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EFFECTIVENESS OF EDUCATION IN ADOLESCENTS WITH PRIMARY ARTERIAL HYPERTENSION TAKING INTO ACCOUNT MODIFIABLE FACTORS AND COMMITMENT TO OVERCOMING THEM

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Summary.

Transition to higher education represents a significant source of psychoemotional stress for adolescents, which may contribute to elevated blood pressure. As the early stage of hypertension is frequently asymptomatic, affected individuals often do not seek medical consultation.

Aim: *to assess the level of awareness among adolescents with primary arterial hypertension regarding the factors contributing to disease development, and to evaluate the effectiveness of a structured educational intervention focusing on modifiable risk factors and adherence to lifestyle modification.*

Methods. *A prospective 12-month study with elements of simple randomisation was conducted. The cohort comprised 187 first-year students of various specialties at Bukovinian State Medical University, with a mean age of 16.2 ± 1.1 years. Screening included measurement of heart rate and blood pressure, as well as a questionnaire to identify probable risk factors for arterial hypertension. Two groups were formed: Group I – individuals with blood pressure >120/80 mm Hg (n = 50; 24 males, 26 females); Group II – individuals with normal blood pressure (n = 137; 64 males, 73 females). Participants received a standardised educational programme addressing the risks of arterial hypertension and evidence-based recommendations for lifestyle modification.*

Results. *Among the 50 individuals (26.7%) with elevated blood pressure who were subsequently diagnosed with primary hypertension based on 24-hour ambulatory blood pressure monitoring, 34 (18.2%; 16 males, 18 females) exhibited blood pressure values exceeding the 95th percentile (for sex and height) for more than 25% of the 24-hour period, consistent with a diagnosis of labile hypertension. Sixteen adolescents (8.5%; 7 males, 9 females) met criteria for sustained hypertension, defined as blood pressure elevation above the 95th percentile for 50-80% of the monitoring period. Questionnaire data revealed that only 35.8% of participants were aware of potential risk factors for arterial hypertension. Of the 187 students, 69 (36.8%) consented to participate in the educational sessions. Follow-up ambulatory blood pressure monitoring in the subgroup that completed the educational programme and fully adhered to lifestyle recommendations demonstrated a clinically significant reduction in blood pressure parameters, confirming the efficacy of the intervention.*

Conclusions. *1. The prevalence of arterial hypertension among adolescents in this cohort was 26.7% (labile hypertension: 18.2%; sustained hypertension: 8.5%).2. Awareness of hypertension risk factors among adolescents was found to be low. 3. The educational programme demonstrated sufficient effectiveness; however, adherence to recommended lifestyle modifications remained suboptimal.*

Keywords: *Hypertension; Adolescent; Life Style; Risk Factors; Health Education.*

Introduction

Historically, arterial hypertension was regarded as a condition predominantly affecting adults, with childhood and adolescent cases considered rare and typically secondary in origin [1]. However, the adoption of standardised protocols for blood pressure measurement and interpretation in paediatric practice has revealed a substantially higher prevalence of elevated blood pressure among children and adolescents [2]. This recognition has prompted heightened attention from clinicians and researchers alike. It is now unequivocally established that the majority of cardiovascular pathology in adulthood originates during childhood, most commonly in adolescence [3]. Consequently, effective mitigation of adult hypertensive disease is unattainable without systematic efforts toward early detection, management, and prevention of cardiovascular disorders in paediatric populations. Arterial hypertension constitutes an independent risk factor for cognitive impairment and is the principal contributor to the development of vascular dementia [4]. Projected increases in hypertension prevalence and its disabling sequelae among working-age individuals represent a significant public health challenge [5-7].

Attainment of target blood pressure values, as defined by contemporary clinical guidelines, remains suboptimal – even within well-resourced healthcare systems. Suboptimal adherence to prescribed therapeutic regimens is a likely contributing factor [8-10].

The European Society of Hypertension Paediatric and Adolescent Guidelines provide explicit diagnostic criteria for adolescent hypertension: office blood pressure measurements on three separate occasions must equal or exceed the 95th percentile for age, sex, and height. Published epidemiological data indicate a prevalence of arterial hypertension in adolescents ranging from 2% to 14.5% [11,12]. Hypertension in this age group is characterised by rapid progression, chronicity, and early target-organ damage [13], underscoring the critical importance of timely diagnosis and intervention.

