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PREVALENCE OF HYPERTENSION AND ITS ASSOCIATION WITH OBESITY IN URBAN ADULTS OF PESHAWAR: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

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Abstract:
Hypertension is one of the most significant global health concerns, accounting for considerable morbidity and mortality due to cardiovascular and cerebrovascular complications. Obesity, a rapidly increasing problem in South Asia, has been strongly linked with the development of hypertension. In Pakistan, especially in urban centers such as Peshawar, rapid lifestyle transitions have contributed to increased risks of both hypertension and obesity. However, there is limited hospital-based empirical evidence on their prevalence and interrelation. This study aims to estimate the prevalence of hypertension among adults visiting tertiary hospitals in Peshawar and to examine its association with obesity, measured through body mass index (BMI) and waist circumference. A hospital-based cross-sectional study was conducted on 500 adults (aged 20–65 years) attending outpatient departments of three tertiary care hospitals in Peshawar. Systematic random sampling was applied. Blood pressure was measured according to WHO guidelines, while obesity was assessed using BMI and central adiposity measures. Logistic regression was used to explore associations between obesity and hypertension, adjusting for age, gender, smoking, and physical inactivity. Preliminary findings indicate that the prevalence of hypertension among participants was 34.8%, while overweight and obesity were present in 42.6% and 27.3% of subjects, respectively. Central obesity, measured by waist circumference, was present in 55.1% of participants. Logistic regression demonstrated a strong positive association between obesity and hypertension (OR = 2.87; 95% CI: 1.92–4.29, p < Hypertension is highly prevalent among urban adults in Peshawar and strongly associated with both general and central obesity. These findings highlight the need for targeted interventions focusing on weight reduction, lifestyle modification, and early screening programs in urban health settings.

Keywords: *Hypertension, Obesity, Body Mass Index, Waist Circumference, Urban Adults, Peshawar, Pakistan*

Introduction

Hypertension, commonly referred to as high blood pressure, is a chronic medical condition characterized by persistently elevated arterial pressure, and it represents a leading cause of premature death globally. The World Health Organization (WHO) estimates that more than 1.28 billion adults aged 30–79 years are living with hypertension, with two-thirds residing in low- and middle-income countries (WHO, 2023). The condition contributes significantly to the global burden of non-communicable diseases (NCDs), being a major risk factor for ischemic heart disease, stroke, renal impairment, and premature mortality (Mills et al., 2020). Importantly, hypertension is a modifiable risk factor, making its early detection and management crucial to reducing NCD-related deaths.

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In Pakistan, hypertension has emerged as a significant public health challenge. National surveys reveal that approximately one-third of adults suffer from hypertension, while many remain undiagnosed or inadequately treated (Jafar et al., 2021). Urbanization, sedentary lifestyles, unhealthy diets, and rising obesity rates have fueled this epidemic. Cities like Peshawar, which are undergoing rapid demographic and lifestyle transitions, provide fertile grounds for the proliferation of hypertension and its associated risk factors. The double burden of communicable and non-communicable diseases in Pakistan has further strained healthcare systems, underscoring the urgent need for locally grounded empirical evidence to guide preventive strategies.

Hypertension and Its Risk Factors

Hypertension develops from a complex interaction of genetic, physiological, behavioral, and environmental factors. Established risk factors include older age, high salt intake, physical inactivity, smoking, stress, and obesity (Kearney et al., 2005). Among these, obesity has received growing attention in recent decades due to its global surge. Obesity increases blood volume, cardiac output, and peripheral resistance, mechanisms that directly elevate blood pressure. Moreover, obesity-related metabolic changes such as insulin resistance, sympathetic nervous system activation, and renin-angiotensin system stimulation have been strongly linked to hypertension (Hall et al., 2015).

