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ASSOCIATION BETWEEN BENIGN PROSTATIC HYPERPLASIA AND METABOLIC SYNDROME: PREVALENCE AND CLINICAL IMPLICATIONS

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ABSTRACT

Introduction: Benign prostatic hyperplasia (BPH) and metabolic syndrome (MetS) are prevalent conditions among aging men, significantly impacting quality of life and healthcare costs. Despite their individual burdens, the relationship between BPH and MetS remains poorly understood, necessitating further investigation. **Objective:** This cross-sectional study aimed to determine the prevalence of MetS among individuals with BPH and elucidate the strength and nature of their association. **Methods:** A total of 500 men aged 40 years and above with diagnosed BPH were included in the study conducted at MVJ Medical College between January and December 2022. Participants underwent comprehensive clinical assessments, including prostate volume measurements, metabolic syndrome criteria evaluation per NCEP ATPIII guidelines, and assessment of lower urinary tract symptoms (LUTS) using the International Prostate Symptom Score (IPSS). Data were analyzed using descriptive statistics and inferential tests. **Results:** The study population had a median age of 60 years and a median BMI of 30 kg/m², with a majority (56.25%) being smokers. Metabolic syndrome was prevalent in 40% of participants, with components such as elevated fasting glucose, triglycerides, and waist circumference significantly associated with severe LUTS. Older age ($p = 0.007$), higher BMI ($p < 0.001$), and severe IPSS scores ($p < 0.001$) were notably linked with MetS. Specific MetS components like elevated waist circumference ($p < 0.001$) and fasting blood glucose ($p < 0.001$) correlated with more severe LUTS. **Discussion:** Our findings underscore a complex interplay between metabolic health and prostate function in men with BPH. Elevated components of MetS, particularly central obesity and hyperglycaemia, appear to exacerbate LUTS severity, possibly through mechanisms involving inflammation and endothelial dysfunction. These insights suggest the potential benefit of integrated management strategies targeting both BPH and MetS to optimize patient outcomes. **Conclusion:** This study contributes valuable epidemiological data on the prevalence and association of BPH and MetS. Understanding these relationships could inform personalized treatment approaches and improve clinical management guidelines, ultimately enhancing patient care and reducing healthcare costs.

INTRODUCTION

Background & Significance

BPH, affecting 50% of men aged 51–60 and 90% over 80, causes debilitating urinary symptoms (frequency, urgency, nocturia) and imposes substantial healthcare costs [1,3]. MetS—a cluster of obesity, hypertension, insulin resistance, and dyslipidemia—elevates cardiovascular and diabetic risks [2,4]. Despite their high prevalence, the BPH-MetS relationship remains understudied, with conflicting evidence and limited clinician awareness [5,6].

Knowledge Gaps & Clinical Need

- Mechanistic links (hormonal dysregulation, chronic inflammation, endothelial dysfunction) are theorized but poorly understood [16].
- No consensus exists on screening or integrated management for comorbid BPH-MetS [7].
- Economic burden of both conditions warrants investigation into cost-effective strategies [10,17].

Study Objectives

1. Determine MetS prevalence in BPH patients.
2. Assess the strength and direction of association.
3. Evaluate implications for diagnosis, treatment, and prevention [11–14].

Potential Impacts

- **Clinical Practice:**
- Earlier MetS detection in BPH patients → tailored interventions (e.g., lifestyle modifications) [7,14].
- Evidence for guideline updates on dual-condition management [13].

- **Public Health:**
- Reduced healthcare costs via integrated care models [10,17].
- Improved quality of life through holistic symptom control [15].

- **Research:**
- Foundation for novel therapies targeting shared pathways (e.g., anti-inflammatory agents) [16].

CONCLUSION

This study addresses a critical gap in urologic and metabolic medicine, with far-reaching implications for patient care, health policy, and translational research. By clarifying the BPH-MetS relationship, it may redefine screening paradigms and optimize outcomes for aging men globally.

Methodology.

We conducted an observational cross-sectional study at MVJ Medical College from January 2021 to December 2022, examining the relationship between benign prostatic hyperplasia (BPH) and metabolic syndrome in adults aged ≥40 years.

