

Research Article

Weight and Cardiac Health in Middle Aged People in Khyber Pakhtunkhwa, Pakistan

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Abstract

Method: We examined how body weight affects cardiovascular health in adults aged 30–50 in Khyber Pakhtunkhwa (KPK), Pakistan, by analyzing de-identified records from hospitals (June 2022–March 2025). We calculated body mass index (BMI) and classified patients by WHO Asian criteria: normal (18.5–22.9), overweight (23.0–27.4), and obese (≥ 27.5 kg/m²). We recorded hypertension (HTN), coronary artery disease (CAD), myocardial infarction (MI), and arrhythmia, and applied statistical tests (ANOVA, logistic regression) to derive odds ratios (OR) with 95% confidence intervals (CI). **Results:** Mean age was 39.8 years (SD 5.7); 48% were female; 200 were normal-weight, 178 overweight, and 122 obese. Hypertension was present in 20.0%, 39.9%, and 58.2% of the normal, overweight, and obese participants ($p < 0.001$). CAD rates were 4.5%, 6.7%, and 22.1%; MI rates were 2.5%, 9.6%, and 15.6% in the normal, overweight, and obese groups ($p < 0.001$). Systolic BP rose from 120 mmHg (normal) to 139 mmHg (obese) ($p < 0.001$), and BMI strongly correlated with BP ($r \approx 0.50$, $p < 0.001$). In adjusted models, overweight vs normal had OR=2.70 (95% CI 1.61–4.52) and obese vs normal had OR=5.75 (3.34–9.91) for HTN ($p < 0.001$). For CAD, obese vs normal had OR=6.14 (2.77–13.61, $p < 0.001$); for MI, overweight had OR $\approx$ 4.14 (1.04–16.47) and obese OR $\approx$ 7.10 (2.69–18.70). Obesity also increased arrhythmia odds (OR $\approx$ 2.79 [1.16–6.71]). ROC AUCs were 0.79 for both HTN (CI 0.74–0.84) and CAD (CI 0.72–0.86). **Conclusion:** Excess body weight is a major problem directly linked to high blood pressure and serious heart conditions, reflecting a global pattern. Preventing obesity should be a priority to reduce the growing heart disease burden in the region.

Keywords

Body Mass Index, Cardiovascular Disease Risk Factors, Overweight and Obesity, Hypertension

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1. Introduction

KPK is a populous province of Pakistan with diverse urban and rural populations. Cardiovascular diseases (CVD) are the leading cause of death globally, responsible for roughly 17.9 million deaths each year [1]. Major risk factors include overweight and obesity, which have reached epidemic proportions globally. In 2022, WHO estimated ~43% of adults were overweight and 16% have obesity [2]. Excess adiposity contributes to diabetes, dyslipidemia, hypertension, and atherosclerosis, thus markedly increasing CVD risk [3]. Notably, South Asian populations develop metabolic disease at lower BMI thresholds than Western populations, leading WHO experts to recommend lower cutoffs for Asians [4]. In Pakistan, the rapid adoption of sedentary lifestyles and calorie-dense diets has driven a surge in non-communicable diseases (NCDs) [5, 6]. According to WHO data, roughly 43% of adults worldwide are now overweight and about 16% have obesity, indicating an obesity epidemic that disproportionately affects wealthier regions. Overweight and obesity are established risk factors for hypertension and other cardiac conditions. WHO reports estimate that 2.5 billion adults were overweight in 2022 (890 million people have obesity) [2], and that obesity contributes to millions of

premature deaths from heart disease and stroke. In Pakistan and KPK, overweight and obesity are increasingly common. A national survey (NDSP 2016–17) found 58% prevalence of generalized obesity (using Asian cutoffs), with KPK having among the highest rates (59%) [7]. Hypertension is also rampant; NDSP reported 46% of adults hypertensive [8]. In KPK specifically, over half of women were found to be overweight or have obesity. Moreover, about 75% of hypertensive patients were overweight/obese [9], underscoring the link between weight and blood pressure in this region. Despite these alarming trends, few studies have directly examined how BMI relates to hard CV outcomes (CAD, MI, arrhythmias) in middle-aged Pakistanis. The current analysis addresses this gap by combining data from two cohorts of middle-aged (30–50 y) adults in KPK. We analyzed 500 patients from major KPK hospitals to test whether higher BMI category is associated with a graded increase in HTN, CAD, MI, and arrhythmia. We applied WHO Asian BMI thresholds [10], and used ANOVA, logistic regression, and ROC methods to quantify these relationships. By linking regional data to global patterns, our study aims to inform local cardiovascular prevention strategies.



