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HIGH-NORMAL ARTERIAL BLOOD PRESSURE IN YOUNG ADULTS AS A PREDICTOR OF ARTERIAL HYPERTENSION: RISK STRATIFICATION AND OPTIMIZATION OF PREVENTION

Tog'oydullayeva Dildora Dilmurodovna
Department of Fundamental Medicine
Asia International University, Bukhara, Uzbekistan
https://orcid.org0009-0008-4222-1334
dilshod.dildora@icloud.com

Abstract.

High-normal arterial blood pressure (BP) in young adults is frequently perceived as a benign finding, although longitudinal evidence indicates a substantially increased probability of future hypertension and cumulative cardiovascular exposure.

Objective. To synthesize national and international evidence on the prognostic role of high-normal BP in young people and to propose a practical, risk-stratified prevention model applicable to primary care in Uzbekistan.

Methods. A structured narrative review of 15 core sources published in 2001–2026 was performed using national clinical protocols, Uzbekistan-based publications, WHO materials and major international cohort studies and guidelines.

Results. Uzbekistan data confirm that high-normal BP is already detectable in adolescents and young adults. In the Framingham cohort, 37.3% of participants younger than 65 years with high-normal BP progressed to hypertension within four years. CARDIA data show a graded increase in later cardiovascular event rates across BP categories in young adulthood. The most actionable modifiers are excess body weight, high salt intake, physical inactivity, tobacco exposure, metabolic abnormalities and inadequate BP monitoring.

Conclusion. High-normal BP in young adults should be treated as an early risk state that requires confirmation, cardiovascular risk assessment, structured lifestyle intervention and planned follow-up rather than passive observation.

Keywords: high-normal blood pressure; young adults; arterial hypertension; prehypertension; prevention; home blood pressure monitoring; cardiovascular risk.

INTRODUCTION

Arterial hypertension (AH) remains one of the principal modifiable determinants of cardiovascular morbidity and premature mortality. Its clinical diagnosis often occurs in middle age, but the biological trajectory commonly begins much earlier, when repeated blood pressure values occupy the upper part of the non-hypertensive range. The 2024 National Clinical Protocol of the Ministry of Health of the Republic of Uzbekistan classifies office BP of 130–139 mmHg systolic and/or 85–89 mmHg diastolic as high-normal BP, consistent with the 2023 European Society of Hypertension framework (1, 9). The 2024 European Society of Cardiology guideline uses the broader term "elevated BP"

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for office BP 120–139/70–89 mmHg, while the 2017 ACC/AHA system labels 130–139/80–89 mmHg as stage 1 hypertension (10, 11). Although terminology differs, all frameworks emphasize that cardiovascular risk rises continuously with BP rather than only after a single diagnostic threshold is crossed.

The problem is especially important in adolescents and young adults. Short-term absolute cardiovascular risk is usually low in this age group, which can lead to therapeutic inertia and long intervals without reassessment. However, exposure to mildly elevated BP over decades may promote endothelial dysfunction, vascular remodeling, increased arterial stiffness, left ventricular load and later target-organ injury. Furthermore, high-normal office BP may coexist with masked hypertension, particularly when obesity, smoking, high salt intake, psychosocial stress, sleep disruption or family history are present. The Uzbekistan clinical protocol therefore recommends BP screening in adults from 18 years of age and identifies high-normal office BP as a setting in which out-of-office measurement can be useful for detecting masked hypertension (1).

National data make prevention in youth particularly relevant. Uzbekistan's population-based STEPS survey documents a substantial national burden of noncommunicable-disease risk factors and provides a standardized basis for blood-pressure surveillance in adults aged 18–69 years (2). In a large Uzbekistan study including 1,371 adolescents and 1,131 medical students, high-normal BP was already identified among adolescents, while mean BP in young adult students was approximately 114.4/75.9 mmHg, demonstrating substantial heterogeneity within a seemingly healthy population (3). Additional studies from Tashkent and other local clinical settings also draw attention to the early occurrence of elevated BP and the need for improved prevention and monitoring (4–8).

The aim of this article was to evaluate the role of high-normal BP in the transition to sustained arterial hypertension among young people and to formulate an optimized prevention strategy based on risk stratification, reliable BP confirmation, lifestyle intervention and structured follow-up in primary care.

Materials and methods

This work was designed as a structured narrative review with an applied preventive focus. Literature was identified from PubMed-indexed publications, WHO resources, the 2024 Uzbekistan national clinical protocol, inLibrary.uz and the Tashkent Medical Academy repository. The core evidence set included 15 sources published from 2001 through September 2026: eight Uzbekistan-based or Uzbekistan-specific sources (53.3%) and seven international guidelines or peer-reviewed studies.

