



Intervention of Hypertension and Diabetes in India in Children and Adults

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ABSTRACT:

Hypertension and diabetes are among the most prevalent non-communicable diseases globally and represent a significant and growing public health burden in India. This review examines the epidemiology, risk factors, and intervention strategies for hypertension and diabetes in both children and adults, with a focus on the Indian population. The rising prevalence is strongly associated with urbanization, sedentary lifestyles, unhealthy dietary patterns, obesity, and socioeconomic disparities. Notably, increasing rates of childhood obesity and early-life risk factors have contributed to the emergence of these conditions in younger populations. The review highlights key modifiable and non-modifiable risk factors, including genetic predisposition, dietary habits, physical inactivity, stress, and environmental influences such as pollution and solar ultraviolet radiation. Evidence-based intervention strategies are discussed, encompassing lifestyle modifications such as dietary management (including DASH and Mediterranean diets), regular physical activity, and weight control. Pharmacological treatments, including antihypertensive agents and antidiabetic drugs such as metformin, SGLT2 inhibitors, and GLP-1 receptor agonists, are also evaluated. Special emphasis is placed on paediatric management, where early diagnosis, family involvement, and behavioral interventions play a crucial role in preventing long-term complications. Technological advancements, including digital health tools and glucose monitoring systems, offer promising support for disease management. Despite progress, gaps remain in awareness, treatment adherence, and healthcare accessibility. Strengthening public health policies, improving early screening, and promoting preventive strategies are essential to mitigate the growing burden of hypertension and diabetes in India across all age groups.

Keywords: Diabetes, Hypertension, Risk Factors, UV Radiations

INTRODUCTION:

India is a country of 1.4 billion people contribute to the global diabetes burden. Updated evidence on the state of the diabetes epidemic among middle-aged and older adults is imperative, given that the risk of diabetes even in young ages and that clinical and public health interventions can prevent diabetes complications. We aimed to estimate the prevalence, awareness, treatment, and control of diabetes in a nationally representative and state-representative sample of Indians aged 45 years and older. Hypertension is a nationally representative survey of adults in India. Our primary outcomes were diabetes prevalence and health service indicators recommended by the WHO. Diabetes prevalence was defined as individuals self-reporting a previous diabetes diagnosis or having HbA1c of 6.5% or higher. The available data did not allow for the identification of type 1 and type 2 diabetes. Diabetes health service indicators were based on four core metrics recommended by WHO: proportion diagnosed out of all individuals with diabetes and out of individuals with diagnosed diabetes, proportion with hypoglycaemia control, proportion with blood pressure control, and proportion self-reporting use of lipid-lowering medications. Outcomes were assessed in the national sample; by state and union territory; and across individual-level characteristics of age, sex, rural versus urban area of residence, education, economic status, and BMI [1].

In children the prevalence of diabetes among adults aged 45 years and older in India was 95%, which amounted to 50.4 million people (49.4–51.4 million). Prevalence among men and women was similar 95%. Urban diabetes prevalence 95% was approximately twice as high as rural prevalence 15%. States with higher levels of economic development tended to have greater age-standardize prevalence. Overall, 60.1% (59.0–61.2) of individuals were aware of their diabetes. Of individuals with diagnosed diabetes, 45.7% (44.3–47.2) achieved hypoglycaemia control, 58.9% (57.5–60.4) achieved blood pressure control, and 6.4% (5.8–7.2) were taking a lipid-lowering medication. Our findings emphasizes the urgent need to scale up policies to better prevent, detect, manage, and control diabetes among middle-aged and older adults in India. Hypertension can trigger other noncommunicable diseases. [2].



RISK FACTORS OF HYPERTENSION AND DIABETES IN ADULTS AND CHILDREN'S

SOLAR UV RADIATION: RISK FACTOR FOR HYPERTENSION

Hypertension is a condition in which repeated examination results in a systolic blood pressure [S blood pressure (BP)] of more than 140 mm Hg in the clinic or health center and a diastolic blood pressure [D blood pressure (BP)] of at least 90 mm Hg. It develops when the arterioles put too much pressure on the vessel walls from the blood, making the heart work harder to keep the pressure and It increases blood pressure (blood pressure (BP)) is one of the leading risk factors for cardiovascular morbidity and mortality worldwide, eclipsing smoking and alcohol, with the lowest risk associated with a usual systolic blood pressure (BP) (S blood pressure (BP)) between 110 and 115 mm Hg, well within the non-sensitive range, blood pressure (BP) is regulated by a myriad of endogenous (neural, cardiac, and endocrine) and exogenous (diet and exercise) factors that can adversely serve to lead to hypertension and excess cardiovascular risk temperature, although there appeared to be an interaction between the two environmental factors. The authors postulate that the mechanism of blood pressure (BP) lowering may be caused by UV-induced mobilization of constituents of the alternative [3].

