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Review Article

Exploring the risk factors associated with hypertension in children: A systematic review

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ABSTRACT

Introduction: Hypertension in children is increasingly becoming a global concern due to its impact on long-term health. This is influenced by several risk factors that can favor the occurrence of hypertension in children. The purpose of this systematic review is to determine the risk factors that can affect the occurrence of hypertension in children.

Methods: Searching articles using Medical Subject Heading (MeSH) with keywords of risk factor AND hypertension OR high blood pressure AND children OR child. This research used academic databases, including Scopus, CINAHL, ScienceDirect, and Google Scholar with inclusion criteria. The article discusses the risk factors for hypertension in children aged 6-19 years, no history of autoimmune and hematological disease, articles published in 2018-2023, studies using observational and quasi-experimental designs in English and using The Joanna Briggs Institute (JBI) Critical Appraisal method.

Results: This research analyzed a total of seven articles. The risk factors for hypertension that often occur in children include excessive nutritional status, lack of physical activity, family history of hypertension, smoking habits in children, excess sodium consumption, and male gender have a higher risk of hypertension.

Conclusion: Obesity has become the dominant factor in hypertension in children. It is recommended that children and adolescents exercise regularly, follow examinations at school or the nearest health facility, and maintain a healthy and regular diet.

Keywords: children; hypertension; risk factor

INTRODUCTION

Hypertension, or high blood pressure, which is often identified as a health problem in adults, is now also increasingly a concern among children. This phenomenon raises serious concerns among health experts and the general public because it can have a long-term impact on children's well-being and quality of life (Grammatikopoulos et al., 2017). The growth of cases of hypertension in children is becoming an increasingly worrying phenomenon. Over the past few years, the incidence of hypertension in children has increased significantly, indicating that not only adults are prone to high blood pressure problems. Therefore, an in-depth understanding of the factors underlying the causes of hypertension in children is required in order to develop effective prevention and treatment strategies (Song et al., 2019).

Data obtained from the National Health and Nutrition Examination Survey (NHANES) in 2017-2018 found that the prevalence of increased blood pressure (BP) reached about 6.2%, while the prevalence of high blood pressure reached 3.9%. Overall, the prevalence of high blood pressure between 2011 and 2018 reached 3.8%. In the United States, a survey of 5,100 schoolchildren showed an incidence of hypertension of about 4.5%. During the period from 2013 to 2016, hypertension affected almost 4% of children in the United States (Goulding et al., 2021). Children often have increased blood pressure, but determining it early often becomes difficult. Therefore, such increases in blood pressure can continue into adulthood, potentially leading to hypertension and coronary heart disease (Goulding et al., 2021). Some of the potential factors that can cause hypertension in children include unhealthy lifestyles, poor diet, lack of physical activity, genetic heredity, and psychosocial stress. Other risk factors from various articles still need to be sought, so this study needs to collect various risk factors that affect hypertension in children. Increased use of technology and drastic changes in food consumption patterns have also contributed to the increase in cases of hypertension in children (Rabi et al., 2020).

From the previous explanation, hypertension can arise both in adulthood and in children. Various factors play a role in the emergence of hypertension in children. Therefore, the purpose of this systematic review is to understand more about the risk factors that contribute to the incidence of hypertension in children. This article not only provides insight into the issue but also emphasizes the urgency of early prevention and management of these diseases to support the health and well-being of future children.

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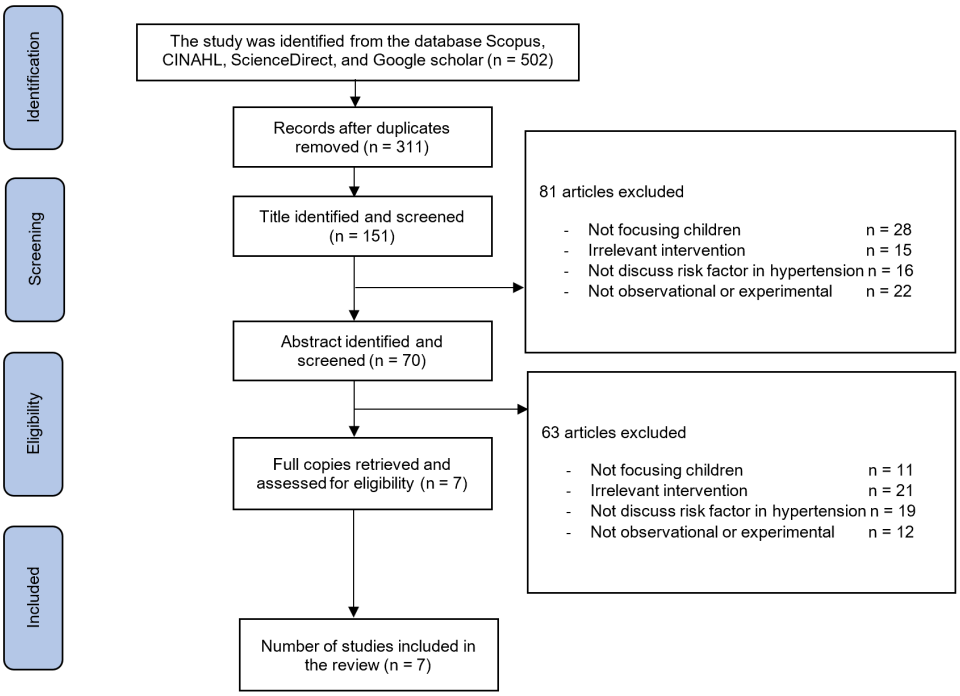