Eligible sources addressed at least one of the following domains: (a) high-normal/elevated BP in adolescents or young adults; (b) progression from non-hypertensive BP categories to sustained AH; (c) long-term cardiovascular consequences of BP measured in young adulthood; (d) BP screening, home blood pressure monitoring (HBPM) or ambulatory blood pressure monitoring (ABPM); or (e) lifestyle-based primary prevention. Reports were excluded from the analytical synthesis when they did not provide a clear BP definition or did not contribute to prevention, prognosis or monitoring.

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For harmonization, the primary operational definition used in this article is the Uzbekistan/ESH high-normal BP category of 130–139 mmHg systolic and/or 85–89 mmHg diastolic (1, 9). When data originated from ACC/AHA categories, the original definitions were retained and explicitly identified. Extracted information was synthesized by BP category, population, outcome and preventive implication. No new patient-level data were generated; therefore, ethics committee approval was not required.

Table 1. Comparison of contemporary office blood-pressure categories relevant to young adults

Framework	Upper non-hypertensive / elevated category	Hypertension threshold	Preventive interpretation
Uzbekistan national protocol, 2024 / ESH 2023 (1, 9)	High-normal: 130–139 and/or 85–89 mmHg	≥140 and/or ≥90 mmHg	Lifestyle modification; risk assessment; consider out-of-office BP
ACC/AHA 2017 (11)	Elevated: 120–129/<80; Stage 1: 130–139 or 80–89 mmHg	≥130 or ≥80 mmHg	Earlier labeling of risk; lifestyle is central in low-risk young adults
ESC 2024 (10)	Elevated BP: 120–139/70–89 mmHg	≥140/90 mmHg	Risk-based prevention across the elevated-BP range

Results

Longitudinal evidence demonstrates a clear gradient of progression from optimal to high-normal BP. In the Framingham Heart Study, among participants younger than 65 years who were not hypertensive at baseline, the four-year incidence of hypertension was approximately 5.3% for optimal BP, 17.6% for normal BP and 37.3% for high-normal BP (13). Thus, moving from the middle to the upper non-hypertensive range was associated with a marked increase in the probability of crossing the diagnostic threshold within only a few years. A 5% weight gain was also associated with higher odds of progression, supporting weight control as a key preventive target (13).

High-normal BP is also relevant beyond progression to a diagnostic label. In Framingham analyses, adults with high-normal BP had greater long-term cardiovascular event risk than those with optimal BP, with adjusted hazard ratios of approximately 2.5 in women and 1.6 in men in the reported age group (12). Although these cohorts were not restricted to young adults, they establish the biological continuity of risk across the BP spectrum.

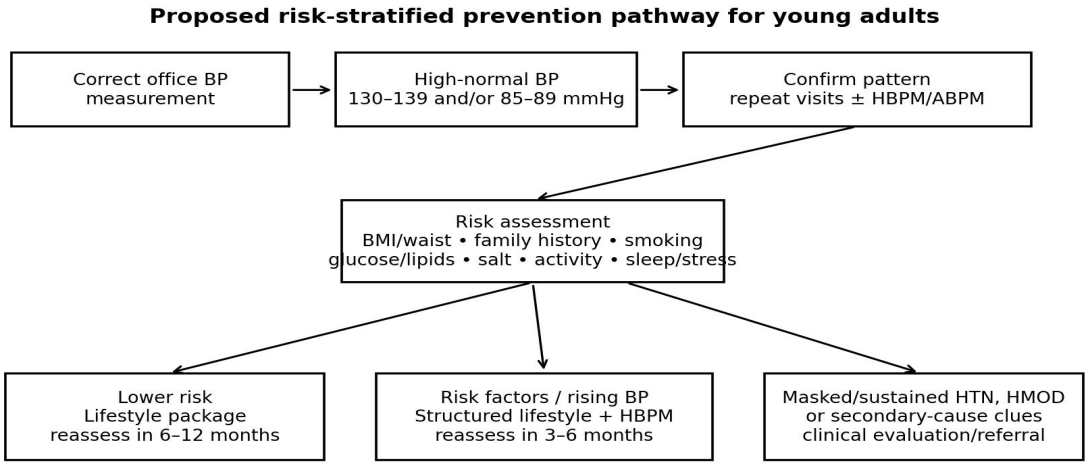
CARDIA provides direct long-term evidence from young adulthood. In 4,851 young adults followed into later life, cardiovascular event incidence increased stepwise from 1.37

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events per 1,000 person-years in the normal BP group to 2.74 with elevated BP, 3.15 with stage 1 hypertension and 8.04 with stage 2 hypertension. Corresponding multivariable-adjusted hazard ratios were 1.67, 1.75 and 3.49 compared with normal BP (14). These findings show that BP status in early adulthood is not merely a temporary measurement phenomenon; it can identify individuals with different long-term cardiovascular trajectories.

