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Article

Blood Pressure Levels, Prevalence, and Innovative Approaches to Prevent Arterial Hypertension in Adolescent and Young Adult Populations

Xashimova Zamira Maxmudjanovna[1*], Mamasoliyev Nematjon Soliyevich[2], Kurbanova Rano Rustambekovna[3]

1. Assistant, Department of Pediatrics, Faculty of Advanced Medical Education, Andijan State Medical Institute, Andijan, Uzbekistan
2. Doctor of Medical Sciences, Professor, Head of the Department of Internal Medicine, Faculty of Advanced Medical Education, Andijan State Medical Institute, Andijan, Uzbekistan
3. CandiDAPte of Medical Sciences, Associate Professor, Department of Internal Medicine, Faculty of Advanced Medical Education, Andijan State Medical Institute, Andijan, Uzbekistan

* Correspondence: zamira.khashimova82@gmail.com

Abstract: This study examines blood pressure characteristics in adolescents and young adults, specifically students from Andijan State Medical Institute, to assess factors influencing blood pressure levels and the prevalence of arterial hypertension. Background: Hypertension in youth poses significant health risks, yet determinants in this age group remain understudied. Objective: To identify lifestyle and genetic influences on blood pressure in adolescents and young adults. Methods: Blood pressure was monitored daily, complemented by questionnaires on participants' physical activity, diet, and family history. Results reveal that both lifestyle habits and hereditary factors substantially impact blood pressure. These findings support the development of targeted prevention strategies to reduce hypertension risk in this population.

Keywords: Blood pressure, Adolescents, Youth, Hypertension, Lifestyle

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1. Introduction

The mortality rate from cardiovascular diseases is continuously increasing despite extensive preventive measures taken in different countries. Current research shows that the greatest risk of cardiovascular disease (CVD) development and progression is associated with dyslipidemia, including hypercholesterolemia and hypertriglyceridemia. ToDAPy, between 6.8 and 8.5 million children worldwide suffer from dyslipidemia. Early diagnosis of these conditions in childhood, adolescence and young adulthood is of key importance for timely initiation of cardiovascular prevention [1]. According to the World Health Organization (WHO), about 18 million people die annually from circulatory diseases [2]. Studies conducted by Mal G.S. et al. (2021) and Thongtang N. et al. (2022) indicate a constant increase in mortality from CVD despite the treatment and preventive measures taken [3,4]. According to the studies of A.V. Kontsevaya et al. (2018) and D.I. Sadykova et al. (2009), dyslipidemia is the main risk factor for cardiovascular diseases [5-8].

The importance of early diagnosis of dyslipidemia and hypercholesterolemia in childhood, adolescence and young adulthood cannot be underestimated. This makes it possible to start cardiovascular prophylaxis in time, which significantly reduces the risk of cardiovascular diseases in the future.

According to the DAPta presented by U.V. Chubochkina et al [6] and I.V. Leontieva [9], as of 2022, about 2300 cases of familial hypercholesterolemia (FHC) have been registered in the Russian RENESSANCE registry (a registry of patients with familial hypercholesterolemia and individuals with very high cardiovascular risk, in whom hypolipidemic therapy has failed). The estimated prevalence of the homozygous form of HHC ranges from 1:160000 to 1:220000. It should be noted that dyslipidemia (DLD) is a common condition among children, adolescents and young adults characterized by elevated blood concentrations of total cholesterol, triglycerides and low-density lipoprotein (LDL-C). [10]

It is important to emphasize that early detection of dyslipidemia in children, adolescents and young adults, as well as the timely initiation of preventive measures or lipid-lowering therapy can significantly reduce the risk of atherosclerosis and, consequently, reduce the likelihood of cardiovascular disease at an early age. Arterial hypertension is preventable because it is associated with exposure to modifiable risk factors. Early detection and correction of these factors early in life can minimize the incidence of cardiovascular disease, stroke, type 2 diabetes mellitus, cancer, hypertension and other chronic non-communicable diseases in the population.

In the study conducted by Parves S., Choudhary L. and Sineglazova A.V. (2020), the level of risk factors for chronic non-communicable diseases (CND) among 235 international students studying at universities in Kazan was analyzed. The age of the participants ranged from 17 to 29 years, the average age was 22 years. The sample included citizens of 17 countries. The prevalence of risk factors was as follows: insufficient consumption of fruits and vegetables - 44.7%, low physical activity - 38%, alcohol consumption - 15.74%, smoking - 8.9%, abdominal obesity - 53% in girls and 25.9% in boys, high blood pressure (BP) - 2.6%, hypercholesterolemia (HCH) - 3%, hyperglycemia - 0.9% and familial predisposition to hypertension - 25.1% [11].

Thus, the study of population features of blood pressure among Andijan pupils and medical students has high scientific and practical significance, contributing to improving the health of the young generation and reducing the burden of cardiovascular diseases in the future.

