BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg

RISK FACTORS FOR THE DEVELOPMENT OF FUNCTIONAL CARDIOVASCULAR DISORDERS IN ADOLESCENTS

Umarova Muqaddasxon Abduqodirovna
Andijan state medical institute
Andijan,Uzbeksitan
doi:https://doi.org/10.5281/zenodo.22841636

Abstract. Functional cardiovascular disorders in adolescence include labile blood pressure elevation, autonomic dysregulation, functional cardiopathy, sinus tachycardia, reduced exercise tolerance and early disturbances of circadian blood-pressure regulation. The aim of this analytical review was to systematize modifiable and non-modifiable risk factors that contribute to their formation and to define a practical screening framework for adolescents. Ten targeted sources were synthesized, including five publications by authors and institutions from Uzbekistan and five international guideline or research sources. Evidence was coded into metabolic, autonomic-psychological, hereditary/perinatal, behavioral and environmental domains. The synthesis indicates that excess body weight and metabolic abnormalities, autonomic imbalance and psycho-emotional load, hereditary predisposition, low physical activity and unfavorable dietary patterns are the most consistently reported risk domains. Early detection should combine repeated standardized blood-pressure measurement, body-mass-index assessment, family history, lifestyle screening and, when indicated, ambulatory blood-pressure monitoring and electrocardiographic or echocardiographic evaluation. A multifactorial prevention model is preferable to isolated assessment of a single risk factor.
Keywords: adolescents, cardiovascular system, functional disorders, arterial blood pressure, autonomic dysfunction, obesity, risk factors, prevention.

Annotatsiya. O‘smirlik davrida yurak-qon tomir tizimining funksional buzilishlari labil arterial bosim ko‘tarilishi, vegetativ regulyatsiya buzilishi, funksional kardiopatiya, sinus taxikardiyasi, jismoniy yuklamaga chidamlilik pasayishi va arterial bosim sutkalik ritmining erta buzilishlari bilan namoyon bo‘lishi mumkin. Ushbu tahliliy maqolaning maqsadi mazkur holatlarning shakllanishiga olib keluvchi modifikatsiyalanuvchi va modifikatsiyalanmaydigan xavf omillarini tizimlashtirish hamda o‘smirlar uchun amaliy skrining yondashuvini asoslashdan iborat. O‘nta manba, jumladan O‘zbekiston mualliflari va muassasalariga mansub beshta nashr hamda beshta xalqaro manba tahlil qilindi. Ortiqcha vazn va metabolik siljishlar, vegetativ disbalans va psixoemotsional zo‘riqish, irsiy moyillik, kam jismoniy faollik va nosog‘lom ovqatlanish asosiy xavf yo‘nalishlari sifatida ajralib turadi.
Kalit so‘zlar: o‘smirlar, yurak-qon tomir tizimi, funksional buzilishlar, arterial bosim, vegetativ disfunksiya, semizlik, xavf omillari, profilaktika.

Аннотация. Функциональные нарушения сердечно-сосудистой системы в подростковом возрасте могут проявляться лабильным повышением артериального давления, вегетативной дисрегуляцией, функциональной кардиопатией, синусовой тахикардией, снижением толерантности к физической нагрузке и ранними нарушениями суточного профиля артериального давления. Цель аналитического обзора — систематизировать модифицируемые и немодифицируемые факторы риска и сформировать практический подход к скринингу подростков. Проанализированы десять целевых источников, из них пять

публикаций авторов и учреждений Узбекистана и пять международных рекомендаций и исследований. Наиболее устойчиво повторяющимися направлениями риска были избыточная масса тела и метаболические нарушения, вегетативный дисбаланс и психоэмоциональная нагрузка, наследственная предрасположенность, низкая физическая активность и неблагоприятные пищевые привычки.

Ключевые слова: подростки, сердечно-сосудистая система, функциональные нарушения, артериальное давление, вегетативная дисфункция, ожирение, факторы риска, профилактика.

INTRODUCTION

Adolescence is a period of rapid somatic growth, endocrine restructuring and maturation of neurohumoral regulation. These changes increase the physiological variability of heart rate, vascular tone and arterial pressure, but they can also expose latent vulnerability of cardiovascular control. Functional disorders are clinically important because symptoms may precede persistent hypertension or structural cardiovascular disease, while early manifestations are often intermittent and are therefore easy to underestimate (1.2.3).