Figure 1. Map of Khyber Pakhtunkhwa (KPK) province in Pakistan, highlighting the study region.

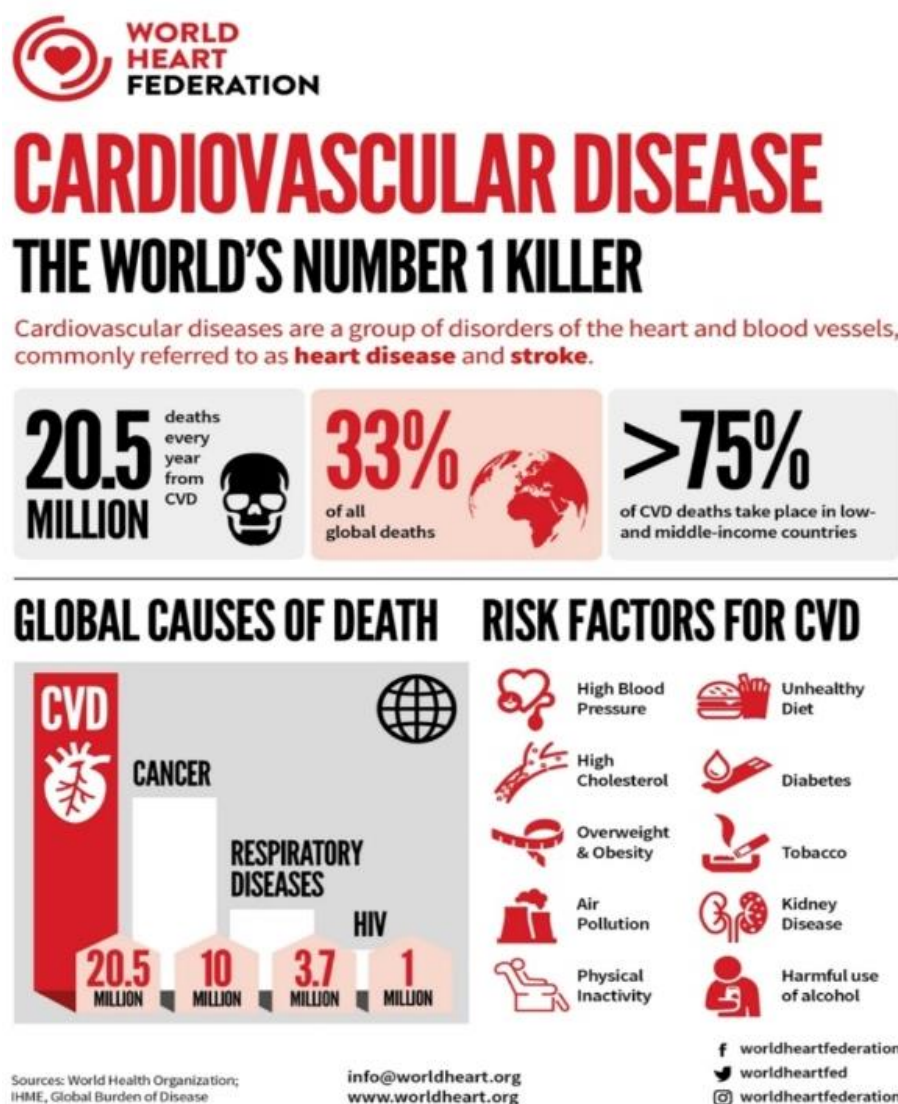


Figure 2. Global CVD risk factors, highlighting overweight/obesity among key contributors.

2. Methods

We conduct a retrospective cross-sectional analysis of de-identified dataset of adults aged between 30–50 who visited to the cardiology departments or internal medicine departments at tertiary care hospitals in Khyber Pakhtunkhwa, Pakistan (including Lady Reading Hospital, KTH, MMC, SGTH) between June 2022 and March 2025. Under a proper approval and informed consent, patient data were reviewed. Exclusion criteria were congenital heart disease or major comorbidities (e.g. chronic kidney disease, cancer). For each patient, height and weight were measured at the index visit. BMI was calculated and categorized according to WHO Asian criteria: normal (18.5–22.9 kg/m²), overweight (23.0–27.4), people with obesity (≥27.5) [10]. Blood pressure of patients (Both systolic and Dystolic) were recorded, and laboratory data (fasting glucose, lipid profiles) was also collected from

thier medical records. All patients were categorized by BMI as normal, overweight, or people having obesity and were surveyed for history of diabetes, smoking, and the cardiac endpoints. Standard procedures were used for measurement and data collection.