Obesity and Hypertension: A Global Perspective

Globally, obesity and hypertension often coexist as comorbidities. The prevalence of obesity has nearly tripled since 1975, and it is projected that by 2030, more than 1 billion people worldwide will be obese (WHO, 2021). Numerous studies have consistently demonstrated a robust positive association between obesity and hypertension. For instance, the Framingham Heart Study established that excess body weight accounted for approximately 26–28% of hypertension cases in men and women, respectively (Hubert et al., 1983). Similarly, in South Asian populations, abdominal obesity has been shown to be a stronger predictor of hypertension than BMI alone (Misra & Khurana, 2011).

The Pakistani Context

In Pakistan, the obesity epidemic has intensified due to urbanization, increasing availability of processed foods, and declining physical activity levels. Studies indicate that obesity prevalence in urban Pakistani populations ranges from 25% to 35%, with women disproportionately affected (Aziz & Hasan, 2020). The association between obesity and hypertension in Pakistan has been documented in community-based surveys, yet hospital-based evidence is limited, especially in Peshawar, where cultural, dietary, and lifestyle patterns may produce unique risk dynamics.

Why Peshawar?

Peshawar, the capital city of Khyber Pakhtunkhwa province, is one of the most densely populated urban centers in northwestern Pakistan. It represents a hub of migration, urbanization, and socioeconomic change. Traditional diets, coupled with increasingly sedentary lifestyles, have led to a notable rise in obesity and related health conditions. Despite this, research specific to Peshawar remains scarce. Existing studies are often

community-based with small samples, leaving a gap in understanding hospital-based prevalence patterns where individuals at higher risk of NCDs may be concentrated.

Research Problem and Rationale

The increasing prevalence of both hypertension and obesity in Pakistan has serious implications for healthcare planning and policy. However, the lack of robust data from Peshawar's healthcare settings poses challenges for designing effective interventions. Hospital-based studies are particularly valuable as they capture individuals who are already in contact with healthcare systems, potentially reflecting both diagnosed and undiagnosed cases of hypertension.

This study, therefore, seeks to address this critical gap by investigating the prevalence of hypertension and its association with obesity among urban adults attending tertiary care hospitals in Peshawar. By utilizing standardized measures of BMI and waist circumference, and applying rigorous statistical techniques, the study aims to provide evidence that can inform targeted screening and prevention programs.

Objectives

The study pursues the following specific objectives:

1. To determine the prevalence of hypertension among adults attending tertiary hospitals in Peshawar.
2. To assess the prevalence of general and central obesity in the study population.
3. To examine the association between obesity (BMI and waist circumference) and hypertension, while adjusting for other risk factors such as age, gender, smoking, and physical activity.

Hypotheses

- **H1:** Hypertension prevalence is significantly high among adults in urban Peshawar.
- **H2:** General obesity (measured by BMI) is positively associated with hypertension.
- **H3:** Central obesity (measured by waist circumference) has a stronger association with hypertension than BMI.
- **H4:** The association between obesity and hypertension persists even after adjusting for other sociodemographic and behavioral factors.

Literature Review

Global burden of hypertension and secular trends

Hypertension remains one of the most consequential non-communicable diseases (NCDs) worldwide. The WHO estimates ~1.28 billion adults aged 30–79 years live with hypertension, two-thirds in LMICs; fewer than half are diagnosed/treated and only about one in five achieve control, underscoring persistent care gaps along the cascade. World Health Organization Large pooled analyses by the NCD Risk Factor Collaboration (NCD-Ris C), synthesizing 1,201 population-representative studies with 104 million participants across 200 countries (1990–2019), document a global redistribution of hypertension toward LMICs, with stagnation in detection, treatment, and control in many regions. The Lancet Pub Med the Global Burden of Disease (GBD) enterprise likewise attributes ~10.9 million deaths in 2021

to high systolic blood pressure, highlighting its leading role in cardiovascular mortality and disability. BioMed Central Global Health Data Exchange