Transition to higher education constitutes a major source of psychoemotional stress for adolescents, which may contribute to blood pressure elevation. Given the predominantly asymptomatic nature of early-stage hypertension, affected individuals often disregard episodic blood pressure fluctuations and refrain from seeking medical evaluation. Consequently, upon completion of

their studies, these individuals may face an elevated risk of adverse cardiovascular events.

The majority of adolescents lack awareness of hypertension risk factors, particularly those amenable to modification. The Framingham Heart Study has delineated key modifiable and non-modifiable risk factors for hypertension, along with their prognostic implications and long-term health consequences [14]. Early identification of these factors in adolescence is therefore of paramount importance for timely preventive action. In this context, structured education of adolescents and their families regarding modifiable risk factors and evidence-based management strategies is essential.

Aim: to assess the level of awareness among adolescents with primary arterial hypertension regarding the factors contributing to disease development, and to evaluate the effectiveness of a structured educational intervention focusing on modifiable risk factors and adherence to lifestyle modification.

The study employed a prospective 12-month design with elements of simple randomisation. The informed consent form and participant survey card were approved by the Bioethics Committee of Bukovinian State Medical University (Protocol No. 1, dated 19 September 2024) in accordance with the principles of the Declaration of Helsinki and the International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use Good Clinical Practice (ICH-GCP) guidelines. The study cohort comprised 187 first-year students of various specialties at Bukovinian State Medical University, with a mean age of 16.2 ± 1.1 years. All participants received a detailed explanation of the study's objectives, procedures, voluntary nature of participation, and confidentiality of data. Examinations were conducted by staff of the Department of Pediatrics and Medical Genetics at the Pediatric Department of the City Children's Hospital, Chernivtsi City Council, Chernivtsi.

Inclusion criteria were: (1) residence in Chernivtsi or Chernivtsi region; (2) age 15 years to 17 years 11 months 29 days; (3) provision of written informed consent.

Exclusion criteria were: (1) presence of chronic somatic disease; (2) age <15 years; (3) residence outside Chernivtsi region; (4) acute infectious illness at the time of screening.

Demographic data (age, sex, place of residence), self-reported episodes of elevated blood pressure, and symptoms of psychological distress (depression, anxiety, stress) were recorded. Screening included heart rate and blood pressure measurement using the standard auscultatory method (Korotkoff technique), with three office readings obtained at two-week intervals, as well as a structured questionnaire to identify probable risk factors for arterial hypertension. Based on screening results, two groups were formed: Group I: individuals with blood pressure >120/80 mm Hg (n = 50; 24 males, 26 females); Group II: individuals with normal blood pressure (n = 137; 64 males, 73 females). Participants in Group I underwent further evaluation in accordance with the National Recommendations and Clinical Guidelines for the Provision of Medical Care «Arterial Hypertension» [15, 16], received a standardised educational intervention on hypertension risk factors, and were provided with individualised recommendations for lifestyle modification.

Statistical analysis was performed using Microsoft Excel for Windows 2011 and JASP, version 0.19.3, applying methods of variation statistics in accordance with contemporary methodological standards. Intergroup comparisons of continuous variables were conducted using Student's t-test; associations between categorical variables were assessed using Pearson's chi-squared (χ^2) test. Statistical significance was defined as $p < 0.05$.

Research results and discussion. The distribution of participants by age, sex, and place of residence is presented in Table 1.

Table 1

The distribution of adolescents by age, sex, and place of residence (n)

Place of residence	Age		Sex	
	15-16 years	17-18 years	Female	Male
Chernivtsi (n=94)	43	51	48	46
Chernivtsi region (n=93)	53	40	51	42

Blood pressure in adolescents was measured in the morning, three times in succession, with the participant seated and using the same arm. Mean values were calculated and interpreted in accordance with the methodological guidelines of V. G. Maidannik and the American Academy of Pediatrics clinical practice guideline [17,18]. Office systolic, diastolic, and pulse pressure measurements are presented in Table 2.

Table 2

The results of blood pressure measurment in adolecents, M±m

Indicators	BP > 120 and/or 80 mmHg n=50	BP < 120 and/or 80 mmHg n=137
Systolic blood pressure	129 ± 1,2	117,0 ± 2,1*
Diastolic blood pressure	77,0 ± 1,9	71,0 ± 1,1*
Pulse pressure	51,0 ± 0,9	45,0 ± 1,2*

*Note. BP – blood pressure; * – p < 0.05.*

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Adolescents with elevated blood pressure underwent 24-hour ambulatory monitoring. Among the 50 individuals (26.7%) diagnosed with primary hypertension on the basis of ambulatory data, 34 (18.2%; 16 males, 18 females) exhibited blood pressure exceeding the 95th percentile (adjusted for sex and height) for more than 25% of the 24-hour period, fulfilling criteria for labile hypertension. Sixteen adolescents (8.5%; 7 males, 9 females) met criteria for sustained hypertension, defined as blood pressure elevation above the 95th percentile for 50-80% of the monitoring period.