Uzbekistan-specific evidence supports active surveillance of younger populations. Khashimova and colleagues evaluated 2,502 adolescents and young adults; among adolescents, high-normal BP (130–139/85–89 mmHg) was reported in 6.9%, while the medical-student subgroup showed a mean BP of 114.4±17.8/75.9±10.1 mmHg (3). A Tashkent study of adolescents aged 13–17 years also emphasized the occurrence of elevated BP phenotypes during school age (4). Local primary-care publications highlight the need for systematic follow-up, patient education and digital or longitudinal monitoring rather than episodic measurement (5, 6).

Figure 1. Proposed risk-stratified prevention pathway for young adults with high-normal BP.



The reviewed evidence identifies excess body weight and weight gain, high dietary sodium exposure, low physical activity, tobacco use, unfavorable metabolic profile, insufficient sleep and persistent psychosocial stress as practical risk amplifiers. These factors are particularly relevant in young adults because they are modifiable before established vascular damage becomes clinically evident. The Uzbekistan protocol recommends lifestyle measures for all patients with hypertension and specifically notes their role in primary prevention among people with high-normal BP and additional risk factors; salt intake below 5 g/day and a healthy dietary pattern are emphasized (1). The DASH-Sodium trial provides experimental evidence that dietary pattern and sodium reduction lower BP, supporting early non-pharmacological intervention (15).

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Figure 2. Cardiovascular event incidence across BP categories in young adulthood in the CARDIA study (adapted numerically from Yano et al. (14)).

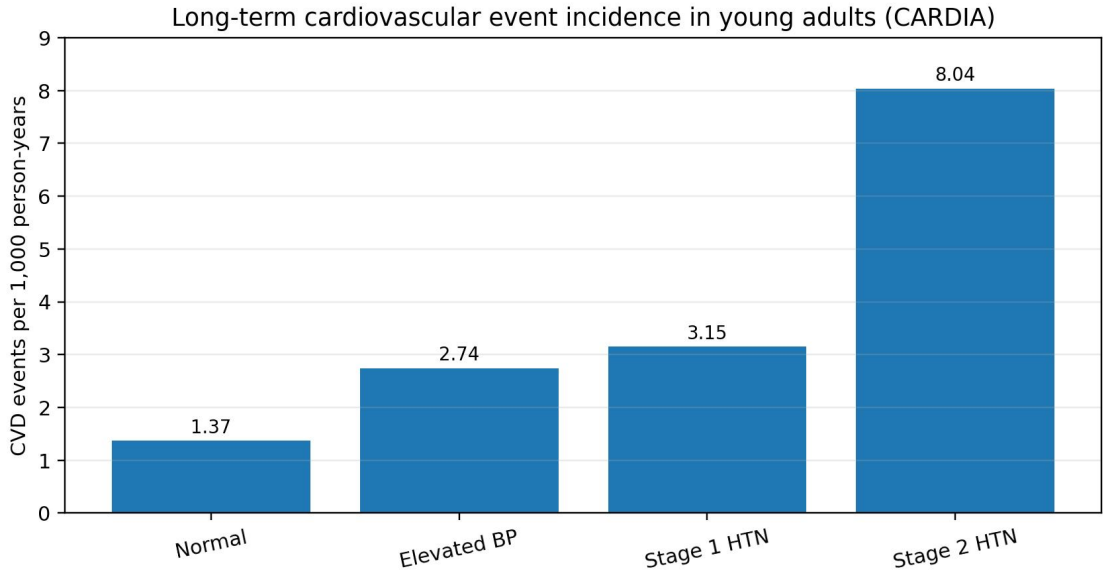


Table 2. Key evidence supporting active prevention in young people with upper-range BP

Source/population	Key finding	Implication
Khashimova et al., Uzbekistan, adolescents/young adults (3)	2,502 participants; high-normal BP reported in 6.9% of adolescents	High-normal BP is already present before adulthood and can be screened early
Framingham, non-hypertensive adults <65 years (13)	4-year progression to HTN: 5.3% optimal, 17.6% normal, 37.3% high-normal	High-normal BP is a strong short-term predictor of incident HTN
CARDIA, 4,851 young adults (14)	CVD incidence: 1.37 normal, 2.74 elevated, 3.15 stage 1, 8.04 stage 2 per 1,000 person-years	Young-adult BP category predicts later cardiovascular outcomes
Uzbekistan national protocol (1)	Screening from age ≥18; HBPM/ABPM useful when masked HTN is suspected	Repeat measurement and out-of-office confirmation should be integrated into prevention

A practical model for young adults should combine measurement quality with risk-based intensity. A single high-normal office reading is insufficient for labeling long-term risk; BP should be repeated under standardized conditions and, when the pattern is inconsistent or risk factors are present, confirmed using HBPM or ABPM. The national protocol recommends office BP screening for adults from 18 years of age and recognizes high-

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normal office BP as a typical context in which masked hypertension may be detected by out-of-office measurements (1).