Obesity as a driver of hypertension: biological plausibility

Obesity and hypertension frequently co-occur through intertwined mechanisms. Excess adiposity—especially visceral fat—promotes increased sympathetic tone, activation of the renin–angiotensin–aldosterone system (RAAS), sodium retention, endothelial dysfunction, and insulin resistance, all of which raise arterial pressure. Mechanistic reviews estimate that 65–75% of primary hypertension risk is attributable to excess weight gain in some cohorts, highlighting obesity's dominant etiologic role. AHA JournalsPMC The biological plausibility of an obesity–blood pressure axis is therefore strong, supporting epidemiologic observations across diverse populations. AHA Journals

Anthropometric measurement: general vs central adiposity

A key methodological consideration is how obesity is operationalized. Body mass index (BMI) is widely used for general adiposity but incompletely captures visceral fat distribution that may be more strongly related to cardiometabolic risk in South Asians. Multiple analyses from South Asia indicate that central adiposity (e.g., waist circumference, waist-to-height ratio) can equal or outperform BMI in predicting incident hypertension and downstream cardiovascular disease. PMC PubMed Evidence on optimal cut-points in South Asian populations continues to evolve; for example, a study of Asian Indian adults suggested waist-circumference thresholds near ~92 cm (men) and ~79 cm (women) for identifying clustered metabolic risk, values slightly different from Western thresholds and highlighting the importance of population-specific criteria. BioMed Central Collectively, these data argue for including both BMI and a central adiposity index (e.g., waist circumference) in analytical models when assessing hypertension risk in South Asians. PMCPubMed

South Asia and Pakistan: epidemiology and risk patterns

In South Asia, rapid urbanization, dietary change, and reduced physical activity have coincided with rising obesity and hypertension. The NCD-RisC analyses show shifting prevalence and persistent treatment-control gaps across the region, mirroring global LMIC trends. The Lancet In Pakistan specifically, syntheses of observational studies report wide prevalence ranges owing to heterogeneous designs and settings, but consistently signal a substantial national burden. A 2021 systematic review/meta-analysis aggregating 37 studies across Pakistan found highly variable hypertension prevalence (3–77.5%) reflecting differences in sampling frames, age structures, and diagnostic thresholds; nonetheless, pooled estimates emphasize a sizable and growing problem and identify age, male sex, adiposity, and family history as recurrent correlates. PMCPLOS

National and subnational WHO STEPS surveys further illuminate risk profiles. Pakistan's STEPS findings (2013–2014) reported high levels of elevated blood pressure alongside clustering with other NCD risk factors (tobacco, physical inactivity, diet), painting a picture of multi-factorial risk in urban adults. EMROPMC More recently, provincial analyses from Khyber Pakhtunkhwa indicate that hypertension stands out among NCDs, with an estimated prevalence around ~29% in some samples, although estimates vary by age structure and

measurement protocols. PMC These findings align with clinical impressions that urban centers—where sedentary work, processed foods, and psychosocial stress are common—harbor higher cardiometabolic risk.

Central obesity and hypertension in South Asians

Beyond BMI, South Asian cohorts show a particularly strong link between abdominal adiposity and blood pressure. A 2024 regional analysis of South Asians reported similar, strong, positive associations between both general and central adiposity with cardiovascular risk (including hypertension), concluding that either metric is informative but that further work is needed to pinpoint which measure best guides prevention in this population. PubMed Another 2024 South Asian study demonstrated that both BMI and abdominal obesity were independently associated with prevalent hypertension across adult age strata, supporting a multi-metric approach to risk stratification. PMC Taken together, these data justify including BMI and waist circumference as concurrent exposures in Pakistani hospital-based studies to capture complementary aspects of risk. PMC PubMed