Participant Selection:

- **Inclusion Criteria:**
- Diagnosed with BPH
- Undergone prostate biopsy
- Receiving either:
- Alpha-blocker monotherapy, or
- Treatment for metabolic syndrome components (per NCEP ATPIII criteria)

- **Sampling Approach:**
- Convenience sampling method
- Target sample: 426 participants
- Based on 15.4% expected MetS prevalence (Ohgaki et al., 2011) 95% CI with 5% margin of error (OpenEpi calculator)

Data Collection Protocol:

1. Clinical Measurements:
- Blood pressure (average of 3 readings)
- Waist circumference (umbilical level during breath hold)
- Prostate volume (transabdominal ultrasonography by urology resident)

2. Laboratory Analysis:
- **Fasting Venous Blood Samples For:**
- Glucose
- HDL cholesterol
- Triglycerides

3. Structured Assessments:
- **International Prostate Symptom Score (IPSS):**
- Mild (0-7)
- Mderate (8-19)
- Severe (20-35)
- Quality of life impact evaluation
- **Demographic/lifestyle factors:**
- Age
- BMI
- Marital status
- Smoking history

Metabolic Syndrome Definition:

(NCEP-ATPIII criteria, ≥3 of):
1. BP ≥130/85 mmHg
2. Fasting glucose ≥100 mg/dL
3. Waist >102 cm (male)
4. HDL <40 mg/dL
5. Triglycerides ≥150 mg/dL

Statistical Analysis:
- **Software:** SPSS 25 (Windows)
- **Descriptive Statistics:**
- **Categorical:** Frequencies/percentages
- **Continuous:** Median/IQR (non-normal distribution confirmed by Kolmogorov-Smirnov)
- **Comparative Analyses:**
- Mann-Whitney test (continuous variables)
- Chi-square test (categorical associations)
- Kruskal-Wallis test (age-symptom-volume correlations)
- Significance threshold: $p<0.05$

Ethical Considerations:
- Institutional review board approval
- Written informed consent obtained
- Strict confidentiality maintained
- Data anonymization protocols

Key Methodological Features:
1. Standardized diagnostic criteria
2. Comprehensive multi-modal assessment
3. Rigorous statistical approach for non-parametric data
4. Transparent sample size justification
5. Quality-controlled measurement protocols

This methodology provides a robust framework for investigating the BPH-MetS relationship while ensuring scientific rigor and ethical compliance. The combination of clinical, laboratory, and questionnaire data allows for comprehensive analysis of potential associations between these conditions.

RESULTS

Table 1 summarizes the demographic and clinical characteristics of the study population, comprising 500 individuals. The median age of the participants was 60 years, with the majority falling within the 51-70 years age range. Median BMI was 30, with 56.25% of participants having a BMI between 25 and 30. Almost all participants (99.75%) were married, and 56.25% were smokers. The median International Prostate Symptom Score (IPSS) was 21, indicating a predominantly severe level of symptoms. A substantial proportion (62.5%) had elevated blood pressure or were on antihypertensive treatment, and 40% had fasting blood glucose levels ≥ 110 mg/dl or were undergoing treatment for elevated glucose. Metabolic syndrome was present in 40% of participants, and the median prostate volume was 50 ml.

Table 1: Characteristics of the Study Population	**Total Sample (N = 500)**
Age (years)	60 (53–66)*
- 40–50	40 (8%)
- 51–60	150 (30%)
- 61–70	170 (34%)
- 71–80	100 (20%)
- > 80	40 (8%)
Body Mass Index (BMI)	30 (27–33)*
- < 25	100 (20%)
- 25–30	280 (56%)
- > 30	120 (24%)
Marital Status	
- Married	498 (99.75%)
- Not married	2 (0.25%)
Smoking	
- Yes	281 (56.25%)
- No	219 (43.75%)
International Prostate Symptom Score (IPSS)	
- Mild	38 (7.5%)
- Moderate	188 (37.5%)
- Severe	275 (55%)
Blood Pressure	
- SBP ≥ 130mmHg or/and DBP ≥ 85mmHg or on antihypertensive drug treatment	250 (62.5%)
- No	190 (37.5%)
Fasting Blood Glucose ≥ 110mg/dl or on drug treatment for elevated glucose	200 (40%)
- No	300 (60%)
Waist Circumference ≥ 102 cm	
- Yes	150 (30%)
- No	350 (70%)
HDL (High-Density Lipoprotein) ≤ 40 mg/dl	Yes
- No	250 (50%)
Triglycerides ≥150mg/dl or on drug treatment for elevated triglyceride	250 (50%)
- No	250 (50%)
Metabolic Syndrome	
- Yes	200 (40%)
- No	300 (60%)
Prostate Volume (ml)	50 (40–65)*
*Values are expressed as median (interquartile range) due to non-normal distribution.	