Table: RISK FACTORS IN ADULTS

Risk Factors	Children	Adults
Genetic Predisposition	Family history of hypertension	Family history of hypertension
Obesity/Overweight	Increasing childhood obesity rates	High prevalence of obesity and overweight
Dietary Factors	High salt intake, low fruits and vegetables	High salt intake, unhealthy diet (fat, salt)
Physical Inactivity	Sedentary lifestyle, lack of exercise	Sedentary lifestyle, low physical activity
Socioeconomic Status	Lower socioeconomic status linked to risk	Socioeconomic disparities influence prevalence
Stress & Psychological Factors	Academic and social stress	Work-related and lifestyle stress
Birth Weight & Early Life Factors	Low birth weight linked to higher risk	Early life factors, including low birth weight
Co-existing Medical Conditions	Obstructive sleep apnoea, kidney diseases	Diabetes, chronic kidney disease, metabolic syndrome
Tobacco & Alcohol Use	Usually not relevant in younger children	Significant risk factor in adults
Environmental Factors	Exposure to pollution and urbanization effects	Urbanization, pollution, and environmental stress

Physical activity was dichotomous into sufficient (≥ 150 minutes/wk.) and insufficient (< 150 minutes/wk.) categories. Nicotine exposure was determined if an individual reported to be a former smoker, current every day smoker, current some day smoker, or smoker with current status unknown and does not take second-hand or family exposure into account; otherwise, they were classified as non-smokers[4].

TREATMENT METHODS/WAYS FOR HYPERTENSION AND DIABETES IN ADULTS

Hypertension management guidelines recommend exercise/physical activity across the lifespan, including childhood and adolescence, because of its demonstrated antihypertensive effects and also its favourable effects on other modifiable CVD risk factors. Guidelines follow current knowledge that regular engagement in physical activity leads to improved heart and body habit us, as well as more favourable measures of metabolically health and reduced inflammation [5].

ADULTS DIETARY TREATMENT

Diet plays an important role in the healthy functioning of the body. Many different dietary patterns are hailed as useful for improving blood pressure (BP) control, most without adequate evidence to substantiate their benefits. It consumes diets low in fat and salt and high in fruit and fibre The Dietary Approaches to Stop Hypertension (DASH) low-sodium and the Mediterranean diet are most widely acknowledged for their benefits to reducing blood pressure (BP) and improving cardiovascular health, albeit not always being viable because of food costs, availability and insecurity, incompatibility with a culturally and ethnically diverse society or food allergies. Broadly, both recommend low saturated fat, low salt, high fibre (from whole grains, fruits and vegetables) and adequate lean protein. Both align with the World Health Organization (WHO) guidance to reduce the risk of noncommunicable disease. The DASH diet, rich in calcium, potassium, magnesium, and micro-nutrients, emphasizes consumption of fruits, vegetables, low-fat dairy products, and reduced saturated fat and cholesterol, and is recommended as an effective dietary intervention to reduce blood pressure (BP) and maintain a healthy weight. The adoption of the DASH diet was accompanied by substantial blood pressure (BP) reduction in adults with and without hypertension. In addition, vegetarian diets have also been associated with lower blood



pressure (BP) in comparison to unrestricted omnivore diets (no salt, sugar or saturated and transfat restrictions) Vegetarian diets have a higher portion of gluten and plant-based protein, which has blood pressure-lowering effects. Moreover, higher content of fibre, antioxidants and potassium as well as lower saturated fat and sodium content in healthy vegetarian diets can contribute to a lower body mass index and BP readings [6].

PHARMACOLOGICAL TREATMENT FOR DIABETES

Metformin and Phenformin are oral anti-diabetic drugs of the guanine class. Metformin is the drug of choice for the treatment of adults with Type 2 Diabetes Mellitus (T2DM) due to its low frequency of side effects. It is currently used by nearly one-third of diabetic patients. Metformin improves insulin action in the liver, decreasing hepatic production of glucose by 10 to 30% and, at the cellular level, it increases the tyro-sine kinase activity of the insulin receptor [7].

Empagliflozin, sold under the brand name Radiance, among others, is an anti-diabetic medication used to improve glucose control in people with type 2 diabetes and for patients with established heart failure with reduced ejection fraction (Hf-ref). Studies have shown great benefits for heart failure (HF) outcomes and decreased hospitalization. It is taken by mouth. Common side effects of empagliflozin include genital yeast infections and hypo-tension, particularly in patients with volume depletion. Other symptoms, such as nausea and vomiting, may occur and seem more pronounced in combination with metformin. Rare but serious adverse events, such as hypoglycemic diabetic acidosis, which may present with hyperventilation, lethargy, or mental status change, have been reported but are infrequent in trials. Other serious but rare adverse events include Fourier's gangrene, a severe skin infection of the groin, and diabetic acidosis that may occur even with normal blood glucose levels [15].

