RESEARCH ARTICLE

INTERNATIONAL JOURNAL OF KINANTHROPOMETRY

DOI: 10.34256/ijk2325

The Burden of Obesity and Hypertension Among a Vegetarian Ethnic Minority Community: A Study Among Jain's of Madhya Pradesh, India

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DOI: https://doi.org/10.34256/ijk2325
Received: 12-09-2023; Revised: 06-12-2023; Accepted: 13-12-2023; Published: 30-12-2023

Resumen

Introducción: La prevalencia de la obesidad está aumentando entre niños y adultos en todo el mundo. La obesidad es uno de los principales factores de riesgo de hipertensión. Así, el estudio tuvo como objetivo documentar la prevalencia de la obesidad, la hipertensión y su asociación entre sí entre la comunidad jainista de la ciudad de Khurai, distrito de Sagar (Madhya Pradesh), India. **Métodos:** Se recogieron datos de 175 participantes pertenecientes al grupo de edad de 20 a 59 años. Se tomaron medidas antropométricas y se calcularon índices como índice de masa corporal, índice cintura-cadera y índice cintura-altura para evaluar la obesidad general y abdominal. La presión arterial se registró mediante un esfigmomanómetro. **Resultados:** La prevalencia de sobrepeso y obesidad se encontró 25,71 por ciento y 9,71 por ciento. Mientras que el 54,28 por ciento y el 48,14 por ciento de los participantes tenían riesgo de obesidad central. La prevalencia de hipertensión fue del 41,14 por ciento. La obesidad y la hipertensión eran más frecuentes entre los hombres y las mujeres tenían más sobrepeso. La hipertensión tuvo una correlación positiva significativa (valor de p <0,01) con los índices antropométricos. El índice de masa corporal impuso el mayor riesgo de aumento significativo (valor de p <0,05) a la hipertensión. **Conclusión:** Los adultos jainistas tenían una alta prevalencia de sobrepeso/obesidad e hipertensión a pesar de ser una comunidad vegetariana. Por lo tanto, se debe prestar más atención a esta comunidad para la prevención, manejo y tratamiento de enfermedades no transmisibles.

Palabras Clave: Hipertensión arterial, Obesidad, Variables antropométricas, Población adulta

Abstract

Introduction: The prevalence of obesity is increasing among children and adults worldwide. Obesity is one of the major risk factors for hypertension. Thus, the study aimed to document the prevalence of obesity, hypertension and their association with each other among the Jain community of Khurai town, Sagar District (Madhya Pradesh), India. **Methods**: Data was collected on 175 participants belonging to the age group of 20-59 years. Anthropometric measurements were taken and indices were calculated such as Body mass index, waist-hip ratio, and waist-height ratio to assess general and abdominal obesity. Blood pressure was recorded using a sphygmomanometer. **Results**: The prevalence of overweight and obesity was found 25.71 percent and 9.71 percent. Whereas, 54.28 percent and 48.14 percent of participants were at risk for central obesity. The prevalence of hypertension was 41.14 percent. Obesity and hypertension were more prevalent among males, females were more overweight. Hypertension had a significant (p-value <0.01) positive correlation with anthropometric indices. Body Mass Index imposed highest significant increase risk (p-value <0.05) on hypertension. **Conclusion**: Jain adults had a high prevalence of overweight/obesity and hypertension despite of being vegetarian community. Therefore, more attention should be directed towards this community for the prevention, management, and treatment of non-communicable diseases.

Keywords: Hypertension, obesity, Anthropometric variables, adult population.

Introduction

Obesity is defined as “abnormal or excessive fat accumulation, which is caused by imbalance between energy intake and expenditure that may damage health” (WHO,2018; Kelishadi et al.,2003). This calorie imbalance leads to an excessive build-up of energy, which is then stored in the body and results in obesity. Obesity can also be caused by a mixed interaction of environmental, socioeconomic, and personal behaviours, as well as genetic factors (Hruby et al.,2015). According to global burden of disease, problem of obesity and overweight has reached epidemic proportion, with over 4 million people dying annually as result of being overweight or obese in 2017 (GBD report, 2019). Globally, more than 1.9 billion individuals (39%) and more than 650 million (13%) were estimated overweight or obese by World Health Organization (WHO, 2018). Mostly continents, with the exception of sub-Saharan Africa and some part of Asia, more people are obese than underweight. Overweight and obesity, once thought to be a problem exclusively of high- income nations, are now sharply increasing in low- and middle – income nations (WHO, 2018). In India, the prevalence of overweight and obesity is rising more rapidly than the global average. For instance, between 1998 and 2015, the incidence of obesity increased from 2.2% to 5.1%, and the prevalence of overweight increased from 8.4% to 15.5% among women (NFHS-2; NFHS-3; NFHS-4). The WHO, World Health Assembly (2013) has pivotal target to control mortality from non- communicable diseases happening worldwide by virtue of increase in obesity (WHO, 2022). Also, the prevention of non- communicable diseases was subsequently added as a worldwide target of UN Sustainable Development Goals (2015) (UN, 2015).

Since, obesity is a known independent risk factor for non- communicable diseases and the rising obesity prevalence globally imposes a significant burden on global public health (Bray et al., 2016). Therefore, it is essential to prevent, detect, and effectively treat obesity in order to minimise the long- term health and financial burden. The accurate diagnosis of individuals should be the first step towards achieving this. In this context, various anthropometric measurements for the assessment of obesity, such as Body Mass Index (BMI), waist circumference, hip circumference, waist- to- hip ratio (WHR) and, waist- to -height ratio (WHtR) have served a variety of functions, including risk assessment, intervention planning, and impact assessment on changes in nutritional or health status (Piqueras et al., 2021).

