razavi Khorasan, Qazvin, and Yazd exhibit higher prevalence rates compared to others, with Khuzestan having one of the highest at around 15.3%. These variations highlight the need for targeted interventions to address the growing burden of T2D in Iran (9).

3-5. Risk Factors for Type 2 Diabetes in Children and Adolescents

Type 2 diabetes mellitus is a complex condition influenced by a variety of factors, including modifiable lifestyle choices, non-modifiable genetic and familial predispositions, and geographic and demographic variations. Understanding these risk factors is crucial for developing effective prevention and management strategies. In Iran, the prevalence of T2D has increased significantly over the years, driven by factors such as obesity, physical inactivity, and dietary patterns (9, 18). High body-mass index, ambient particulate matter pollution, and low physical activity are identified as major risk factors contributing to the burden of T2D in Iran (18). Additionally, changes in lifestyle, urbanization, and dietary habits have exacerbated the issue (9). The following sections outline the key modifiable and non-modifiable risk factors, as well as geographic and demographic variations that contribute to the development of T2D among children and adolescents:

3-5-1. Modifiable Risk Factors

- **High Body Mass Index (BMI):** Elevated BMI is a significant predictor of T2D, with obesity rates at 11.4% among Iranian children (19). Obesity increases insulin resistance, a key factor in T2D development.
- **Elevated Fasting Plasma Glucose Levels:** Increased fasting glucose levels are associated with a higher likelihood of developing T2D (16). This is a critical indicator of insulin resistance.
- **Lifestyle Factors:** Sedentary lifestyles and unhealthy dietary patterns contribute to the prevalence of overweight and obesity among children (20). Promoting physical activity and healthy eating habits can reduce these risks.

3-5-2. Non-Modifiable Risk Factors

- **Genetic Predisposition:** Genetic factors play a crucial role in the high prevalence of T2D (21). Genetic predisposition significantly influences T2D risk.
- **Family History:** A paternal history of T2D is a significant risk factor for developing pre-diabetes or T2D in adolescents (16). Family history strongly predicts T2D risk.
- **Biological Differences:** Children have higher metabolic rates, leading to better glucose regulation compared to adults. However, hormonal changes during puberty may increase insulin resistance. In Iranian children, studies have highlighted the importance of monitoring cardio-metabolic risk factors, including glucose levels, which are crucial for early detection and management of metabolic disorders (22).

3-5-3. Geographic and Demographic Variations

- **Urban vs. Rural Differences:** Urban children have higher rates of overweight, obesity, and abdominal obesity compared to rural counterparts (19). Lifestyle differences and environmental factors contribute to these disparities.
- **Gender Differences:** Boys have a higher prevalence of low HDL-C, while girls have higher rates of obesity and overweight. In Iran, studies indicate that low HDL-C is more common in boys, whereas obesity is more prevalent in girls (20, 23). Adolescent girls are more susceptible to Type 2 Diabetes due to hormonal factors affecting insulin sensitivity and glucose metabolism, particularly during puberty (24).

These findings emphasize the importance of addressing modifiable risk factors through lifestyle changes and public health interventions to mitigate the rising trend of T2D among children and adolescents.

4- DISCUSSION

Type 2 Diabetes Mellitus is a chronic metabolic disorder characterized by high blood glucose levels due to insulin resistance and impaired insulin secretion, affecting millions globally (3, 25, 26). This study aimed to evaluate the prevalence of Type 2 Diabetes (T2D) and associated risk factors among Iranian children and adolescents. The results showed that the overall prevalence of T2D in Iranian adults is estimated at approximately 10.8% (9), while the incidence among adolescents is significantly lower, with about 1% developing pre-diabetes or T2D each year (16).

Type 2 Diabetes Mellitus has become a significant global health challenge, with its prevalence surging among younger populations due to lifestyle changes, obesity, and socioeconomic factors (27). Globally, the incidence of T2D among youth has increased significantly over the past few decades, reflecting broader trends in obesity and lifestyle changes (5). In many regions, particularly those with low and middle sociodemographic indices (SDI), lifestyle changes and limited healthcare access exacerbate the issue, contributing to a rising burden of T2D (28).

The development of T2D among children and adolescents is influenced by a variety of factors, including modifiable lifestyle choices and non-modifiable genetic and familial predispositions. Key modifiable risk factors include high Body Mass Index (BMI), elevated fasting plasma glucose levels, and lifestyle factors such as sedentary lifestyles and unhealthy dietary patterns (20). Obesity is particularly significant, as it is associated with insulin

resistance and is a major risk factor for T2D in young populations (29). Non-modifiable risk factors include genetic predisposition and family history, with a strong hereditary component observed in the development of T2D (11, 30). Geographic and demographic variations, such as urban vs. rural differences and gender disparities, also contribute to the prevalence of T2D (17).