Uzbek studies of adolescents with autonomic dysfunction and functional cardiopathy show that imbalance of autonomic regulation is associated with complaints such as palpitations, cardialgia, fatigue and reduced adaptive reserves. Ambulatory blood-pressure monitoring has revealed deviations in nocturnal blood-pressure decline and variability in adolescents with autonomic dysfunction, suggesting that apparently functional symptoms may coexist with measurable disturbances of vascular regulation (2.3.4). These observations support a broader concept in which functional cardiovascular disorders represent an early adaptation failure rather than a purely benign symptom complex.

Risk formation is multifactorial. Hereditary predisposition and perinatal factors interact with excess body mass, dyslipidemia, insulin resistance, low physical activity, dietary imbalance, chronic psychological stress and autonomic dysregulation. In an Andijan adolescent cohort with primary arterial hypertension, family history was frequent, physical activity was reduced and excess body weight was documented in a substantial subset; target-organ and vascular changes were more common in more severe hypertension (5). International pediatric guidelines similarly emphasize obesity, family history, lifestyle, repeated standardized blood-pressure measurement and ambulatory monitoring when persistent or masked hypertension is suspected (6.7.8).

Excess adiposity deserves particular attention because it links behavioral exposure to hemodynamic and metabolic pathways. Sympathetic activation, insulin resistance, endothelial dysfunction, altered sodium handling and increased circulating volume can all contribute to blood-pressure elevation. In adolescents with obesity and hypertension, abnormalities of the circadian blood-pressure profile and early myocardial remodeling have been documented, while recent pediatric obesity guidance recommends routine blood-pressure assessment and evaluation for cardiometabolic comorbidity in overweight and obese youth (8.10).

The purpose of this study was to synthesize the principal risk factors associated with functional cardiovascular disorders in adolescents, compare the contribution of local and international evidence, and formulate a screening and prevention framework applicable to medical educational and primary-care settings.

MATERIALS AND METHODS

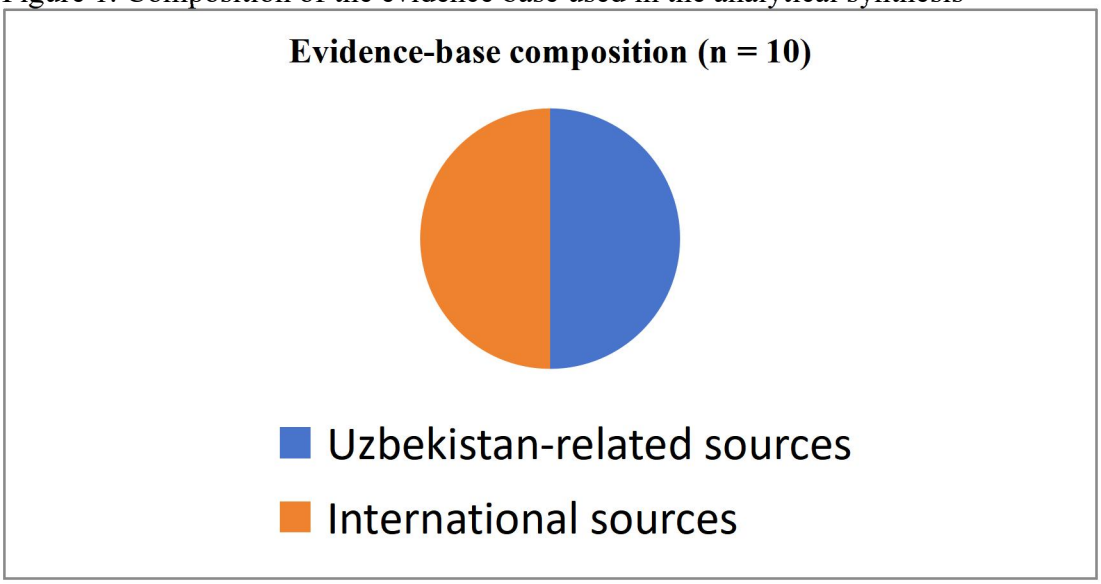
This work was designed as a targeted analytical review structured according to the IMRAD model. The evidence base consisted of ten sources selected for direct relevance to adolescents,

functional cardiopathy, autonomic dysfunction, pediatric arterial hypertension, obesity, cardiometabolic risk or blood-pressure monitoring. To satisfy the requirement for national context, five sources were authored by or affiliated with institutions in Uzbekistan and five were international guidelines or peer-reviewed studies (1-10).