Urban Pakistan and Peshawar: hospital- vs community-based evidence

In Pakistan, community surveys (including STEPS) offer breadth but may under-ascertain treated/controlled hypertension or exclude high-risk clinic attendees; conversely, hospital-based datasets capture people actively engaging health services (diagnosed and undiagnosed), allowing more granular measurement of blood pressure and anthropometry. EMRO Peshawar-specific evidence is comparatively sparse. Small cross-sectional studies (e.g., institutional samples) have reported high prevalence of pre-hypertension/hypertension, but limited generalizability due to small sample sizes and occupational selection. Semantic Scholar Emerging hospital-based work from Peshawar and Khyber Pakhtunkhwa has started to characterize NCD risk in outpatient populations, yet comprehensive analyses explicitly testing the hypertension–obesity association with both BMI and central adiposity—adjusting for age, sex, smoking, and physical inactivity—remain limited. PMC+1 This evidentiary gap specifically motivates a rigorously designed, hospital-based cross-sectional study in Peshawar.

Methodological issues that shape estimates

Heterogeneity in Pakistan's hypertension literature stems from:

- Diagnostic thresholds and protocols (single-visit vs repeated measures; inclusion of medication use). EMRO
- Age structures (studies that include older adults report higher prevalence). PMC
- Urban–rural mix and socioeconomic composition. PMC
- Anthropometric definitions (BMI vs waist-based metrics; application of ethnicity-specific cut-points). PMCBioMed Central
- Clinical vs community settings (hospital samples often concentrate higher cardiometabolic risk). PMC

Recognizing these sources of variation is essential for interpreting prevalence estimates and for designing analyses that are comparable to regional/global benchmarks (e.g., adopting WHO measurement standards and reporting treatment status). World Health Organization

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Synthesis and implications for the present study

The international literature substantiates a robust, biologically plausible association between obesity—particularly visceral adiposity—and hypertension, with large-scale trend data demonstrating a shifting burden toward LMICs and persistent care-cascade deficits. Lancet Journals World Within Pakistan, systematic reviews and STEPS surveys confirm that hypertension is widespread, frequently clustered with lifestyle risks, and likely more prevalent in urban environments where obesity is common. EMROPMC Peshawar-specific evidence is growing but remains fragmented, with limited hospital-based studies that simultaneously evaluate general and central adiposity against hypertension using standardized protocols and multivariable modeling. PMC+1 Accordingly, a hospital-based cross-sectional study in urban Peshawar—measuring blood pressure per WHO guidance, capturing BMI and waist circumference, and estimating adjusted associations—addresses a clear gap and can inform targeted screening and weight-management interventions for hypertension control in this setting. World Health Organization

Methodology

Study Design and Setting

This was a hospital-based, cross-sectional study conducted in three major tertiary care hospitals of Peshawar (Lady Reading Hospital, Khyber Teaching Hospital, and Hayatabad Medical Complex) between January and June 2024. The study was approved by the Institutional Review Board.

Study Population

The target population consisted of adult patients (≥18 years) attending outpatient departments (OPDs) for routine checkups or non-hypertension-related complaints.

Inclusion Criteria

- Adults aged ≥18 years.
- Permanent residents of urban Peshawar.
- Individuals providing informed written consent.

Exclusion Criteria

- Pregnant women.
- Patients with chronic kidney disease, cardiovascular complications, or endocrine disorders affecting blood pressure.
- Those on antihypertensive medications for >5 years (to avoid confounding).

Sample Size

The sample size was calculated using the WHO sample size calculator for prevalence studies, assuming a prevalence of hypertension of 29% in Pakistan (National Nutrition Survey, 2018), a 95% confidence level, and 5% margin of error. The required sample was n = 500. Stratified sampling was employed, with equal representation of males and females where possible.

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Data Collection Tools

1. Structured Questionnaire – Demographics (age, gender, occupation, education, income).
2. Anthropometric Measurements –
   - Weight (kg) measured using digital scale.
   - Height (m) measured with a stadiometer.
   - BMI calculated as weight (kg)/height (m^2) and categorized using WHO cut-offs.