Figure 1. PRISMA Flowchart

METHODS

Design

This study used a systematic review method.

Search Strategy

The systematic review search used keywords "risk factor" AND hypertension OR "high blood pressure" AND child* with Boolean operators. The article search was conducted in July 2023 with inclusion criteria; the article discusses the risk factors for hypertension in children aged 6-19 years, articles published in 2018-2023, and studies using observational and quasi-experimental designs in English.

Study Selection

The independent variable was sibling rivalry, and the dependent variable was knowledge about sibling rivalry and development level.

Data Extraction

The purpose of the data extraction process in this study is to extract information from existing records in accordance with the purpose of the research. Each study collects information related to various aspects, such as year, language, population, research design, objectives, methods, interventions, instruments used, follow-up period, and research findings. The findings section also includes those data that need to be analyzed, such as the year, interventions, analytical methods, results, and conclusions.

Risk of Bias

The importance of identifying the risk of bias in this systematic review lies in the review of data extraction, which includes evaluating the suitability of research objectives and results and the suitability of research design using cross-sectional and quasi-experimental methods. JBI's list of critical assessments for cross-sectional and quasi-experimental research is used to assess the quality of the research. Several of the twelve items assessed were found to have a degree of bias.

Quality Appraisal

The assessment was carried out based on The Joanna Briggs Institute (JBI) Critical Appraisal on the inclusion and exclusion criteria of seven articles used in the systematic review. To assess the quality of articles, the first thing to do is to choose the tools in JBI, which are; checklists for analytical cross-sectional and cohort studies, and then, evaluate according to the criteria on the checklist and set a score.

Data Analysis

Three independent reviewers collaboratively synthesized qualitative data and conducted discussions in evaluating selected studies. This systematic review records all interventions incorporating the results of previous studies.

RESULTS

According to the PRISMA flowchart (Fig.1), the following steps are taken in conducting an article or literature search. Quasi-experimental and cross-sectional methods resulted in 502 articles out of 502 rejected searches. From the feasibility test of full-text articles, seven research articles were examined.

This study found seven articles that discuss the risk factors that affect hypertension in children. The population in this study was school children aged 6-19 years. The seven articles discussed the risk factors for hypertension in children in the form of obesity, genetics, smoking, lack of physical activity, daily nutritional intake, and gender (Table 2).

Tabel 1. Critical Appraisal Results

No	Authors and years	JBI Critical Appraisals Score, Score (%)	Quality Evaluation
1.	Angesti et al., 2018	7/8 (87.5)	Good
2.	Liang et al., 2020	6/8 (75.0)	Good
3.	Mayasari et al., 2019	6/8 (75.0)	Good
4.	Fahrany, 2019	7/8 (87.5)	Good
5.	Ibrahim et al., 2019	8/8 (100.0)	Good
6.	Hidayatullah and Pratama, 2019	7/8 (87.5)	Good
7.	Liang et al., 2020	9/11 (82.0)	Good

Tabel 2. Results of systematic review of risk factors for hypertension in children