Sources were coded using a predefined matrix. Each publication was examined for explicit discussion of five major risk domains: (a) excess body weight or metabolic abnormalities; (b) autonomic dysfunction or psycho-emotional load; (c) hereditary or perinatal predisposition; (d) insufficient physical activity; and (e) dietary factors, including excessive sodium intake or energy-dense nutrition. A domain was counted only when it was directly identified as a risk factor, associated characteristic or prevention target in the source. Because the included materials differed in design, sample size and outcome definition, formal meta-analysis and pooled effect estimation were not performed.

The outcome of the synthesis was therefore qualitative and semi-quantitative. Frequency counts describe how many of the ten selected sources explicitly addressed a risk domain; they do not represent prevalence among adolescents and should not be interpreted as patient-level risk probabilities. Clinical recommendations were derived by triangulating repeated findings from Uzbek studies with major pediatric blood-pressure and obesity guidelines (5.6.7.8).

Figure 1. Composition of the evidence base used in the analytical synthesis



The evidence base was intentionally balanced: one half consisted of Uzbekistan-related publications and one half of international sources. This structure allowed local observations on autonomic dysfunction, functional cardiopathy and adolescent hypertension to be interpreted alongside standardized pediatric guideline recommendations without allowing one evidence context to dominate the synthesis.

Table 1. Structure of the selected evidence base and its contribution to the review

Evidence block	Sources	Primary contribution	Setting/type
Uzbek autonomic / functional	1-4	Autonomic imbalance, functional cardiopathy, blood-pressure variability, adaptive	Clinical observational studies/reviews; Uzbekistan-affiliated

Evidence block	Sources	Primary contribution	Setting/type
cardiopathy evidence		reserve	authors
Uzbek adolescent hypertension evidence	5	Family history, reduced activity, overweight, target-organ findings	Adolescent clinical cohort, Andijan
Pediatric hypertension guidelines	6-7	BP classification, standardized measurement, ABPM, lifestyle and cardiovascular risk evaluation	International guideline documents
Pediatric obesity guideline	8	Obesity-related cardiometabolic screening, BP monitoring and lifestyle treatment	International guideline
Risk-factor study and obesity-hypertension study	9-10	Metabolic, social, hereditary risk; obesity, circadian BP and remodeling	Peer-reviewed adolescent research

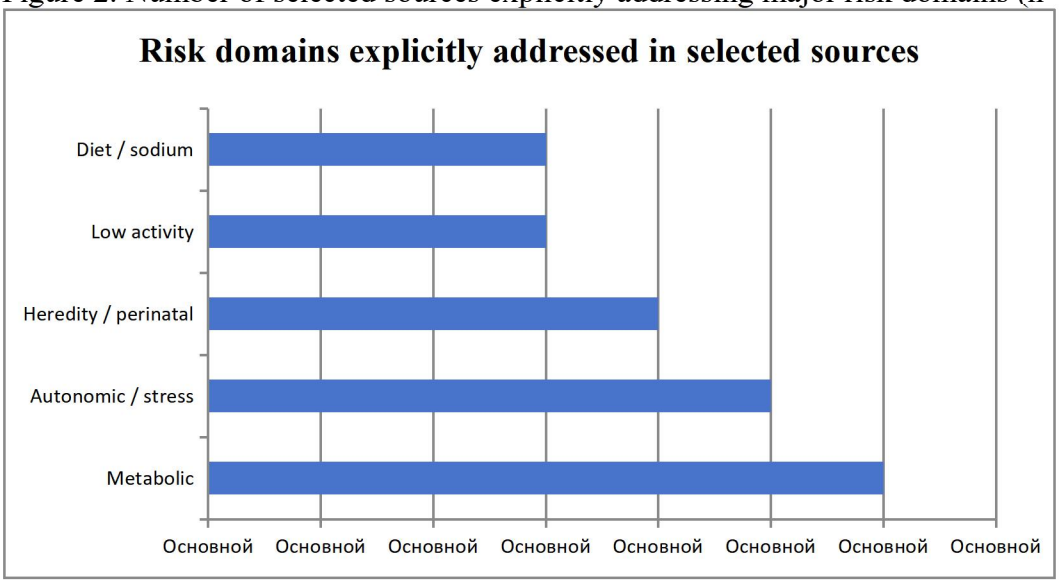
Table 1 demonstrates that the selected sources cover complementary levels of cardiovascular risk: regulation and symptoms, blood-pressure phenotype, metabolic load and clinical screening. This is important because functional cardiovascular disorders rarely result from a single isolated exposure; rather, they emerge when regulatory vulnerability coincides with metabolic or behavioral stressors.