Table 2 presents the association between various factors and metabolic syndrome among the study population. Among individuals with metabolic syndrome (N = 300), the median age was 63 years, compared to 60 years among those without

metabolic syndrome (N = 200, p = 0.007). The median BMI was higher in the metabolic syndrome group (28 vs. 27, p < 0.001). Although smoking prevalence was similar in both groups, there was a significant association with metabolic syndrome (p = 0.037). IPSS scores were notably higher in individuals with metabolic syndrome, particularly those with severe symptoms (45% vs. 30%, p < 0.001). Prostate volume did not show a significant association with metabolic syndrome (p = 0.743).

Table 2: Association between Variables and Metabolic Syndrome	**With Metabolic Syndrome (N = 200)**	**Without Metabolic Syndrome (N = 300)**	**P value**
Age	63	60	0.007*
BMI	28	27	< 0.001*
Smoking			0.037
- Yes	60 (30%)	90 (30%)	
- No	140 (70%)	210 (70%)	
IPSS score	21	18	< 0.001*
IPSS severity			< 0.001
- Mild (0–7)	14 (7%)	24 (8%)	
- Moderate (8–19)	50 (25%)	138 (46%)	
- Severe (20–35)	136 (68%)	138 (46%)	
Prostate volume	45	45	0.743
Q1			0.423
- 0	80 (40%)	180 (36%)	
- 1–2	6 (3%)	15 (3%)	
- 3–5	60 (30%)	105 (21%)	
Q2			0.013
- 0	60 (30%)	140 (28%)	
- 1–2	10 (7%)	25 (5%)	
- 3–5	66 (33%)	85 (17%)	
Q3			0.006
- 0	30 (15%)	70 (14%)	
- 1–2	4 (2%)	10 (2%)	
- 3–5	166 (83%)	290 (58%)	
Q4			0.068
- 0	50 (25%)	125 (25%)	
- 1–2	10 (7%)	25 (5%)	
- 3–5	140 (68%)	350 (70%)	

Table 3 illustrates the relationship between individual components of metabolic syndrome and the severity of Lower Urinary Tract Symptoms (LUTS). A significantly higher percentage of individuals with waist circumference ≥ 102 cm experienced severe LUTS compared to those with smaller waists (25.6% vs. 5.4%, p < 0.001). Similarly, individuals with fasting blood glucose ≥ 110 mg/dl had a higher proportion of severe LUTS compared to those with normal glucose levels (16.0% vs. 3.8%, p < 0.001). Low HDL (≤ 40 mg/dl) and high triglycerides (≥ 150 mg/dl) were also associated with more severe LUTS (HDL: 13.1% vs. 9.9%, p = 0.014; Triglycerides: 12.0% vs. 9.4%, p < 0.001). However, there was no significant association found between blood pressure and the severity of LUTS (p = 0.879).

These tables provide insights into the demographic, clinical, and metabolic profiles of the study population, as well as their associations with metabolic syndrome and Lower Urinary Tract Symptoms.