2. Materials and Methods

The observational one-stage epidemiologic study was conducted to obtain a population picture of blood pressure (BP) level and prevalence of AH among the population of adolescence and youth in the conditions of Andijan city of Fergana Valley of Uzbekistan. The material for the study was a continuous representative sample of adolescent pupils (n=1371) and medical students (n = 1131) of I -VI courses of Andijan State Medical Institute at the age of 18-22 years [12].

Epidemiologic, general clinical, biochemical and instrumental methods were used in the study. Epidemiologic methods included a survey to identify cardiovascular and chronic non-infectious diseases (CVD/CND) and their risk factors. General clinical investigations included general blood and urine tests, as well as physical and subjective methods. Biochemical studies determined the level of total cholesterol and glucose in venous blood. Instrumental methods included anthropometric measurements such as body mass index.

3. Results and Discussion

To study the population characteristics of different levels of BP, we analyzed the DAPta obtained in a comparative study of a representative sample of adolescents and young men (2502 people).

Of these, the study of mean BP levels was carried out in 1371 (54.8%) population of students (11-17 years) adolescents (684 boys; 27.3% and 687 girls; 27.5%) and in 1131 (43.2%) adolescent (18-22 years) medical students, 575 (23.0%) boys and 556 (22.2%) girls (the results of statistical analysis of the obtained DAPta are presented in the Table). Mean blood pressure in adolescents and medical students by gender (M±SD) [13].

Table 1. The table shows that the mean levels of BP in adolescents and young men were - 109.2±15.2 (SAP), 72.4±9.72 (DAPP) and 32.6 ±15.1 mmHg (pulse pressure-PD).

Groups		Systolic Blood Pressure (mm Hg)		Diastolic Blood Pressure (mm Hg)		Pulse Pressure (mm Hg)		n	%
		M±SD	Min-max	M±SD	Min-max	M±SD	Min-max		
Teen Students	Male.	104,9±11,1	90-120	69,4±8,22	50-80	35,0±14,0	10-70	684	27,3
	Female.	104,8±10,6	90-120	69,5±8,38	50-80	35,1±13,4	10-70	687	27,5
	Total	104,9±10,8	90-120	69,5±8,30	50-80	35,0±13,7	10-70	1371	54,8
Medical Students	Male.	114,7±18,1	90-160	75,8±10,4	50-100	31,1±15,2	10-70	575	23,0
	Female.	114,1±17,5	90-160	76,1±9,84	50-100	28,0±16,8	10-70	556	22,2
	Total	114,4±17,8	90-160	75,9±10,1	50-100	29,6±16,1	10-70	1131	45,2
Overall		109,2±15,2	90-160	72,4±9,72	50-100	32,6±15,1	10-70	2502	100,0

As can be seen from the DAP presented in the table, the mean levels of SAP, DAP and PP in male medical students are 114, ±17.8, 75.9 ±10.1 and 29.6 ±16.1 mmHg, respectively. In young male and female students, the mean BP values do not differ and are defined in the following levels respectively: SAP - 114.7 ±18.1 and 114.5±17.5 each, DAPP - 75.8 ±10.4 and 76.1±9.84 each, PD - 31.1 ±15.2 and 28.0±16.8 mm.Hg each. But in the population of adolescent pupils, compared to young men, significantly low values of mean BP level were determined: SAP - 104.9±10.8 mmHg and DAP - 69.5±8.30 mmHg, respectively (P1<0.05; P2<0.05) [14].

Pulse pressure values were significantly higher (35.0±13.7mm.Hg versus 29.6±16.1mm.Hg in adolescents than in young men) in adolescents (P<0.05). Mean values of SAP, DAP, and PD (in mm.Hg) in adolescent boys and girls were determined as follows: 104.9±11.1 and 104.8±10.6, 69.4±8.22 and 69.5±8.38, 35.0±14.0 and 35.1±13.4, respectively. Systolic BP is determined in young men with an increase of 9.5mmHg and diastolic BP with an increase of 5.4mmHg (P1<0.05; P2<0.05). Pulse pressure was determined in young men compared with adolescents with a decrease of 5.4 mm.Hg (P<0.05) [15].

It seems of interest - to find out the possibility of the influence of some biochemical factors, in particular the content of cholesterol in serum, on the distribution of BP levels (optimal BP, normal BP, high, normal BP, AH I degree, isolated systolic BP). We performed this kind of analyses in our results in the population of adolescents and young men, revealed population patterns of distribution of BP levels according to WHO criteria depending on blood cholesterol content in adolescent students 11-17 years old [16]. In the course of the study average BP levels in adolescent pupils aged 11-17 years of Andijan city have a certain dependence on normocholesterolemia (NCH) and hypercholesterolemia (HCH) [17]. In the population of adolescents optimal BP (SAP<120; DAP<80 mmHg) is determined by the prevalence of 67.4%. The prevalence of this level of BP in adolescents with HCS and NHS is 71.0% and 62.7%, respectively; that is,

depending on this factor, optimal BP is defined with an 8.3% difference in prevalence [RR=1.132; 95% Cl=1.049-1.222; $\chi 2$=3.191; P<0.01].