RESULTS

The synthesis identified a convergent pattern across local and international evidence. Excess body weight and related metabolic abnormalities formed the most frequently discussed domain. Six of the ten sources directly linked overweight, obesity, insulin resistance, dyslipidemia or metabolic syndrome with blood-pressure abnormalities or cardiovascular adaptation (5.6.7.8.9.10). Obesity increases circulatory demand and is associated with sympathetic activation, endothelial dysfunction and impaired sodium handling. These mechanisms can initially present as labile pressure elevation, exaggerated heart-rate response or altered nocturnal pressure regulation before sustained hypertension becomes established.

Autonomic and psycho-emotional factors were the second most recurrent domain. Five sources emphasized autonomic imbalance, stress-related dysregulation or reduced adaptive capacity (1.2.3.4.9). Uzbek studies are particularly informative in this area: adolescents with functional cardiopathy or autonomic dystonia showed altered autonomic tone, reduced tolerance to physical or mental load and deviations in ambulatory blood-pressure patterns (1.2.3.4). These findings support evaluation of symptoms such as palpitations, episodic cardialgia, dizziness and unexplained fatigue within a regulatory framework rather than treating them as isolated complaints.

Figure 2. Number of selected sources explicitly addressing major risk domains (n = 10)



The frequency distribution in Figure 2 should be interpreted as an evidence-mapping result, not as epidemiological prevalence. Its value is prioritization: metabolic/adiposity-related risk and autonomic or psycho-emotional dysregulation appear most consistently across heterogeneous evidence, while hereditary, activity and dietary factors remain important components of the same multifactorial pathway.

Hereditary and perinatal predisposition was identified in four sources, especially in studies of adolescent hypertension. A positive family history increases pre-test probability of early blood-pressure abnormalities, while adverse perinatal history may contribute to long-term neurohumoral and vascular programming (5.6.9). Family history should therefore be collected systematically, including hypertension, premature cardiovascular disease, obesity and type 2 diabetes in first-degree relatives.

Behavioral factors were also relevant. Insufficient physical activity was identified in three core sources and is strongly linked to weight gain, lower cardiorespiratory fitness and impaired autonomic adaptation (5.7.8). Dietary patterns characterized by excess energy and sodium intake were repeatedly targeted by international pediatric guidance because they contribute to obesity and elevated blood pressure (6.7.8). Tobacco exposure was less consistently represented in the selected set, but local data documenting parental smoking and adolescent smoking behavior indicate that passive and active nicotine exposure should remain part of risk assessment (5).

Table 2. Major risk factors, mechanisms and practical screening markers in adolescents

Risk factor/domain	Pathophysiological link	Possible functional manifestations	Practical screening markers
Overweight, obesity, insulin resistance, dyslipidemia	Sympathetic activation, endothelial dysfunction, higher circulating volume, metabolic vascular stress	Labile or sustained BP elevation, tachycardia, reduced exercise tolerance, altered circadian BP profile	BMI-for-age, waist/anthropometry where appropriate, repeated BP, lipid/glucose evaluation when indicated