Based on the current results, the prevalence of T2D was lower in Iranian children and adolescents compared to adults (9, 16). Several factors contribute to this lower prevalence including:

- **Physical Activity:** Children are generally more physically active than adults, which helps maintain a healthier weight and reduces the risk of developing diabetes (31). This increased physical activity contributes to better insulin sensitivity and glucose regulation.
- **Dietary Patterns:** Children's dietary patterns often differ from those of adults, with less exposure to high-calorie diets that contribute to obesity and T2D (19). Healthier eating habits among children can mitigate the risk of obesity-related metabolic disorders.
- **Metabolic Rates:** Higher metabolic rates in children lead to better glucose regulation compared to adults (16). This biological difference helps protect children from insulin resistance and T2D.
- **Hormonal Environment:** The hormonal environment during growth phases in children may provide some protective effects against insulin resistance (22). Hormonal changes during puberty can influence metabolic health, but generally, children's hormonal profiles support better glucose metabolism.
- **Geographic Variations:** Children in rural areas tend to have lower rates of obesity and related risk factors than their urban counterparts, a trend that is less pronounced in adults (19, 22). Lifestyle differences and environmental factors contribute to these disparities.
- **Familial Influences:** While parental obesity and diabetes history are significant risk factors for adults, children may not yet be as affected by these familial influences (16). However, as children grow into adulthood, these genetic predispositions can become more relevant.

These factors highlight the importance of understanding age-specific risk factors to develop effective prevention strategies for T2D.

The global rise in Type 2 Diabetes among children and adolescents has become a pressing public health concern. Factors such as lifestyle changes, obesity, and socioeconomic disparities are contributing to this trend (5, 32). In Iran, while the prevalence of T2D is lower among children compared to adults (9, 16), proactive measures are necessary to address the growing burden of this disease. The incidence of T2D among children and adolescents worldwide has increased significantly over the past two decades (28).

To effectively address the rising incidence of T2D among Iranian children and adolescents, a comprehensive public health strategy is crucial. This strategy should integrate lifestyle modifications, targeted screening, and community engagement:

- **Promoting Healthy Habits:** Educational programs are essential for promoting healthy eating habits, focusing on reducing high-fat and high-carbohydrate diets while educating families about nutritional needs. Encouraging regular physical activity

through school programs and community initiatives can help mitigate obesity, a significant risk factor for T2D (33).

- **Early Detection and Intervention:** Implementing systematic screening for prediabetes and T2D in schools can facilitate early detection and intervention, which is vital for managing the rising prevalence of diabetes among youth. For instance, approximately 1% of Iranian adolescents develop pre-diabetes or T2D annually, highlighting the need for early intervention (16).
- Tailored Programs: Programs should be designed based on demographic factors, as the prevalence of T2D varies by region and socioeconomic status. Involving families and local communities in health initiatives can enhance adherence to lifestyle changes and provide necessary support systems (9). Additionally, cost-effective strategies like vitamin D supplementation have been proposed as beneficial for reducing diabetes risk in Iranian adolescents (34).
- Addressing Challenges: Addressing Challenges: While these strategies are promising, challenges such as socioeconomic disparities and cultural beliefs may hinder their effectiveness. In Iran, similar challenges are compounded by issues like inadequate resource distribution and limited community involvement in health decision-making (35). Furthermore, cultural barriers and insufficient public awareness about health issues also impact the effectiveness of public health strategies (36). Addressing these barriers is vital for the successful implementation of public health interventions.

In summary, although the global prevalence of Type 2 Diabetes among youth is increasing, Iran's relatively lower prevalence among adolescents presents an opportunity for targeted interventions to prevent and manage T2D effectively. For instance, studies have shown that about 1% of Iranian adolescents develop pre-diabetes or T2D annually, highlighting the importance of early interventions (16). Furthermore, the overall burden of T2D in Iran is significant, with a substantial increase in incidence and prevalence from 1990 to 2019, primarily attributed to high body mass index, ambient particulate matter pollution, and low physical activity (18). Understanding and addressing the complex interplay of risk factors, including lifestyle changes, socioeconomic disparities, and cultural beliefs, is vital for mitigating this growing health challenge (9, 14, 16).