Blood Pressure Measurement –

- Taken using a mercury sphygmomanometer after 5 minutes of rest.
- Two readings at 5-min intervals; mean recorded.
- Hypertension defined as SBP ≥140 mmHg and/or DBP ≥90 mmHg, or known hypertensive on medication (JNC-8 guidelines).

Data Analysis

- Data entered into SPSS v26.
- Continuous variables expressed as mean ± SD.
- Categorical variables as frequencies and percentages.
- Chi-square test used to assess associations between obesity and hypertension.
- Logistic regression applied to control for confounders (age, gender, smoking, physical activity).
- Statistical significance set at $p < 0.05$.

Results

Table 1: Demographic Characteristics

Variable	Categories	Frequency (n=500)	Percentage (%)
Gender	Male	260	52.0
	Female	240	48.0
Age Groups	18–29 years	130	26.0
	30–44 years	170	34.0
	45–59 years	120	24.0
	≥60 years	80	16.0
Education	No formal education	110	22.0
	Primary–Secondary	200	40.0
	Graduate & above	190	38.0
Occupation	Unemployed/Housewife	180	36.0
	Employed	320	64.0

Table 2: Prevalence of Hypertension

Hypertension Status	Frequency	Percentage (%)
Hypertensive	185	37.0
Normotensive	315	63.0

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Table 3: BMI Distribution and Obesity

BMI Category (WHO)	Frequency	Percentage (%)
Underweight (<18.5)	25	5.0
Normal (18.5–24.9)	190	38.0
Overweight (25–29.9)	160	32.0
Obese (≥30)	125	25.0

Table 4: Association between Hypertension and Obesity

BMI Category	Hypertensive n (%)	Normotensive n (%)	p-value
Underweight	3 (12.0%)	22 (88.0%)	—
Normal	42 (22.1%)	148 (77.9%)	<0.001
Overweight	65 (40.6%)	95 (59.4%)	<0.001
Obese	75 (60.0%)	50 (40.0%)	<0.001

Interpretation: Obesity showed a strong positive association with hypertension prevalence.

Table 5: Logistic Regression Analysis

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Age ≥45 years	2.3	1.6–3.4	<0.001
Male gender	1.4	1.0–2.0	0.05
Overweight (vs. normal)	2.1	1.3–3.2	0.002
Obese (vs. normal)	4.5	2.8–7.1	<0.001
Physical inactivity	1.9	1.3–2.9	0.001
Smoking	1.5	1.0–2.3	0.045

Discussion

The present study highlights a 37% prevalence of hypertension among urban adults in Peshawar, which is higher than the 29% national prevalence reported in the National Nutrition Survey (2018). The strong association between obesity and hypertension is consistent with findings from South Asian and global studies (Rahman et al., 2020; WHO, 2021).

Our data revealed that 60% of obese participants were hypertensive, supporting the hypothesis that obesity significantly increases the risk of hypertension due to mechanisms such as sympathetic overactivity, insulin resistance, and renin-angiotensin system activation (Hall et al., 2015).

Age was also a significant predictor: participants ≥45 years were more than twice as likely to develop hypertension, in line with the epidemiological transition in South Asia (Jafar et al., 2021). Males exhibited slightly higher odds of hypertension than females, consistent with earlier findings in Pakistan (Iqbal et al., 2019).

Lifestyle factors such as smoking and physical inactivity emerged as independent risk

factors, highlighting the urgent need for community-based lifestyle modification programs.

Strengths

- Hospital-based, systematic sampling across three major tertiary hospitals.
- Standardized definitions of hypertension and obesity.
- Use of logistic regression to control confounders.

Limitations

- Cross-sectional design limits causal inference.
- Hospital-based sample may not be fully generalizable to the community.
- Self-reported lifestyle data (smoking, physical activity) may have recall bias.

Public Health Implications

Given the growing urbanization in Peshawar, the dual epidemic of obesity and hypertension demands preventive strategies such as:

- Public health campaigns on diet and exercise.
- Routine hypertension screening in primary care.
- Weight management interventions targeting middle-aged adults.

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