Risk factor/domain	Pathophysiological link	Possible functional manifestations	Practical screening markers
			(5.6.8.10)
Autonomic dysfunction and psycho-emotional stress	Imbalance between sympathetic and parasympathetic regulation; stress-mediated catecholamine response	Palpitations, cardialgia, dizziness, heart-rate variability changes, labile BP	Symptom history, resting HR/BP, orthostatic assessment, ECG; ABPM when BP pattern is unclear (1.2.3.4)
Family history and perinatal factors	Genetic susceptibility and early-life programming of vascular/neurohumoral regulation	Earlier or more persistent BP abnormalities in susceptible adolescents	Family history of HTN/premature CVD/diabetes; birth and perinatal history (5.6.9)
Low physical activity / low fitness	Reduced vascular conditioning, impaired autonomic adaptation, promotion of adiposity	Early fatigue, excessive HR response, reduced exercise tolerance	Physical-activity history, sedentary time, fitness/exercise tolerance where clinically indicated (5.7.8)
Unbalanced diet / high sodium intake	Positive energy balance, obesity, sodium-related BP elevation	BP variability or elevation, weight gain, metabolic abnormalities	Dietary history, sodium-rich foods, sugary drinks, meal pattern; BP/BMI monitoring (6.7.8)
Nicotine and passive smoke exposure	Sympathetic stimulation, endothelial stress and adverse vascular conditioning	Tachycardia, BP elevation and reduced vascular reserve	Confidential tobacco/vaping history and household smoke exposure (5.7)

The practical implication of Table 2 is that routine adolescent assessment can be organized as a layered screen. The first layer includes repeated standardized blood-pressure measurement, pulse, BMI, family history, physical activity, diet, nicotine exposure and symptom review. The second layer is reserved for persistent abnormalities or high-risk combinations and may include ambulatory blood-pressure monitoring, ECG, echocardiography, metabolic testing and specialist evaluation (3.5.6.7.8).

DISCUSSION

The reviewed evidence supports a model in which functional cardiovascular disorders develop at the intersection of regulatory vulnerability and cumulative cardiometabolic load. During adolescence, autonomic maturation and hormonal shifts can temporarily increase hemodynamic variability. When this physiological instability is combined with obesity, inactivity, sleep or dietary disruption, hereditary predisposition or chronic stress, compensatory mechanisms may become

insufficient. Functional cardiopathy and labile hypertension can therefore be viewed as clinically meaningful markers of impaired adaptation rather than as diagnoses that automatically imply structural heart disease (1.2.3.4).

The strongest modifiable target is excess weight and its metabolic consequences. International guidance recommends routine BMI assessment and blood-pressure measurement in children and adolescents, with additional evaluation of cardiometabolic comorbidity when overweight or obesity is present (6.8). Local and regional data reinforce this strategy. In the Andijan hypertension cohort, excess body weight and reduced physical activity coexisted with marked familial burden, and in adolescents with obesity and hypertension, higher body mass was associated with more stable hypertension and adverse circadian or myocardial changes (5.10). Thus, weight management should be integrated into cardiovascular prevention rather than handled as a separate problem.

Autonomic dysfunction deserves equal clinical attention because it can amplify the cardiovascular response to psychological and physical stress. Uzbek research has repeatedly documented autonomic abnormalities in adolescents with functional cardiopathy and has shown that ABPM may detect disturbances that are not apparent from a single office measurement (1.2.3.4). This supports careful differentiation between transient office-related elevation, persistent hypertension and masked or circadian abnormalities. Current pediatric blood-pressure guidelines likewise give ABPM an important role in confirmation and phenotyping of pediatric hypertension (6.7).

The evidence also argues against relying on isolated thresholds. A mildly elevated office blood pressure in an overweight adolescent with a strong family history and autonomic symptoms carries different clinical meaning from the same reading in an otherwise low-risk adolescent. Risk clustering should therefore determine the intensity of follow-up. Repeated measurements, longitudinal growth and BMI trajectories, family history, lifestyle exposures and symptom burden are more informative when interpreted together (5.6.7.9).

Preventive interventions should focus on daily behaviors that influence several pathways simultaneously. Regular age-appropriate physical activity improves cardiorespiratory fitness, body composition and autonomic balance; dietary quality and sodium moderation support both weight and blood-pressure control; avoidance of nicotine protects endothelial and autonomic function; and adequate sleep and stress management may reduce sympathetic overactivation. Family involvement is important because dietary habits, activity patterns and tobacco exposure are frequently shared within households (5.7.8).