Behavioural risk factors were prevalent: 57 adolescents (30.4%) reported current tobacco use; 37 (19.7%) consumed alcohol 2-3 times per week; 40 (21.4%) habitually added salt to meals. Notably, 122 participants (65.2%) led a predominantly sedentary lifestyle, and a positive family history of arterial hypertension was reported in 49 (26.2%).

Additional risk factors identified by questionnaire included: premature cardiovascular mortality in first-degree relatives (<55 years, 13.2%); familial hypertension (19.7%); obesity (21.4%); and diabetes mellitus (26.2%).

Relatives of adolescents reported environmental and behavioural cardiovascular risk factors, including occupational hazards (27.8%), hazardous alcohol use (38.8%), irregular daily routines (55.8%), unhealthy dietary patterns (42.9%), and chronic psychoemotional stress (55.4%).

The survey revealed that the majority of adolescents lack knowledge regarding correct blood pressure measurement and heart rate assessment. In response to the question, «Are you able to measure your blood pressure and perform self-monitoring?», only 45 adolescents (24.1%) answered affirmatively. Among these, 1.6% measured blood pressure once daily, 6.4% once weekly, and 7.4% only when symptomatic. Probable risk factors for primary arterial hypertension in adolescents were analysed (Table 3).

Survey data indicated that only 35.8% of adolescents were aware of potential risk factors for arterial hypertension (Figure 1).

Table 3

Probable risk factors for primary arterial hypertension in adolescents

Indicator	Adolescents with hypertension (n=50)		Adolescents in the comparison group (n=57)		χ2	P
	Total	%	Total	%		
Disrupted daily routine	36	72.0	13	22.8	3.15	<0.05
Physical inactivity	40	80.0	10	17.5	4.57	<0.01
Unbalanced diet	37	74.0	11	19.2	3.89	<0.05
Psychological stress	41	82.0	12	21.1	3.91	<0.05
Emotional strain	23	46.0	8	14.0	3.28	<0.05
Overweight or obesity	39	78	5	8.7	8.96	<0.01
Tobacco use	38	76.0	5	8.7	8.73	<0.01
Alcohol consumption	8	16.0	5	8.7	1.72	>0.05
Excessive salt intake	18	36.0	3	5.2	6.92	<0.01
High-fat diet	37	74.0	11	19.2	3.89	<0.05
Positive family history	36	72.0	13	22.8	3.15	<0.05
Sleep disturbances	8	16.0	5	8.7	1.72	<0.05
Parental education level	18	36.0	23	40.3	1.13	<0.05
Occupational hazards (parental)	2	4.0	5	8.7	1.11	>0.05
Sex	26	52.0	23	40.4	1.66	>0.05
Medication use	5	10.0	4	7.0	1.13	<0.05

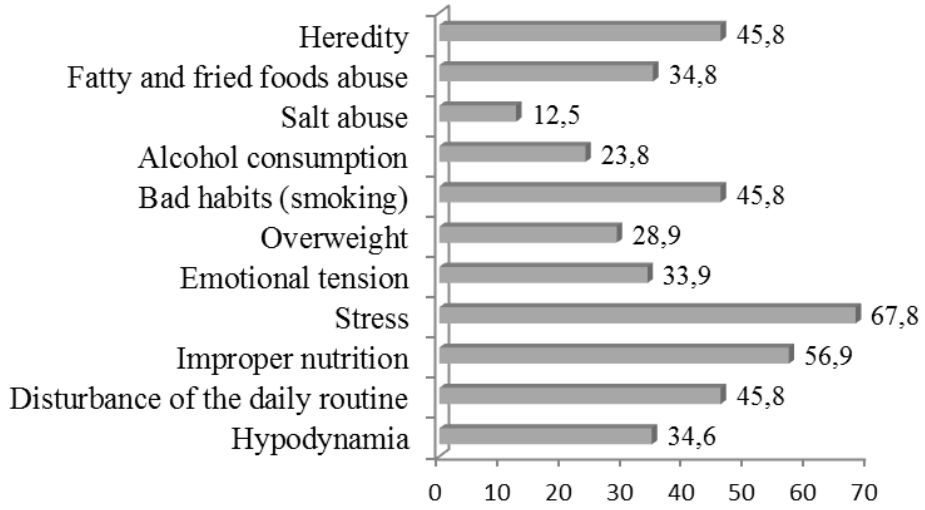

Figure 1. Awareness of adolescents regarding probable risk factors for arterial hypertension (%)