No	Authors, year	Study design, instrument, and analysis	Findings
1.	Angesti et al., 2018	Study Design: Cross-sectional Population: 144 high school students under 17 years old Instrument: Semi-Quantitative Food Frequency Questionnaire (FFQ), Perceived Stress Scale, Physical Activity Questionnaire for Adolescents Data analysis: Chi-square and multiple logistic regression	The results showed as many as 42.4% of respondents experienced hypertension. There is a significant relationship between BMI/U nutritional status and family history of hypertension in hypertension. The most dominant factor that affects adolescent hypertension is a family history of hypertension.
2.	Liang et al., 2020	Study Design: Cross-sectional Population: 13597 primary school children aged 6-12 Instrument: self-reported food intake frequency questionnaire and self-reported activity categories Data analysis: logistic regression model	The prevalence of hypertension is severe in children living in the countryside, especially in those who are characterized by being overweight/obese, living with grandparents, having maternal gestational hypertension, and a more abundant diet. Our study emphasizes the importance of prevention in the impact of high blood pressure at the childhood stage, and it is essential to screen and track hypertension from childhood and adolescence, especially in rural areas. It is essential to periodically measure the blood pressure level of children in primary and secondary schools, which can improve children's health and prevent cardiovascular diseases in adults.
3.	Mayasari et al., 2019	Study Design: Cross-sectional Population: 200 adolescents aged 15-17 years Instrument: Sphygmomanometer, perceived stress scale (PSS) Data analysis: multilevel logistic regression	Based on the findings of the study, it can be concluded that there is a significant relationship between economic level, genetic history, sex, obesity, diet, sleep duration, and stress levels with the incidence of hypertension in adolescents aged 15-19 years. Differences at the school level also indicate a contextual impact on the incidence of hypertension in these age groups.
4.	Fahrany, 2019	Study Design: Cross-sectional 176 high school students 15-19 years old Instrument: Questionnaire Data analysis: chi-square test, the Fisher test, and logistic regression	38 (29.9%) children who do little/less physical activity and have hypertension; 37 (84.1%) children who smoke frequently and have hypertension; 24 (27.3%) children who have a family history of hypertension and have hypertension
5.	Ibrahim et al., 2019	Study Design: Cross-sectional Population: 1745 school children aged 6-12 years Instrument: portable stadiometer, Oyedeji's social classification Data analysis: Chi-square and Z test	The prevalence of hypertension in children of primary school age has a low level, which is equal to 3.0%, and obesity (BMI above the 95th) is the only anthropometric factor associated with the condition. The Socioeconomic Status of the parents, family history of hypertension, the tendency to snore, as well as the order of birth as the firstborn did not show any relationship with the incidence of hypertension in these children.

No	Authors, year	Study design, instrument, and analysis	Findings
6.	Hidayatullah and Pratama, 2019	Study Design: Cross-sectional Population: 80 teenagers aged 15-19 years Instrument: Microtoise, scales, and smoking habit questionnaire Data analysis: Spearman Rank	There are 16 adolescents (20%) who have the habit of often and who have the habit of smoking sometimes as much as smoking, 57 adolescents (71.2%) and who have the habit of rarely smoking by 7 adolescents (8.8%). Thirty-six adolescents (45%) had Grade 1 obesity, while 44 (55%) had Grade 2 obesity. There were 7 adolescents (8.8%) experiencing pre-hypertension, 52 adolescents (65%) experiencing Stage 1 hypertension and 21 adolescents (26.2%) experiencing Stage 2 hypertension. There is no relationship between smoking habits and the incidence of hypertension in adolescents aged 15-19 years in the village of Dayen Peken (p-value = 0.213 ≥ α = 0.05). There is a relationship between obesity and the incidence of hypertension in adolescents aged 15-19 years in the village of Dayen Peken (p-value = 0.037 ≤ α = 0.05)
7.	Liang et al., 2020	Study Design: Retrospective cohort Population: 17007 children aged 6-12 years Instrument: family health history questionnaires, a quantitative food frequency questionnaire Data analysis: logistic regression model	The incidence of hypertension reaches 12.55% in the southwestern region of China. Children with obesity combined with rural residence, low family income, birth weight (<3000 g) (BWP25), or >10 months of breastfeeding have a significantly increased prevalence of hypertension (37.06%, 30.41%, 30.04%, and 30.84% each). Obesity, high heart rate, BWP25, >10 months of breastfeeding, low family income, rural residence, abnormal lipid metabolism, and abnormal blood counts are associated with an increased risk of hypertension. And the adjusted R2 values are 14.45 and 24.88%, excluding and excluding serum index.