This review has limitations. The ten-source set was purposefully targeted rather than exhaustive, and included studies used different definitions of functional cardiovascular abnormalities. Frequency counts in Figure 2 therefore indicate recurrence of themes within the selected evidence, not effect size or population prevalence. Nevertheless, concordance between Uzbekistan-based observations and major pediatric guidelines strengthens the practical conclusion that adolescent cardiovascular screening should be multifactorial and longitudinal.

CONCLUSION

Functional cardiovascular disorders in adolescents are best understood as multifactorial disturbances of cardiovascular adaptation. The most consistently identified risk domains are excess body weight and metabolic abnormalities, autonomic and psycho-emotional dysregulation, hereditary or perinatal predisposition, insufficient physical activity and unfavorable dietary behavior (1.5.6.7.8.9.10).

Early prevention should begin before persistent hypertension or structural damage develops. A practical screening minimum includes repeated standardized blood-pressure measurement, heart

rate, BMI assessment, family and perinatal history, evaluation of physical activity and diet, and targeted inquiry about autonomic symptoms and nicotine exposure. Adolescents with persistent abnormal findings, multiple clustered risks or suggestive symptoms should undergo expanded evaluation, including ABPM and other instrumental or laboratory tests according to clinical indications (3.5.6.7).

A coordinated approach involving pediatricians, family physicians, school health services and families can identify modifiable risk early and reduce the probability that reversible functional abnormalities progress to established cardiovascular disease in adulthood.

REFERENCES:

1. Kurtiyeva Sh., Inoyatova F.I., Gafurov B.G. Hozirgi zamon o‘smirlarida funksional kardiopatiya sindromini sabablari [Causes of functional cardiopathy syndrome in modern adolescents]. Journal of Theoretical and Clinical Medicine. 2021;(1):39-43.
2. Kurtieva S. Clinical and anamnestic characteristics of the health state of adolescents with vegetative dysfunction syndrome. The American Journal of Medical Sciences and Pharmaceutical Research. 2021;3(06):1-12. doi:10.37547/TAJMSPR/Volume03Issue06-01.
3. Kurtieva S. 24-hour blood pressure monitoring in adolescents with vegetative dystonia syndrome. The American Journal of Medical Sciences and Pharmaceutical Research. 2022;4(01):1-8. doi:10.37547/TAJMSPR/Volume04Issue01-01.
4. Nazarova J. Functional cardiopathy syndrome in modern adolescents. The American Journal of Medical Sciences and Pharmaceutical Research. 2021;3(01):6-11. doi:10.37547/TAJMSPR/Volume03Issue01-02.
5. Obidova G.A. Faktory riska i porazhenie organov pri arterialnoy gipertenzii u podrostkov [Risk factors and organ damage in arterial hypertension in adolescents]. Tashkent Medical Academy - Medical Journal of Young Scientists: conference proceedings. 2023:91.
6. Flynn J.T., Kaelber D.C., Baker-Smith C.M., et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. Pediatrics. 2017;140(3):e20171904. doi:10.1542/peds.2017-1904.
7. Lurbe E., Agabiti-Rosei E., Cruickshank J.K., et al. 2016 European Society of Hypertension guidelines for the management of high blood pressure in children and adolescents. Journal of Hypertension. 2016;34(10):1887-1920. doi:10.1097/HJH.0000000000001039.
8. Hampl S.E., Hassink S.G., Skinner A.C., et al. Clinical Practice Guideline for the Evaluation and Treatment of Children and Adolescents With Obesity. Pediatrics. 2023;151(2):e2022060640. doi:10.1542/peds.2022-060640.
9. Kostyuchenko Yu.R., Potupchik T.V., Evert L.S., et al. Sotsialnye i metabolicheskie faktory riska arterialnoy gipertenzii u podrostkov [Social and metabolic risk factors for arterial hypertension in adolescents]. Doctor.Ru. 2023;22(3):70-75. doi:10.31550/1727-2378-2023-22-3-70-75.
10. Trushkina I.V., Leontyeva I.V. Sostoyanie serdechno-sosudistoy sistemy u detey i podrostkov s ozhireniem i arterialnoy gipertenziey [The cardiovascular system in children and adolescents with obesity and arterial hypertension]. Russian Bulletin of Perinatology and Pediatrics. 2011;56(4):47-56.