Adolescents enrolled in the study were invited to participate in an educational seminar addressing modifiable and non-modifiable risk factors for arterial hypertension, as well as practical training in blood pressure measurement and heart rate assessment. Table 4 outlines the recommended lifestyle modifications and the proportion of participants who initiated and maintained these changes over a 6-month period. Of the 187 adolescents, 69 (36.8%) consented to attend the educational sessions.

Thus, the majority of adolescents who attended the programme demonstrated adherence to the proposed lifestyle modification measures. However, a substantial proportion failed to achieve sustained behavioural change. Notably, only 45.9% of tobacco users successfully abstained. Analysis of barriers to implementation revealed three principal factors: (1) lack of recognition or understanding of the condition, leading to non-adherence; (2) inability to self-manage without external support; and (3) fear of peer criticism (Figure 2).

Table 4

Recommendations for lifestyle modification among adolescents, n (%)

Recomendation	Number of participants who initiated changes	Number of participants who completed shifts
Weight management (body mass index)	23 (33.3)	15 (65.2)
Balanced nutrition (carbohydrate, salt, and fluid intake control)	69 (100)	45 (65.2)
Physical activity (aerobic)	69 (100)	49 (71.0)
Tobacco cessation	37 (53.6)	17 (45.9)

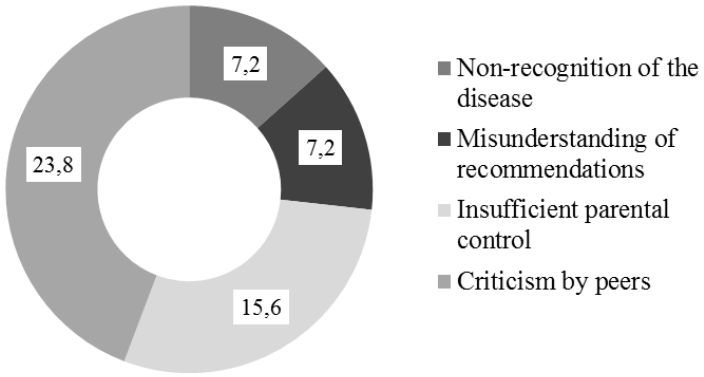

Figure 2. Factors contributing to non-completion of the proposed educational programme by adolescents

Repeated blood pressure (BP) monitoring in the subgroup of adolescents who completed the educational programme and fully adhered to lifestyle modification recommendations demonstrated the sufficient efficacy of the intervention and its potential as a key component in the primary prevention of arterial hypertension in adolescents (Table 5).

Table 5

Effectiveness of screening and educational intervention for primary hypertension in adolescents (n, %)

Number	Establishment of elevated BP	A diagnosis of primary hypertension has been established	
		Labile hypertension	Sustained hypertension
Before intervention			
187	50 (26.7)	34 (68.0)	16 (32.0)
After intervention			
50	18 (36.0)	10 (20.0)	8 (16.0)

According to the literature, the prevalence of arterial hypertension in school-aged children ranges from 2.4% to 14.0%, and among adolescents, from 18.0% to 22.0% [19]. It is now well established that the pathophysiological origins of arterial hypertension are often established during childhood and adolescence, coinciding with the final maturation of neurogenic and humoral regulatory systems. Notably, hypertension in adolescents is frequently asymptomatic; our findings corroborate this «silent» clinical course. Risk factors for arterial hypertension encompass a broad spectrum of adverse influences on the adolescent organism, including overweight or obesity, physical inactivity, excessive salt and fat intake, sleep disturbances, and chronic psychological and emotional stress [20,21]. Increasing attention is being directed toward hereditary predisposition [22] and the risk of disease chronicity. Our study confirms these probable contributors and underscores the importance of identifying modifiable factors during adolescence, as early intervention may mitigate the progression to hypertension in adulthood. Adherence to antihypertensive treatment regimens among diagnosed patients ranges from 25% to 45%, with only 25-30% achieving target blood pressure levels [23]. Awareness of risk factors is critical: one study reported that 53.6% of medical students were aware of their hypertension diagnosis, though only half pursued treatment [24]. In our cohort, only a third of adolescents demonstrated awareness of hypertension risk factors – a finding that necessitates the development of targeted health education and awareness programmes. Of the 187 participants, 69

(36.8%) consented to attend educational sessions and follow recommendations. Nevertheless, adherence to sustained lifestyle modification – particularly tobacco cessation, dietary change, and reduction of sedentary behaviour – remained low.