DISCUSSION

Nutritional status such as excessive sodium intake, low potassium intake, high sugar consumption, and low dietary fiber can be one of the risk factors for hypertension in children. Research conducted by Angesti (2018) stated that as many as 29 children, which is equivalent to 63% of the total sample, had hypertension, and it was found that the chances of children with higher nutritional status developing hypertension were 3.2 times greater compared to children who had normal nutritional status. Research on nutritional status was also conducted by Liang (2020), who stated that 44.9% and 40.14% of children who had more nutritional status had hypertension. This is following the theory that every 10% increase in body weight increases blood pressure by 7 mmHg, increasing the risk of hypertension fivefold in obese people (Fitriana et al., 2012). Research conducted by Mayasari (2019) also states that children with obesity have a 2.15 times higher risk of developing hypertension than children with no obesity. This is because, if the body is obese, the heart will pump blood faster throughout the body, resulting in stronger pressure and increased blood pressure. In obese children at rest, cardiac output increases, accompanied by an increase in the volume of blood pumped with each beat. In addition, in obese adolescents, the wall of the carotid artery is also thickened, which is why blood pressure rises (Safitri, 2020).

The second risk factor is a lack of physical activity. Research conducted by Fahrany (2019) showed that, from 176 samples, 38 (29.9%) children who did light/less physical activity had hypertension. Children who do physical activity are more or less at risk of hypertension compared to children who do enough physical activity. The results of the study found that less physical activity is one of the most dominant risk factors for the occurrence of hypertension in children (Fahrany, 2019). In addition, research by Liang (2020) shows that a person will experience increased insulin levels, and the body becomes hungry quickly due to a lack of physical activity. This follows the theory that insulin functions as an appetite regulator and has an anabolic effect on fat storage in cells and glucose transport. Insulin has a sensitivity that indicates that physical activity is related to blood pressure (Ruus et al., 2018).

The third factor is a family history of hypertension. Research conducted by Fahrany (2019) shows that 3.9 times children who have a family history of hypertension are at risk of developing hypertension. This also follows the results of research conducted by Ibrahim (2019). This is possible because of genetic factors that form two types of hypertension; among others, monogenic hypertension is the least common, and hypertension from mutations in 10 genes and disorders of the renal tubule protein that functions in sodium transport disorders. There is also polygenic hypertension caused by several major and minor genes, including genes involved in the renin-angiotensin-aldosterone (RAA) system. Each gene will give different results because hypertension is also one of the diseases influenced by various factors, and each study was conducted in different environments and races (Angesti et al., 2018).

The fourth factor is smoking habits. Research conducted by Hidayatullah (2019) showed that, from 80 samples, 16 (20%) children who often smoked had hypertension and explained that smoking habits were not related to high blood pressure. In contrast to research conducted by Fahrany (2019), smoking behavior is often associated with the incidence of hypertension. But not infrequently also occurring in

adolescents, the risk of hypertension will increase 1.13 times in people who smoke more than 10 cigarettes/day. The difference is likely to be caused because the impact of smoking will usually appear 10-20 years later, and the impact of smoking is not only an impact on active smokers but also an impact on passive smokers (Gobel et al., 2020).

The fifth risk factor is excessive salt consumption. Research conducted by Liang (2020) shows that excessive salty consumption is a risk factor for high blood pressure in children. This is due to sodium retention; the fluid from the cells will increase, and the water from the low-concentration electrolyte solution will move at a higher concentration so that the blood plasma volume increases and cardiac output also increases, resulting in increased blood pressure. In addition, the diameter of the arteries will shrink so that the blood vessels will become narrower and trigger the heart to pump blood volume harder, resulting in increased blood pressure (Grillo et al., 2019).

The sixth risk factor indicates that gender plays a role in the occurrence of hypertension in children. According to research by Mayasari (2019), there exists an almost significant correlation between gender and hypertension incidence in children. Angesti (2018) conducted a study involving 144 samples, revealing that 29 (48.3%) male children were diagnosed with hypertension. However, this does not establish a significant association between gender and hypertension. Notably, in boys, systolic blood pressure tends to increase more than in girls, consistent with the notion that during childhood and adolescence, boys experience a more pronounced rise in blood pressure compared to girls (Naha et al., 2016). This phenomenon is attributed to hormonal influences, particularly androgen hormones in boys, which are believed to impact blood pressure, leading to a greater increase compared to girls (Kawada et al., 2015).

CONCLUSION

Based on a comprehensive review of seven articles, it is evident that several risk factors commonly contribute to hypertension in children. These factors include being overweight, insufficient physical activity, a family history of hypertension, smoking among children, excessive intake of sodium, and gender. Notably, obesity emerges as a predominant risk factor in the development of hypertension among children. To mitigate these risks, it is advisable for children and adolescents to engage in regular physical exercise, undergo routine health screenings at school or nearby healthcare facilities, and adhere to a balanced and nutritious diet.

Declaration of Interest

There are no conflicts of interest.

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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