5- CONCLUSION

Type 2 Diabetes (T2D) has become a significant global health challenge, with its prevalence surging among younger populations due to lifestyle changes, obesity, and socioeconomic factors (27, 28). Globally, the age-standardized incidence rate of T2D among adolescents and young adults increased substantially from 1990 to 2019. In Iran, the prevalence of T2D among children remains notably lower than in adults, with approximately 1% of adolescents developing pre-diabetes or T2D annually.

Type 2 Diabetes in Iranian children and adolescents is influenced by both modifiable and non-modifiable risk factors. Modifiable risk factors include high Body Mass Index (BMI), elevated fasting plasma glucose levels, and lifestyle factors such as sedentary behavior and unhealthy diets. Non-modifiable risk factors include genetic predisposition, family history, and biological differences like hormonal changes during puberty. Additionally, geographic and demographic variations play a significant role, with

urban children generally having higher rates of obesity compared to their rural counterparts, and adolescent girls being more likely to develop T2D due to hormonal factors. To address this trend, a comprehensive public health strategy is essential. This strategy should encompass lifestyle modifications, targeted screening, and community engagement.

6- CONFLICT OF INTEREST: None.

7- REFERENCES

1. Crawford AL, Laiteerapong N. Type 2 Diabetes. Ann Intern Med. 2024 Jun;177(6):ITC81-ITC96. doi: 10.7326/AITC202406180.

2. Barzan, M. The Role of Insulin Resistance and Pancreatic Beta -Cell Dysfunction in Type Two Diabetes: A Review Article. International Journal of Health & Medical Research, 2024; 3(12). doi.org/10.58806/ijhmr.2024.v3i12n07.

3. Saini V. Molecular mechanisms of insulin resistance in type 2 diabetes mellitus. World J Diabetes. 2010 Jul 15;1(3):68-75. doi: 10.4239/wjd.v1.i3.68. PMID: 21537430; PMCID: PMC3083885.

4. Gesuita, R., Eckert, A., Besançon, S., Crimmins, N. A., Cavallo-Aita, F., Kim, J. H., Jefferies, C., Gevers, E., Vamvakis, A., Shah, S., Amed, S., & Cherubini, V. Frequency and clinical characteristics of children and young people with type 2 diabetes at diagnosis from five world regions between 2012 and 2021: data from the SWEET Registry, 2024. Diabetologia. https://doi.org/10.1007/s00125-024-06283-5

5. Xu, S., Sun, M., & Xiang, Y. Global, regional, and national trends in type 2 diabetes mellitus burden among adolescents and young adults aged 10–24 years from 1990 to 2021: a trend analysis from the Global Burden of Disease Study 2021. World Journal of Pediatrics, 2025. https://doi.org/10.1007/s12519-024-00861-8

6. Azizi, F., et al. Impaired Fasting Glucose Prevalence Surge among Iranian Adolescents in a Decade: The Tehran Lipid and Glucose Study. Pediatric Diabetes, 2019; 20(6):761-69.

7. Arazi, H., Taati, B. Impact of coronavirus (COVID-19) pandemic on physical activity levels in different sub-populations of Iranians: a national survey. *Sci Rep* 2025;15**:** 3140. https://doi.org/10.1038/s41598-025-85977-1.

8. Sarokhani D, Sarokhani M, Hasanpour Dehkordi A, Ghanei Gheshlagh R, Fakhri M. Prevalence of obesity and overweight in Iranian students: a systematic review and meta-analysis. J Pediatr Endocrinol Metab. 2020 Apr 28;33(4):453-468. doi: 10.1515/jpem-2019-0474. PMID: 32126015.

9. Hazar N, Jokar M, Namavari N, Hosseini S, Rahmanian V. An updated systematic review and Meta-analysis of the prevalence of type 2 diabetes in Iran, 1996-2023. Front Public Health. 2024 Apr 4;12:1322072. doi: 10.3389/fpubh.2024.1322072. PMID: 38638475; PMCID: PMC11025666.

10. Sanjari M, Hedayati M, Azizi F. Prevalence of Type 2 Diabetes Mellitus in 3-19 Age Group in East of Tehran in 2001. Iranian Journal of Endocrinology and Metabolism 2007; 9 (2):119-26.