In the adolescent population, the prevalence of normal blood pressure (NBP) [SAP 124-129 mmHg and DAP 80-84 mmHg] was 21.3%. Depending on the presence and absence of HCS, the detection rate of NAD is - 21.1% and 21.6%, respectively, i.e., determined with almost the same prevalence [RR=0.977%; 95% Cl=0.796-1.199; $\chi 2$=0.218; P>0.05]. In this studied adolescent population, the prevalence of high normal BP-VNAD (SAP-130-139 and DAP-85-89 mmHg) is -6.9%. In adolescents with and without GCS, this category of BP is detected with a frequency of 3.6% and 11.2%, respectively, i.e., with a difference in its prevalence of 7.6% [RR=0.323; 95% Cl=0.210-0.496; $\chi 2$=5.172; P<0.001]. It was noted that the prevalence of 1st degree AH according to WHO criteria (SAP=140-159 and DAPD=90-99 mmHg) in adolescents is -3.8% in the presence of GCS - 3.9% and in the presence of NHS - 3.7%, i.e. with a difference of 0.2% in the prevalence of AH depending on this risk [18].

According to our DAPta, we found that in the adolescent population, isolated systolic AH - IHSAH (SAP≥140 and DAP <90 mmHg) occurs with a prevalence rate of 0.6%, in the presence of HHS- 0.4% and in the absence of NHS- 0.8% [RR=0.464; 95% Cl=0.111-1.934; $\chi 2$=1.054; P>0.05].

Taking into account that AH, as a rule, in adolescents often has a latent course, the possibility of identifying adolescent and young male students, “threatened” in terms of high blood pressure (BP) for the implementation of these preventive programs seems to be extremely high. Given this need, the timeliness and importance of epidemiologic studies of AH in adolescents and young men becomes clear [19].

According to the “new” American Criteria for Assessment of BP and AH, the prevalence of NAD in the surveyed population of adolescents with SAP<130 mmHg and DAP<80 mmHg:

1) Among the general population of adolescents- 83.7% and 91.2%;

2) In adolescents with HCV, 92.1% and 94.6%;

In adolescents with NHS, 84.3% and 86.8% [RR=1.092; 95% Cl=1.049-1.137; $\chi 2$=4.320; P<0.001 for SAP<130 mmHg; RR=1.089; 95% Cl=1.051-1.129; $\chi 2$=4.732; P<0.001 for DAP<80 mmHg] [20].

The incidence of prevalence of SAH (SAP>130 mm.Hg) and DAPH (DAP>80 mm.Hg. In the general population of adolescents (according to the “new” criteria)-6.9% and 5.0% each, in adolescents with GCS-3.6% and 1.6% each, and in adolescents with NHS-11.2% and 9.5% each, respectively [RR=0.323; 95% Cl=0.210-0.496; $\chi 2$=5.172; P<0.001 for SAP≥130 mm Hg; RR=0.323; 95% Cl=0.210-0.496; $\chi 2$ =5.172; P<0.001 for SAP≥130 mm Hg. Hg; RR=0.162; 95% Cl=0.088-0.300; $\chi 2$=5.800; P<0.001 for SAP≥80 mmHg] [21-24].

According to the “new” (American) criteria, SAH (SAP≥140 mm.Hg) and DAPH (DAP≥90 mm.Hg.) grade II were observed with prevalence rates of 4.4% and 3.8% in the general population of adolescents, 4.3% and 3.9% in the population of adolescents with HCV, and 4.5% and 3.7% in adolescents with NHS, respectively [RR=0.945; 95% Cl=0.575-1.554; $\chi 2$=0.221; P>0.05 for SAP≥140 mm Hg; RR=0.945; 95% Cl=0.575-1.554; $\chi 2$=0.221; P>0.05 for SAP≥140 mm Hg. Hg; RR=1.054; 95% Cl=0.614-1.089; $\chi 2$=0.194; P>0.05 for SAP≥90 mmHg].

Thus, the findings indicate that there is an actual association of mean BP levels and prevalence of AH in both adolescents and young men with blood cholesterol content. With age, the detection of AH in dependence on GCS increases more than 4 times [25].

4. Conclusion

The study revealed that there are significant population features of blood pressure among Andijan pupils and medical students. Deviations from normal values are often recorded in adolescents and young people, which indicates the need for early detection and prevention of arterial hypertension. The identified risk factors and peculiarities of the DAPily profile of blood pressure emphasize the importance of regular monitoring and implementation of preventive measures to reduce the incidence of cardiovascular diseases in this population.

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