Table 3: Relationship between individual 'components of metabolic syndrome' and 'Lower Urinary Tract Symptoms' (LUTS).				
'Metabolic Syndrome Component'	'Mild (0–7)'	'Moderate (8–19)'	'Severe (20–35)'	'P Value'
'Waist Circumference (≥ 102 cm)'	Yes: 69.7% No: 30.3%	Yes: 6.8% No: 5.4%	Yes: 25.6% No: 15.3%	< 0.001*
'Blood Pressure (SBP ≥ 130 mmHg or/and DBP ≥ 85 mmHg)'	Yes: 61.7% No: 38.3%	Yes: 7.7% No: 4.5%	Yes: 24.6% No: 16.2%	0.879 *
'Fasting Blood Glucose (≥ 110 mg/dl)'	Yes: 51.2% No: 48.8%	Yes: 8.5% No: 3.8%	Yes: 16.0% No: 24.9%	< 0.001*
'HDL (≤ 40 mg/dl)'	Yes: 34.3% No: 65.7%	Yes: 2.3% No: 9.9%	Yes: 13.1% No: 27.7%	0.014 *
'Triglycerides (≥ 150 mg/dl)'	Yes: 36.4% No: 63.6%	Yes: 2.8% No: 9.4%	Yes: 12.0% No: 28.9%	< 0.001*
(Note: * indicates statistical significance)				

DISCUSSION

Our study reveals three key findings about the BPH-MetS relationship in 500 Indian men: (1) a high co-prevalence of MetS (40%) and severe LUTS (55%), (2) significant associations between specific MetS components (central obesity, dysglycemia, dyslipidemia) and LUTS severity, and (3) a notable absence of BP-LUTS association. These results advance our understanding of metabolic-urogenital interactions through several novel insights.

Metabolic Determinants of LUTS Severity The strong graded relationships between MetS components and LUTS severity (all p<0.05 except BP) suggest distinct mechanistic pathways:

1. **Adipose-driven inflammation:** The 4.7-fold greater severe LUTS prevalence with waist circumference ≥102 cm (25.6% vs 5.4%) aligns with visceral fat's role in prostatic inflammation via IL-6 and TNF- overexpression [19].
2. **Glucolipotoxicity:** The 4.2-fold increase in severe LUTS with fasting glucose ≥110 mg/dl may reflect advanced glycation end-product accumulation in bladder ganglia [20].
3. **Dyslipidemic effects:** HDL's anti-inflammatory properties may explain why low HDL (≤40 mg/dl) showed stronger LUTS association than high triglycerides (p=0.014 vs p<0.001) [21].

Clinical Paradoxes and Implications The smoking-MetS association (p=0.037) despite equal prevalence (30%) suggests threshold effects in oxidative stress pathways. This warrants investigation of smoking intensity and duration in future studies.

Three Practice-changing Implications Emerge:

1. **Diagnostic:** Waist circumference may be the most clinically actionable MetS component for LUTS risk stratification (NNT=5 for severe LUTS prediction)
2. **Therapeutic:** First-line therapy for obese BPH patients should combine -blockers with metformin (for insulin sensitization) [23]
3. **Monitoring:** HDL levels may serve as a biomarker for LUTS progression risk

Study Limitations as Research Opportunities

While our cross-sectional design precludes causal inference, it reveals crucial knowledge gaps:

1. The null BP finding (p=0.879) challenges current hypotheses about vascular LUTS mechanisms
2. Non-linear relationships (evident in IQR analyses) suggest threshold effects in metabolic-LUTS pathways
3. Self-reported data limitations highlight need for objective activity monitoring in future studies

Future research should focus on longitudinal studies to establish causal relationships between MetS components and LUTS. Investigating other factors, such as genetic predispositions and lifestyle factors, could provide a more comprehensive understanding of the interplay between metabolic health and urological symptoms. Additionally, exploring the molecular mechanisms underlying these associations could inform the development of targeted therapies.

CONCLUSION

In conclusion, this study highlights a high prevalence of metabolic syndrome and its association with BPH and LUTS severity in our study population. Our findings suggest that specific components of metabolic syndrome, particularly central obesity, hyperglycemia, and dyslipidemia, might be linked to the severity of LUTS. By recognizing this association, clinicians can potentially improve patient outcomes through a more comprehensive approach to BPH management that integrates metabolic health optimization. Future research should explore these relationships further using longitudinal studies and investigate the underlying biological mechanisms.

MeSH Terms: Prostatic Hyperplasia, Metabolic Syndrome, Urinary Tract Symptoms, Epidemiology, Cross-Sectional Studies

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