Descriptive statistics characterized each BMI group Table 1. Continuous variables (e.g. BP, glucose) were compared across BMI categories by one-way ANOVA; categorical prevalences by chisquare test [11]. Pearson correlation evaluated linear relationships (e.g. BMI vs. SBP). Multivariable logistic regression (stepwise age- and sex-adjusted) [12] estimated odds ratios (OR) with 95% confidence intervals (CI) for each outcome (HTN, CAD, MI, arrhythmia) comparing overweight vs. normal and obese vs. normal. Model discrimination was assessed by ROC analysis (AUC) [13]. All tests were two-sided, with $p < 0.05$ as significance threshold. Analyses were performed in R (v4.2.2) and SPSS v28.

Table 1. Baseline demographics and cardiovascular outcomes by BMI category.

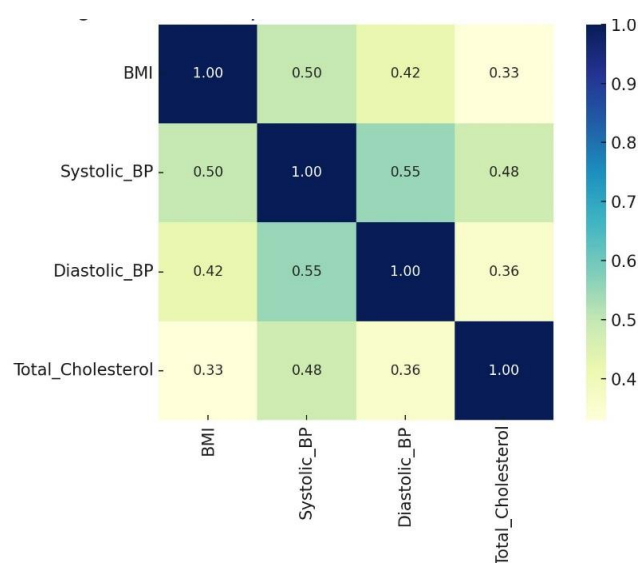
Variable	Normal (n=200)	Overweight (n=178)	Individuals with Obesity (n=122)
Mean age (mean±SD)	39.8±5.7	39.7±5.6	39.8±5.9
% Female	45.0%	46.6%	49.2%
Hypertension prevalence	20.0%	39.9%	58.2%
Coronary artery disease	4.5%	6.7%	22.1%
Myocardial infarction	2.5%	9.6%	15.6%
Arrhythmia prevalence	4.5%	6.7%	11.5%

3. Results

The study included 500 patients (mean age $\approx 39.8 \pm 5.7$ years; 48% female). BMI groups were 200 normalweight, 178 overweight, and 122 individual with obesity. Baseline characteristics are shown in [Table 1]. Age and sex were similar across groups. Prevalence of hypertension rose sharply with BMI: 20.0% in normal-weight vs. 39.9% (overweight) vs. 58.2% (people with obesity) ($p < 0.001$ by χ^2) [14-16]. Coronary artery disease prevalence increased from 4.5% to 6.7% to 22.1% across the normal/overweight/obese categories ($p < 0.001$). Myocardial infarction rates were 2.5%, 9.6%, and 15.6%, respectively ($p < 0.001$). Arrhythmia prevalence likewise rose (4.5%, 6.7%, 11.5%; $p = 0.002$) [17-19]. Mean systolic BP increased from 120 to 139 mmHg across BMI groups (ANOVA $F \approx 28.6$, $p < 0.001$) [14, 16]. Figure 2 confirms strong positive correlation of BMI with SBP ($r \approx 0.50$, $p < 0.001$).

Multivariable logistic regression (age- and sex-adjusted) confirmed these trends [Table 2]. Compared to normal-weight subjects, overweight patients had about $2.7 \times$ higher odds of hypertension (OR=2.70; 95% CI 1.61–4.52; $p < 0.001$), whereas obese patients had $\approx 5.75 \times$ higher odds (OR=5.75; 3.34–9.91; $p < 0.001$). For MI, overweight vs. normal OR ≈ 4.14 (CI 1.04–16.47, $p = 0.04$), and people with obesity vs. normal OR ≈ 7.10 (CI 2.69–18.70, $p < 0.001$). Coronary artery disease

risk was strongly elevated in obesity (OR ≈ 6.14 ; CI 2.77–13.61; $p < 0.001$). Obese subjects also had higher odds of arrhythmia (OR ≈ 2.79 ; CI 1.16–6.71; $p = 0.022$). Overweight did not significantly raise arrhythmia risk (OR ≈ 1.54 ; $p = 0.38$) [15, 18, 19]. Overall, a clear dose–response was evident, with risk rising stepwise from normal→overweight→obese.