Table 3. Proposed follow-up and prevention intensity for young adults with high-normal BP

Risk tier	Typical profile	Recommended actions	Suggested reassessment
Lower	High-normal BP confirmed; no major risk factors or suspected organ damage	Education; salt reduction; healthy diet; regular activity; weight maintenance; avoid tobacco	6–12 months
Intermediate	High-normal BP + overweight, family history, smoking, inactivity, high salt intake, stress/sleep problems	Structured lifestyle plan; HBPM; BMI/waist; fasting glucose and lipids as clinically indicated	3–6 months
High	Persistent upward BP trend, multiple metabolic risks, suspected masked HTN	HBPM/ABPM; clinician review; assess global risk and possible hypertension-mediated organ damage	1–3 months
Referral/diagnostic pathway	Office BP ≥140/90, confirmed hypertension, severe readings, secondary-cause clues or organ damage	Diagnostic evaluation and management according to national protocol; assess secondary causes when indicated	Prompt / individualized

4. Discussion

The principal finding of this synthesis is that high-normal BP in youth should not be interpreted as "normal enough" when it persists. It represents a measurable transition zone in which future hypertension is more likely and in which preventive intervention is still predominantly non-pharmacological. The Framingham progression data demonstrate a steep rise in incident hypertension across non-hypertensive categories, while CARDIA demonstrates that BP measured in young adulthood separates long-term cardiovascular risk trajectories (12–14). Together, these observations support a life-course approach: the duration of exposure matters, not only the BP value recorded at the moment of diagnosis.

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The divergence among guideline labels requires careful communication. An individual with BP 134/86 mmHg is “high-normal” by the Uzbekistan/ESH framework but “stage 1 hypertension” by ACC/AHA criteria and falls within “elevated BP” in the 2024 ESC framework (1, 9–11). This apparent disagreement should not distract from the shared preventive message. For young adults without very high cardiovascular risk or target-organ damage, the immediate priorities are measurement confirmation, risk-factor control and follow-up. Pharmacological treatment should not be inferred solely from the terminology used in this review; treatment decisions must follow the applicable national clinical protocol and the individual clinical context.

For Uzbekistan, an optimized model should begin in primary care, universities and other settings with access to young adults. Accurate cuff sizing, rest before measurement and repeated readings reduce misclassification. Because high-normal office BP may conceal masked hypertension, HBPM and ABPM can prevent both underdiagnosis and unnecessary labeling (1). At the same time, prevention should move from generic advice to measurable goals: lower salt intake, normalize excess weight, perform regular aerobic and resistance activity, avoid tobacco exposure, improve sleep regularity and address persistent stress. Local publications also support strengthening continuity of care and monitoring, including electronic approaches where feasible (5, 6).

The proposed risk tiers can improve efficiency by avoiding identical follow-up for every young person. A healthy young adult with stable high-normal BP and no additional risks may be reassessed at longer intervals, whereas an individual with obesity, strong family history, smoking, metabolic abnormalities or a rising BP trajectory warrants earlier review and out-of-office measurement. This approach is consistent with the risk-based logic of contemporary European recommendations (9, 10).

This review has limitations. The selected literature is heterogeneous in age definitions and BP classification systems, and several Uzbekistan studies are cross-sectional or descriptive. Longitudinal national data specifically tracking high-normal BP in 18–30-year-olds to incident hypertension remain limited. Therefore, the numerical risk estimates from Framingham and CARDIA should not be transferred directly to the Uzbekistan population without validation. A prospective multicenter cohort using standardized office BP, HBPM/ABPM, anthropometry, metabolic markers and lifestyle measures would be a valuable next step.

Conclusion

Persistent high-normal arterial blood pressure in young adults is an early cardiovascular risk phenotype and a clinically useful predictor of progression toward sustained arterial hypertension. Prevention can be improved by replacing passive observation with a structured pathway: standardized repeat BP measurement, selective HBPM/ABPM, assessment of body weight and metabolic and behavioral risk factors, targeted lifestyle modification, and follow-up intervals matched to risk. Uzbekistan’s national protocol already provides a suitable framework for screening from 18 years of age and for recognizing high-normal BP as a context requiring preventive attention. The major

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research priority is a national longitudinal study of young adults that quantifies progression rates and tests whether structured, digitally supported lifestyle and BP-monitoring programs reduce incident hypertension (1–3, 5, 9, 14).

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