Differences in BMI and Renal Function across Healthy Populations with Different Constitution Types and Influencing Factors of Blood Pressure

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Abstract [**Objectives**] To investigate differences in BMI and renal function across constitution types and influencing factors of blood pressure. [**Methods**] 92 college student volunteers aged 18 - 25 from January 2023 to December 2024 were selected. BMI, blood pressure, and renal function markers—blood urea nitrogen (BUN), creatinine (Cr), uric acid (UA), were compared across constitution types. Multiple stepwise regression analysis was applied to identify the influencing factors of blood pressure. [**Results**] Among 92 healthy participants aged 18 - 25, Shar-predominant constitution accounted for 50%, Khii-predominant for 25%, and Badgan-predominant for 20.65%. Significant differences existed in mean systolic and diastolic blood pressure across constitution types (systolic: $F=4.56$, $P=0.001$; diastolic: $F=3.78$, $P=0.005$). Shar-predominant group showed significantly higher systolic blood pressure than other types ($P<0.05$), while Khii-predominant group had higher diastolic pressure. Shar-predominant constitution demonstrated significantly greater height, weight, and BMI compared to other types ($P<0.05$). Males exhibited significantly higher height, weight, and BMI than females ($P<0.05$). Shar-predominant group showed significantly elevated urea, uric acid, and creatinine levels compared to other constitution types ($P<0.05$). Males had significantly higher mean urea, uric acid, and creatinine levels than females ($P<0.05$). Correlation analysis revealed stronger associations between BMI, renal function, and blood pressure in Shar-predominant group ($r>0.50$, $P<0.05$). Multiple regression analysis identified BMI as the primary influencing factor for blood pressure, followed by urea and uric acid. In Shar-predominant group, BMI exerted the strongest effect on blood pressure ($\beta=0.60-0.65$, $P<0.001$). [**Conclusions**] This study provides important evidence for health management in populations with different constitution types.

Key words Mongolian medicine, Constitution, BMI, Renal function, Blood pressure

1 Introduction

Hypertensive patients demonstrate metabolic disorders in triglyceride and serum uric acid (UA) levels[1-2], with significant correlations existing among lipid profiles, BMI, renal function, and blood pressure variability[3]. Studies suggest that addressing risks from hypertension, dyslipidemia, and renal insufficiency should persist throughout pre-disease and disease phases. Preventive measures before disease onset ("preventive treatment of undisease") may effectively reduce hyperuricemia with overweight/obesity[4]. Traditional Chinese Medicine posits significant differences in blood pressure and renal function indicators across constitution types. Personalized treatment for different hypertension subtypes can enhance efficacy and genuinely delay disease progression[5]. Constitution characteristics serve as crucial references in the "Ten Diagnostic and Therapeutic Elements" of Mongolian medicine. Effective diagnosis and treatment require full consideration of individual constitution to ensure appropriate application of therapeutic approaches[6]. B. Tsrentogtoh demonstrated associations between hypertension/hyperlipidemia and constitution types, with Badgan - Shar constitution showing highest lipid levels and constituting majority (52%) of hypertensive patients[7]. Qi Qiqige *et al.* proposed that constitution-specific regulatory methods based on "preventive treatment" philosophy can achieve optimal outcomes through targeted interventions after constitutional identification[8]. This study classified constitutions into seven types based on Mongolian medical theory, comparing blood pressure, BMI, and renal function across groups to identify associated factors.

2 Materials and methods

The study was approved by ethics committees of the Mongolian National University of Medical Sciences and Inner Mongolia International Mongolian Medical Hospital (Ethics No. 2023/3-10 and 2024-015). After obtaining informed consent, 133 college volunteers aged 18 - 25 were recruited from January 2023 to December 2024. Through inclusion criteria screening (relatively healthy individuals with no genetic disease history, no infectious diseases within 3 months, no antibiotic use within 1 week, normal mental status, non-pregnant/non-menstruating), 92 participants met requirements.

Height and weight were measured using a mechanical stadiometer (Model: CP30B, Shenzhen YunKangBao Technology Co., Ltd). Blood pressure measurement required participants to

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rest quietly for ≥5 min in seated position. The right upper arm was exposed with elbow positioned at heart level. The cuff was wrapped snugly 2.5 cm above the antecubital fossa. Three consecutive measurements were averaged.

Blood collection: 5 mL of venous blood was drawn after overnight fasting. Biochemical indices were analyzed using Beckman DXI-800 automated chemiluminescence analyzer. Samples were divided into 7 groups: Khii-Shar, Shar-Khii, Badgan-Shar, Shar-Badgan, Badgan-Khii, Khii-Badgan, and mixed constitution. Comparative analyses were conducted across groups, with multiple stepwise regression analysis identifying the influencing factors of blood pressure.

3 Results and analysis

3.1 Constitution type distribution As shown in Table 1, among 92 healthy participants aged 18 – 25, Shar-predominant constitution was most common (50%), followed by Khii-predominant (25%) and Badgan-predominant (20.65%).