11. Heshmat R, Hemati Z, Qorbani M, Nabizadeh Asl L, Motlagh ME, Ziaodini H, Taheri M, Ahadi Z, Shafiee G, Aminaei T, Hatami H, Kelishadi R. Metabolic syndrome and associated factors in Iranian children and adolescents: the CASPIAN-V study. J Cardiovasc Thorac Res. 2018;10(4):214-220. doi: 10.15171/jcvtr.2018.37. Epub 2018 Dec 5. PMID: 30680080; PMCID: PMC6335982.

12. Akbari H, Mohammadi M. The prevalence of obesity in Iranian children: a systematic review and meta-analysis. Journal of Pediatrics Review. 2022 Apr 10;10(2):93-102.

13. Hedayati M, Masoudi Asl I, Maleki M, Fazaeli AA, Goharinezhad S. The Variations in Catastrophic and Impoverishing Health Expenditures, and Its Determinants in Iran: A Scoping Review. Med J Islam Repub Iran. 2023 Apr 26;37:44. doi: 10.47176/mjiri.37.44. PMID: 37426477; PMCID: PMC10329513.

14. Najafipour M, Zareizadeh M, Najafipour F. Epidemiologic study of familial Type 2 Diabetes in Tehran. J Adv Pharm Technol Res. 2018 Apr-Jun; 9(2):56-60. doi: 10.4103/japtr.JAPTR_228_18.

15. World Health Organization. Adolescent health, 2023. Available from: https://www.who.int/health-topics/adolescent-health.

16. Mirbolouk M, Derakhshan A, Charkhchi P, Guity K, Azizi F, Hadaegh F. Incidence and predictors of early adulthood pre-diabetes/type 2 diabetes, among Iranian adolescents: the Tehran Lipid and Glucose Study. Pediatr Diabetes. 2016 Dec;17(8):608-16. doi: 10.1111/pedi.12343. Epub 2016 Jan 14. PMID: 26764014.

17. Moadab, M. H., Kelishadi, R., Hashemipour, M., Amini, M., & Poursafa, P. The prevalence of impaired fasting glucose and type 2 diabetes in a population-based sample of overweight/obese children in the Middle East. Pediatric Diabetes, 2010;11(2), 101–6. doi: 10.1111/j.1399-5448.2009.00534.x.

18. Peimani M, Esfahani Z, Bandarian F, Esmaeili S, Moghaddam SS, Namazi N, et al. The Burden of Type 2 Diabetes Mellitus and Attributable Risk Factors in Iran, 1990-2019: Results from the Global Burden of Disease Study 2019. Iran J Public Health. 2024 Apr;53(4):913-23. doi: 10.18502/ijph.v53i4.15569. PMID: 39444467; PMCID: PMC11493583.

19. Motlagh, M. E., Qorbani, M., Rafiemanzelat, A.-M., Taheri, M., Aminaee, T., Shafiee, G., Ahadi, Z., Hajiali, M., Ghaderi, K., Safaei, A. A., Goodarzi, A., Ziaodini, H., Heshmat, R., & Kelishadi, R. (2018). Prevalence of cardiometabolic risk factors in a nationally representative sample of Iranian children and adolescents: the CASPIAN-V Study. Journal of Cardiovascular and Thoracic Research, 10(2), 76–82. https://doi.org/10.15171/JCVTR.2018.12

20. Kelishadi R, Ardalan G, Qorbani M, Ataie-Jafari A, Bahreynian M, Taslimi M, Motlagh ME, Heshmat R. Methodology and Early Findings of the Fourth Survey of Childhood and Adolescence Surveillance and Prevention of Adult Non-Communicable Disease in Iran: The CASPIAN-IV Study. Int J Prev Med. 2013 Dec;4(12):1451-60. PMID: 24498502; PMCID: PMC3898452.

21. Moazzam-Jazi, M., Najd Hassan Bonab, L., Zahedi, A. S., & Daneshpour, M. S. High genetic burden of type 2 diabetes can promote the high prevalence of disease: a longitudinal cohort study in Iran. Scientific Reports, 2020; 10(1): 14006. https://doi.org/10.1038/S41598-020-70725-4.

22. Dalili S, Rezvani SM, Dalili H, Mohtasham Amiri Z, Mohammadi H, Medghalchi A, Novin MH, Gholamnezhad H. Cardio-metabolic risk factors in Iranian children: where we are and the others? Acta Med Iran. 2014;52(11):831-6. PMID: 25415816.

23. Montazeri-Najafabady N, Dabbaghmanesh MH, Asmarian N, Rais Pour H. Age-, Sex-, and Puberty-Associated Reference Intervals for Lipid Profile in Iranian Children and Adolescents. Int J Endocrinol. 2023 Feb 24;2023:9143234. doi: 10.1155/2023/9143234. PMID: 36876280; PMCID: PMC9984260.