TREATMENT OF HYPERTENSION IN CHILDREN

The child's habits, including their level of physical activity, sleep patterns, diet, and any signs of stress or emotional tension, so it is necessary to assess the child's body mass index (BMI). It is also important to learn about habits related to salt, sugar, fast food, and sugary drinks, as well as time spent in front of screens (TV, computer, mobile devices)(16). The physical examination helps to determine the child's physical condition and identify possible signs that indicate the presence of hypertension or other conditions. Blood pressure (BP) is measured several times using the correct technique to get reliable results. It is important to record blood pressure (BP) in both arms if necessary. The child's height and weight are measured to calculate body mass index (BMI) to assess obesity and its associated effects. The parent should find out the child's habits: level of physical activity, sleep patterns, diet, presence of stress, and emotional tension. Overweight and obesity are important risk factors for hypertension.

CHECKING PHYSICAL HEALTH STATUS OF CHILDREN

The physical examination helps the doctor determine the child's physical condition and identify possible signs that indicate the presence of hypertension or other conditions. Blood pressure (BP) is measured several times using the correct technique to get reliable results. It is important to record blood pressure (BP) in both arms if necessary. The doctor listens to the heart and lungs, checks the pulse in the extremities, and examines the skin. He or she will look for signs of cardiac hypertrophy or other abnormalities. Physical examination may also assess the presence of oedema on the extremities, which may indicate kidney problems that contribute to an increase in blood pressure (BP). Assessment of target organ function, such as the eyes and respiratory status. If the physician identifies risk factors or suspicion of secondary arterial hypertension during the history and physical examination, further investigations may be required.

Regular health checks are crucial for early detection and control of arterial hypertension in children. Regular blood pressure checks are recommended, especially in children with risk factors. Screening should be done as part of preventive check-ups with paediatricians or in school health offices. In addition, regular height and weight measurements will help to monitor BMI and identify cases of overweight early, allowing for timely intervention and lifestyle changes. It is important that the doctor actively discusses children's health with parents, providing recommendations on how to reduce risks and maintain a healthy lifestyle [6].

FAMILY SUPPORT:

Family involvement in the process of developing healthy habits is also important. Creating a supportive environment where the whole family is actively involved in lifestyle changes increases the likelihood that children will follow their parents' lead. Joint physical activities such as walking, cycling, or playing sports together not only promote physical development but also strengthen family relationships. Cooking together and teaching children the basics of healthy eating helps to establish healthy habits for the future.



The use of technology for monitoring and learning is also becoming increasingly relevant. Mobile applications can be useful for tracking physical activity and food intake, allowing parents and children to monitor their habits and record changes. Implementing medicine solutions for regular health monitoring allows doctors to more quickly identify problems and discuss issues with patients. Creating online resources and support groups where parents can share experiences and receive advice on hypertension prevention and healthy lifestyles fosters a community that supports children's health and well-being socioeconomic status of a family often determines the level of access to healthy food and exercise opportunities. In low-income families, it is generally more difficult to provide a varied and balanced diet [7].

Diet and physical activity

The first line of treatment for children with hypertension includes pharmacological interventions that focus on diet and physical activity. Diet is a powerful tool in promoting a normal body mass index and blood pressure (BP) in children. The current recommendation for children with hypertension includes the Dietary Approaches to Stop Hypertension diet (also known as the DASH diet). This diet includes foods such as fresh vegetables and fruits, whole grains, nuts, and legumes, and excludes foods that contain excessive amounts of sodium, sugars, and fats. Emphasize fruits, vegetables, whole grains, lean protein, low-fat dairy, and limit sugar, processed foods, saturated fats, and ultra-high sodium items [8].

PHARAMACOLOGICAL AND DIETERY TREATMENT OF DIABETES

Type 2 diabetes in children happens when their bodies don't use insulin properly (insulin resistance), often linked to obesity. Treating it usually starts with lifestyle changes like healthy eating and exercise, but medicines are often needed to control blood sugar.

The first medicine doctors usually give is metformin. It helps the body use insulin better and lowers blood sugar. Metformin is safe and well-studied in children.

In recent years, newer medicines have become available for kids with Type 2 diabetes. Two important types are:

SGLT2 inhibitors (like dapagliflozin): These help the kidneys remove excess sugar through urine. They lower blood sugar and can help reduce weight. These drugs are approved for children over 10 years old and are used if metformin alone isn't enough.