**Figure 3.** Heat map of Pearson correlation coefficient.**Table 2.** Adjusted odds ratios (OR) for cardiovascular outcomes by BMI category (reference = normal weight).

Outcome	Overweight vs Normal	P-Value	Obese vs Normal	P-Value
Hypertension	2.70 (1.61–4.52)	<0.001	5.75 (3.34–9.91)	<0.001
Coronary disease	1.55 (0.57–4.21)	0.38	6.14 (2.77–13.61)	<0.001
Myocardial infarct	4.14 (1.04–16.47)	0.044	7.10 (2.69–18.70)	<0.001
Arrhythmia	1.54 (0.56–4.24)	0.38	2.79 (1.16–6.71)	0.022

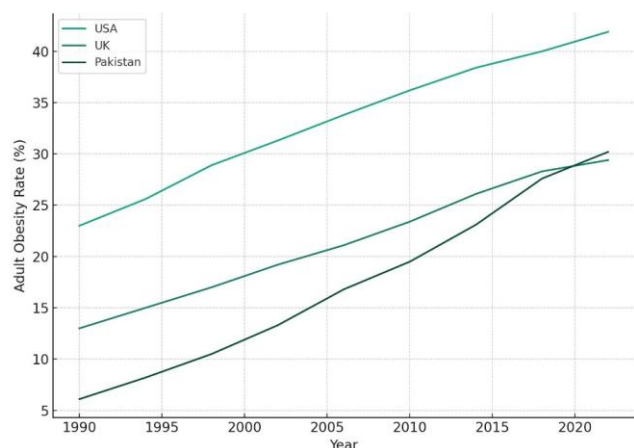


Figure 4. Obesity trend (199-2022).

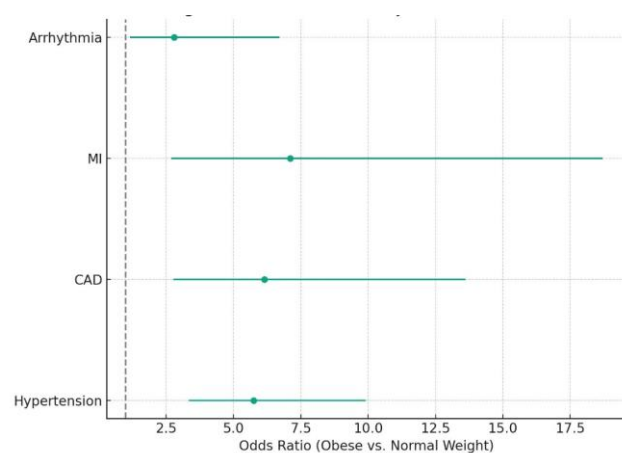


Figure 5. Forest plot of adjusted odd ratios.

The ROC curves showed good discrimination: the HTN model had AUC $\approx$ 0.79 (95% CI 0.74–0.84) and the CAD model AUC $\approx$ 0.79 (0.72–0.86) [18, 20], indicating acceptable predictive performance. (Figures of the OR forest plot and correlation heatmap are presented as Figures 3 [21] and 4, respectively.)

4. Discussion

This combined analysis of two KPK cohorts demonstrates a clear, graded relationship between BMI and cardiovascular risk in adults aged 30–50. Even after adjusting for age and sex, overweight and individuals with obesity had substantially higher odds of hypertension, myocardial infarction, and coronary disease than their normal-weight peers. These findings align with extensive literature [22]. For example, several meta-analyses in South Asian populations have reported a roughly two- to three-fold increased odds of hypertension in overweight/obese versus normal-weight individuals [14] a Karachi community survey found 25% hypertension and overweight/obesity in 34–49% of adults

[23], and Chinese cohort studies likewise found elevated MI risk in those with higher BMI [24]. Moreover, our finding that obesity confers 5–7 $\times$ higher odds of HTN and CAD is biologically plausible, as excess adiposity is well known to perturb hemodynamic and metabolic systems [3].