Conclusions. 1. The prevalence of arterial hypertension among adolescents in this study was 26.7% (labile hypertension: 18.2%; sustained hypertension: 8.5%). 2. Awareness of hypertension risk factors among adolescents was found to be low. 3. The educational programme demonstrated sufficient efficacy; however, adherence to recommended lifestyle modifications was suboptimal.

Keywords: Hypertension; Adolescent; Risk Factors; Health Education.

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ЕФЕКТИВНІСТЬ НАВЧАННЯ ПІДЛІТКІВ ІЗ ПЕРВИННОЮ АРТЕРІАЛЬНОЮ ГІПЕРТЕНЗІЄЮ З УРАХУВАННЯМ МОДИФІКОВАНИХ ЧИННИКІВ ТА ПРИХИЛЬНОСТІ ДО ЇХ ПОДОЛАННЯ

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Резюме.

Початок навчання у закладах вищої освіти викликає психоемоційне перенапруження підлітків, що може бути чинником підвищення артеріального тиску. Оскільки початкова стадія хвороби в переважній більшості перебігає безсимптомно, підлітки не звертаються за медичною допомогою.

Мета: дослідити рівень поінформованості підлітків із первинною артеріальною гіпертензією щодо чинників розвитку патології та оцінити ефективність їх навчання з урахуванням модифікованих чинників та прихильності до подолання.

Методи дослідження. Дизайн дослідження включав проспективне дослідження впродовж 12 місяців з елементами простої рандомізації. У дослідження були залучені 187 студентів різних спеціальностей першого курсу Буковинського державного медичного університету. Середній вік залучених в дослідження здобувачів освіти становив 16,2±1,1 роки. Скринінгове обстеження включало вимірювання частоти серцевих скорочень, артеріального тиску та анкетування (визначення ймовірних факторів ризику артеріальної гіпертензії). Сформовано дві групи підлітків: група I – особи з показниками АТ >120/80 мм.рт.ст. (50 осіб, 24 хлопці та 26 дівчат) та група II – особи з нормальними показниками АТ (137 осіб, 64 хлопці та 73 дівчини). Підлітки були залучені до навчання за відповідною програмою щодо ймовірних ризиків розвитку артеріальної гіпертензії та їм були надані рекомендації щодо модифікації способу життя.

Результати. Серед 50 26,7%) осіб, які мали відмінні від норми показників артеріального тиску та були віднесені до групи первинної артеріальної гіпертензії за результатами добового моніторування, у 34 (18,2%) осіб (16 хлопців та 18 дівчат), добовий час гіпертензії, який перевищував 95-перцентиль відповідно до статі та зросту, становив вище 25% від добового часу. Це дозволило встановити у них лабільну артеріальну гіпертензію. У 16 (8,5%) підлітків (7 хлопців та 9 дівчат) встановлено стабільну артеріальну гіпертензію, оскільки підвищення АТ більше 95-перцентилі відзначено впродовж 50-80% добового часу. За результатами опитування встановлено, що тільки третина підлітків (35,8%) поінформовані щодо ймовірних факторів розвитку артеріальної гіпертензії. Із 187 підлітків, які були залучені в дослідження, відвідувати навчальні заняття погодилися 69 (36,8%). Результати повторного контролю артеріального тиску у групі пілітків, які проходили навчання та виконали повністю рекомендації щодо модифікації способу життя, показали достатню ефективність навчальної програми.

Висновки. 1. Частота артеріальної гіпертензії у підлітків становить 26,7% (18,2% – лабільна артеріальна гіпертензія та 8,5% – стабільна артеріальна гіпертензія). 2. Визначено низьку поінформованість підлітків щодо чинників ризику розвитку артеріальної гіпертензії. 3. Ефективність навчальної програми для підлітків достатня, а прихильність щодо подолання модифікованих чинників ризику низька.

Ключові слова: артеріальна гіпертензія; підлітки; прихильність до зміни спсобу життя; чинники ризику; навчання.

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