GLP-1 receptor agonists (like liraglutide or tirzepatide): These help lower blood sugar by increasing insulin release and also help reduce appetite and weight. Some of these drugs are being used more in children with Type 2 diabetes, especially if they have obesity [9].

Conclusion

Hypertension and diabetes are two of the most widespread chronic diseases globally and are rising due to factors like aging, urbanization, unhealthy diet, obesity, and sedentary lifestyles.

In India, these diseases are increasingly contributing to the national disease burden, making their control a critical public health goal. **Children at Risk:** Childhood obesity and poor lifestyle habits are increasing hypertension and diabetes rates in children. Early detection, lifestyle changes, and supportive parenting are crucial in pediatric cases. **Lifestyle Management:** Diet (e.g., DASH and Mediterranean diets), physical activity, weight management, stress control, and sleep are essential components of non-pharmacological management. **Pharmacological Advances:** New drug classes like non-steroidal MRAs, testosterone syntheses inhibitors, and modern diabetes medications (e.g., empagliflozin) show promise. Resistant hypertension requires combination therapy and individualized plans. **Technological Innovations:** Diabetes patches (for glucose monitoring and insulin delivery) offer non-invasive and real-time solutions, especially beneficial for children and adults with type 2 diabetes. Under IHCI (Indian hypertension control initiative), blood pressure control improved from 1.4% to 5%, demonstrating feasibility but highlighting the need for scale and sustainability. Over 1.28 billion people suffer from hypertension globally 537 million people live with diabetes, expected to rise to 853 million by 2050. The risk of hypertension and type 2 diabetes in children is rising due to obesity, stress, poor diet, and lack of physical activity. Early interventions significantly lower long-term health risk.

REFERENCES:

1. Prof. T. V. Sekher, Dr. David Flood, Hunter Green, Dr. Peifeng Hu, Prof. Mohammed K. Ali, Dr. Ashwini Shete, Dr. Sarang Pedgaonkar, Prof. Kenneth M. Langa, Prof. Eileen M. Crimmins, Prof. David E. Bloom, and Prof. Jinkook Lee. [https://www.thelancet.com/journals/langlo/article/PIIS2214-109X\(23\)00502-8/fulltext](https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(23)00502-8/fulltext)



2. Kapil V, Gupta AK. Solar UV radiation: a potential modifiable risk factor for hypertension. *Journal of the American Heart Association*. 2020 Mar 3; 9(5):e015627. (<https://www.ahajournals.org/doi/full/10.1161/JAHA.120.015627>)
3. Putri LR, Azam M, Nisa AA, Fibriana AI, Kanthawee P, Shabbir SA. Prevalence and Risk Factors of Hypertension among Young Adults: An Indonesian Basic Health Survey. *The Open Public Health Journal*. 2024 Dec 10; 17(1).
4. Zhu AL, Le AD, Li Y, Palaniappan LP, Srinivasan M, Shah NS, Wong SS, Valero-Elizondo J, Elfassy T, Yang E. Social determinants of cardiovascular risk factors among Asian American subgroups. *Journal of the American Heart Association*. 2024 Apr 16; 13(8):e032509. (<https://www.ahajournals.org/doi/full/10.1161/JAHA.123.032509>)
5. Oh R, Kim S, Park SH, Jang M, Cho SH, Kim JY, Lee YB, Jin SM, Hur KY, Kim G, Kim JH. Elevated triglyceride-glucose index is a risk factor for cardiovascular events in adults with type 1 diabetes: a cohort study. *Cardiovascular Diabetology*. 2025 Apr 2;24(1):150.
6. Kulikova LY, Edelmezhidov MM, Salimov MM, Voloshina EA, Kolesnikova MY, Akhayeva GS, Baisheva AK. Features of diagnostics and control of blood pressure in children: modern approaches in paediatrics. *Latin American Journal of Hypertension*. 2024;19(10):405-12
7. Charchar FJ, Prestes PR, Mills C, Ching SM, Neupane D, Marques FZ, Sharman JE, Vogt L, Burrell LM, Korostovtseva L, Zec M. Lifestyle management of hypertension: International Society of Hypertension position paper endorsed by the World Hypertension League and European Society of Hypertension. *Journal of Hypertension*. 2024 Jan 1; 42(1):23-49.
8. Giri AB, Shinde VT, Lengare PR, Shinde RD. Lifestyle modifications: A key to managing diabetes. *GSC Biological and Pharmaceutical Sciences*. 2020 Dec 30; 13(3):141-8.
9. Wang GS, Hoyte C. Review of biguanide (metformin) toxicity. *Journal of Intensive Care Medicine*. 2019 Nov; 34(11-12):863-76.

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