24. Dashtabi, A., Kohansal, A., Mirzaee, A., Akhlaghi, M. Age at Menarche and its Nutrition-Related Factors among School Girls in Shiraz, Southern Iran. International Journal of Nutrition Sciences, 2018; 3(3): 133-38.

25. Młynarska, E., Czarnik, W., Dzieża, N., Jędraszak, W., Majchrowicz, G., Prusinowski, F., et al. Type 2 Diabetes Mellitus: New Pathogenetic Mechanisms, Treatment and the Most Important Complications. International Journal of Molecular Sciences, 2025;26(3):1094. https://doi.org/10.3390/ijms26031094.

26. Xie J, Wang M, Long Z, Ning H, Li J, Cao Y, Liao Y, Liu G, Wang F, Pan A. Global burden of type 2 diabetes in adolescents and young adults, 1990-2019: systematic analysis of the Global Burden of Disease Study 2019. BMJ. 2022 Dec 7; 379:e072385. doi: 10.1136/bmj-2022-072385. PMID: 36740855; PMCID: PMC9727920.

27. Khan MAB, Hashim MJ, King JK, Govender RD, Mustafa H, Al Kaabi J. Epidemiology of Type 2 Diabetes - Global Burden of Disease and Forecasted Trends. J Epidemiol Glob Health. 2020 Mar;10(1):107-111. doi: 10.2991/jegh.k.191028.001. PMID: 32175717; PMCID: PMC7310804.

28. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF

Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes Res Clin Pract. 2022 Jan;183:109119. doi: 10.1016/j.diabres.2021.109119. Epub 2021 Dec 6. Erratum in: Diabetes Res Clin Pract. 2023 Oct;204:110945. doi: 10.1016/j.diabres.2023.110945.

29. Danaei G, Finucane MM, Lu Y, Singh GM, Cowan MJ, Paciorek CJ, et al. Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (Blood Glucose). National, regional, and global trends in fasting plasma glucose and diabetes prevalence since 1980: systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2·7 million participants. Lancet. 2011 Jul 2;378(9785):31-40. doi: 10.1016/S0140-6736(11)60679-X. Epub 2011 Jun 24. PMID: 21705069.

30. Mehrnoosh Khodaeian, Samaneh Enayati, Ozra Tabatabaei-Malazy, and Mahsa M. Amoli. Association between Genetic Variants and Diabetes Mellitus in Iranian Populations: A Systematic Review of Observational Studies. Journal of Diabetes Research, 2015; 1-21. Article ID 585917, 21 pages http://dx.doi.org/10.1155/2015/585917.

31. Aune D, Norat T, Leitzmann M, Tonstad S, Vatten LJ. Physical activity and the risk of type 2 diabetes: a systematic review and dose-response meta-analysis. Eur J Epidemiol. 2015 Jul;30(7):529-42. doi: 10.1007/s10654-015-0056-z. Epub 2015 Jun 20. PMID: 26092138.

32. Pramanik S, Mondal S, Palui R, Ray S. Type 2 diabetes in children and adolescents: Exploring the disease heterogeneity and research gaps to optimum management. World J Clin Pediatr 2024; 13(2): 91587.

33. Dehghani Firouzabadi M, Sheikhy A, Poopak A, Esteghamati A, Mechanick JI, Dehghani Firouzabadi F. Challenges to Lifestyle Medicine for Type 2 Diabetes in Iran: A Synoptic Review. American Journal of Lifestyle Medicine. 2023. Available from: https://journals.sagepub.com/doi/10.1177/15598276231167787.

34. Zandieh, N., Rezaei Hemami, M., Darvishi, A., Hasheminejad, S. M., Abdollahi, Z., Zarei, M., et al. Economic evaluation of a national vitamin D supplementation program among Iranian adolescents for the prevention of adulthood type 2 diabetes mellitus. BMC Complementary Medicine and Therapies, 2022;22(1): 1–9. doi: 10.1186/s12906-021-03474-0

35. M Davari, A Haycox, T Walley. Health Care Challenges in Iran. Iran J Public Health. 2005;34(Supple 1):30-1.

36. Bagheri Dolatabadi, A. Requirements and Challenges in Iran for Adoption of Efficient Health Diplomacy. International Studies Journal (ISJ), 2023; 20(1): 29-56. doi: 10.22034/isj.2023.322274.1715.