Table 1 Distribution and percentage of constitution types among healthy individuals aged 18 – 25 years (n = 92)

Constitution type	Number of people	Percentage//%
Shar-Khii	28	30.43
Shar-Badgan	18	19.57
Khii-Shar	15	16.30
Badgan-Shar	14	15.22
Badgan-Khii	5	5.43
Khii-Badgan	8	8.70
Mixed	1	1.09

3.2 BMI, renal function differences and influencing factors of blood pressure The study revealed that Shar-predominant constitutions (*e.g.*, Shar-Khii and Shar-Badgan) had significantly greater height, weight, and BMI compared to other types (P < 0.05). Khii-predominant constitutions (*e.g.*, Khii-Shar and Khii-Badgan) showed lower values, while Badgan-predominant groups (*e.g.*, Badgan-Shar and Badgan-Khii) displayed intermediate levels. Males exhibited significantly higher height, weight, and BMI than females (P < 0.05).

Shar-predominant groups (*e.g.*, Shar-Khii and Shar-Badgan) demonstrated significantly elevated urea, uric acid, and creatinine levels versus other types (P < 0.05). For Khii-predominant constitutions (*e.g.*, Khii-Shar or Khii-Badgan), levels of urea, uric acid, and creatinine were lower. For Badgan-predominant constitutions (*e.g.*, Badgan-Shar or Badgan-Khii), levels of urea, uric acid, and creatinine were moderate. Males had significantly higher mean urea, uric acid, and creatinine levels than females (P < 0.05), with both constitution type and sex showing significant effects (P < 0.05).

Significant differences existed in systolic (F = 4.56, P = 0.001) and diastolic (F = 3.78, P = 0.005) blood pressure across constitution types, indicating constitution's significant impact (P < 0.05). Shar-predominant groups (*e.g.*, Shar-Khii and Shar-Badgan) showed significantly higher systolic pressure than other types (P < 0.05). Khii-predominant groups had higher diastolic pressure, particularly Khii-Badgan constitution (mean 71.17 mmHg), significantly exceeding Badgan-Shar group's 65.67 mmHg (P = 0.023).

4 Discussion

This study comprehensively analyzed BMI, renal function (urea, uric acid, creatinine), and blood pressure (systolic/diastolic) data across three fundamental constitutions (Khii, Shar, Badgan), revealing associations and risk factors between blood pressure, BMI, and renal function among different constitution types. BMI significantly influenced both systolic and diastolic blood pressure, with the strongest effect observed in Shar-predominant constitutions (β = 0.60 – 0.65, P < 0.001). This aligns with prior studies[5], confirming overweight/obesity as critical risk factors for hypertension[9]. BMI showed substantial but relatively weaker effects on blood pressure in Khii- and Badgan-predominant groups compared to Shar types. This may relate to Shar's "hot" nature[10], characterized by heightened metabolic activity, amplifying weight-related blood pressure fluctuations. Urea and uric acid significantly affected blood pressure, though their impact was weaker than BMI. Elevated uric acid may induce vascular endothelial dysfunction and inflammation, thereby elevating hypertension risk[11]. Creatinine (Cr) showed no significant effect, while urea and uric acid better reflected tubular function and metabolic status. Shar-predominant constitutions exhibited the strongest correlations among BMI, renal function, and blood pressure, indicating tight interconnections between physique, kidney function, and blood pressure. This may stem from Shar's "hot" nature, where heightened metabolism amplifies blood pressure responsiveness to weight and renal changes. Badgan-predominant groups showed moderately strong correlations, suggesting notable links among BMI, renal function, and blood pressure. Badgan's "cold" nature[12] may slow metabolism, yet weight and renal impacts on blood pressure remain clinically relevant. The BMI-constitution association aligns with findings from Siqin Bilige *et al.*[13]. Khii-predominant groups displayed moderate correlations, implying partial connections among these factors. Khii's "wind" nature[14] may contribute to blood pressure variability, though its overall influence was weaker. BMI, urea, and uric acid were significant blood pressure risk factors, with BMI exerting the strongest effect. These findings highlight weight control as a key strategy for hypertension prevention and management. As creatinine (Cr) showed no significant impact, future studies should explore additional renal function markers.

5 Conclusion

This study provides critical evidence for health management in

populations with distinct constitution types. For instance, Shar-predominant individuals require prioritized weight control and renal health monitoring to mitigate hypertension risk. Badgan- and Khii-predominant groups should also address BMI and renal impacts on blood pressure, though intervention strategies may be more flexible. Limitations include a small sample size, particularly for certain constitutions (*e. g.*, mixed types), potentially affecting result stability. Unaccounted confounders (*e. g.*, diet, exercise, genetics) warrant inclusion in future research for comprehensive analysis. By revealing BMI-renal function-blood pressure relationships and risk factors across constitutions, this study supports personalized health management strategies. Future studies should expand sample sizes and integrate additional variables to deepen understanding of constitution-health interactions.

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