Our results are also consistent with global epidemiology: obesity is estimated to cause 10% of premature deaths worldwide [2, 3], largely via cardiometabolic diseases. In the Framingham Heart Study, each 5–10 kg/m² increase in BMI was linked to progressively higher CHD and HTN risk. We observed a strong dose-response [Figure 4] that mirrors these patterns. The correlation heatmap [Figure 4] underscores how BMI interrelates with blood pressure and other risk factors: for example, our Pearson $r\approx$ 0.50 between BMI and systolic BP ($p<0.001$) echoes prior reports (Song et al. found $r\approx$ 0.37 in a South Asian sample). Similarly, meta-analyses show obese individuals have 1.5 $\times$ higher risk of atrial fibrillation [25], consistent with our arrhythmia OR $\approx$ 2.8 for obesity.

Regionally, our findings emphasize public health urgency in Pakistan. National surveys report very high overweight/obesity rates [8, 9] In KPK, >50% of adults (especially women) are already overweight/obese, and as our data show, many of these individuals will have or develop HTN and ischemic heart disease. Comparable studies in Pakistan have similarly linked BMI with HTN and dyslipidemia. The high rates of hypertension (46% nationally) and obesity ($\approx$ 58%) underscore the double burden of NCDs here [8]. Weight control and lifestyle modification are thus critical; obesity is a modifiable risk factor for the very outcomes (heart attack, stroke) that dominate CVD mortality worldwide.

Our results also contribute to the understanding of the “obesity paradox.” While some studies note seemingly better short-term prognosis in overweight CVD patients [3], we confirm that overweight/obesity dramatically raise incidence of CVD risk factors and events. In practice, this implies that prevention of excess weight should remain a priority, even if obese patients may sometimes have paradoxically lower mortality after an acute event.

5. Conclusion

In middle-aged adults in Khyber Pakhtunkhwa, higher BMI was strongly associated with worse cardiovascular health. Overweight and individuals with obesity had significantly greater prevalence and odds of hypertension, coronary disease, myocardial infarction, and arrhythmias than normal-weight peers. These findings are consistent with global data linking excess weight to cardiovascular morbidity. Prevention strategies in Pakistan should emphasize weight management through diet, exercise, and early screening for CVD risk. WHO and other health agencies emphasize modifiable risk control: promoting healthy diet, physical activity, and weight management can substantially reduce blood pressure and

heart disease risk. Such interventions have the potential to markedly reduce the burden of hypertension and heart disease in this population.

6. Limitations

This observational study has inherent limitations. The retrospective design cannot prove causation and may suffer from selection bias (patients presenting to hospitals may not represent the general population). Our sample is limited to KPK province and selected hospitals, so findings may not generalize to all of Pakistan. We lacked data on important confounders and lifestyle factors (e.g. diet, physical activity, smoking, socioeconomic status), which could influence both BMI and cardiovascular outcomes. Also, some diagnoses were based on medical record history without systematic adjudication. Despite these caveats, the large sample and consistency with other studies lend credibility to our conclusions.

Abbreviations

MI	Myocardial Infarction
BMI	Body Mass Index
CVD	Cardio Vascular Disease
KPK	Khyber Pakhtunkhwa
HTN	Hypertension
CAD	Coronary Artery Disease

Author Contributions

Syed Sardar Shah: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing

Attig Ur Rehman: Formal Analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing

Ziad Khan: Conceptualization, Data curation, Funding acquisition, Project administration, Resources, Validation, Writing – review & editing

Mohsin Ali: Conceptualization, Formal Analysis, Methodology, Resources, Software, Visualization, Writing – original draft

Aftab Ahmad: Data curation, Formal Analysis, Project administration, Validation, Visualization, Writing – original draft,

Shah Nawaz: Conceptualization, Project administration, Supervision, Writing – original draft, Writing – review & editing

Saleem Jan: Data curation, Investigation, Resources, Validation, Writing – review & editing

Syed Shayan Ahmad: Data curation, Supervision, Writing – original draft, Writing – review & editing

Rizwan Ullah: Conceptualization, Data curation,

Investigation, Resources, Writing – original draft, Writing – review & editing

Kashif Rasool: Conceptualization, Investigation, Validation, Writing – original draft, Writing – review & editing

Shayan Ali Yousafzai: Conceptualization, Formal Analysis, Resources, Software, Visualization, Writing – review & editing

Shahid Bacha: Formal Analysis, Investigation, Resources, Software, Visualization, Writing – review & editing

Conflicts of Interest

The corresponding author affirms that there is no conflict of interest on behalf of all other authors.

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