Being overweight or obese has several negative effects, such as an increase risk of hypertension and series of related metabolic and cardiorenal diseases (Hall et al., 2015). In South Asia, high blood pressure (BP) is the third most important risk factor for disease related burden (Lim et al., 2012). Hypertension, is one of the major risk factors of death and disability in India (ICMR, 2017). In India, hypertension is directly responsible for 57% of all stroke deaths and 24% of all coronary heart disease (CHD) deaths (Gupta., 2004). According to National Family Health Survey (NFHS-5), prevalence of hypertension among male was 24% and 21% among females, reported increase from 17% and 19% from NFHS- 4 (Jordan & Birkenfeld, 2016). The cardiovascular health status and healthcare systems in India are significantly impacted by hypertension (Leeder et al., 2004; Srinath et al., 2005). Since, according to the growing body of research, hypertension and obesity are on the rise among adults in India. And, one of the major risk factors for hypertension is obesity, along with changing lifestyle such as change in dietary habits, consumption of tobacco and, sedentary lifestyle etc (Anchala et al., 2014). Hence, evaluating changes in prevalence through time, dynamic changes in population structure, economic development, education levels, and lifestyles should be taken into account (Li et al., 2021). Therefore, it will be interesting to study prevalence of obesity and hypertension among Jain adults, as they follow strict principal of vegetarian diet and Anastasia or Anthau (eating after sunset is not allowed) (Proter, 2022; Starr, 2021). To best of our knowledge, there are no published literature on obesity and hypertension among Jain adults of central India (Jain of Bundelkhand). Thus, study aimed to understand the prevalence of obesity and hypertension among Jain community. The objectives of this study are 1) To study the prevalence of obesity (general & abdominal) among Jain adults 2) To study the prevalence of hypertension 3) To study the association of obesity and hypertension.

Materials and Methods

Study Design: A community-based, cross-sectional study was conducted in Khurai town (Sagar District) of Madhya Pradesh, India. Among the Jain adults of age group of 20- 59 years. Door to door survey was conducted to collect information from participants and random sampling method was used to select participants. Present study was conducted among 175 participants (87 males & 88 females).

Questionnaire method was adapted to collect information related to sociodemographic (marital status, education qualification, family income and occupation), smoking and alcohol consumption, modified Kuppuswamy scale (2019) (Wani, 2019) was used to asses socioeconomic status, and anthropometric Measurements (Height, weight, waist circumference and hip circumference) and Blood pressure was measured.

Outcome Variables Measurements

Anthropometric Measurements such as Height was measured using Anthropometer rod, Weight measured using Weighing Machine, waist circumference and hip circumference using Steel tape (Freemans; 3M). Blood pressure was measured mercury sphygmomanometer (Sphygmomanometer- Diamond; 70008). All the measurement were taken by following International Society for the Advancement of Kinanthropometry (ISAK) protocol (Norton, 2018).

Further, indices were calculated such as Body mass index (BMI) (weight in kg/height in metre squared) was categorised into underweight (BMI>18.0 kg/m^2), normal (BMI 18.0– 24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), and obesity (BMI ≥ 30.0 kg/m^2) (NIH,1998). Waist-hip ratio (WHR) (at risk ≥ 0.90 for men & ≥ 0.85 for women) (WHO, 2011), Waist Height ratio (WHtR) (at risk ≥ 0.5 for both men & women) (WHO, 2011). Blood pressure was classified using JNC VIII guidelines, hypertension was defined as average of SBP>140mm Hg or/ and DBP > 90 mm Hg (Bhatia et al., 2022).

This study was approved by the Ethical Committee of the Department of Anthropology at the University of Delhi, India. The Declaration of Helsinki was followed to the conduct of the study.

Statistical methods: Data analysis and compilation were done using SPSS version 22.0. Basic Descriptive statistics (mean and standard deviation) were calculated to assess distribution of obesity and Hypertension across the sample. An independent sample t-test was used to examine the difference in means of obesity and hypertension indicators between males & females. Chi-square test was performed to study association between obesity and hypertension. Pearson correlation used to study the correlation of various obesity indicators and other social determinants with blood pressure & odds ratio to understand the relative increase or decrease in risk for occurrence of outcome interested.

Results

Table 1. Baseline characteristics of the population

S.No	Characterstics	Males Mean ± Sd	Females Mean ± Sd	P-Value
1	Numbers (%)	87(49.71)	88(50.28)	
2	Age	36±15.56	36.13±13.24	0.950
3	Height(cm)	167.56±7.97	155.75±6.72	0.000
4	Weight(kg)	67.54 ± 12.38	58.5 ± 12.19	0.000
5	BMI (kg/m*m)	24.08 ± 4.06	24.04 ± 4.96	0.686
6	Waist circumference(cm)	86.63 ± 9.7	81.65±10.8	0.002
7	Hip circumference(cm)	95.04 ±11.8	95.52±10.3	0.772
8	Waist hip ratio	0.915 ± .09	0.85 ± .062	0.000
9	Waist height ratio	0.51 ± .08	0.52 ± .073	0.258
10	Systolic blood pressure (mm Hg)	130.70 ± 14.3	121.89±13.70	0.000
11	Diastolic blood pressure (mm Hg)	96.31±74.3	85.36±8.54	0.171

** Significance at p-value ≤ 0.001; * Significance at p-value ≤ 0.05

The present study was conducted among 175 participants. Out of which 88 (50.28%) were females and 87(47.72%) were males. The t-test results depicted that males were significantly taller compared to females (167.56 cm vs 155.75 cm), weight of males was significantly higher than their female counterparts (67.54 kg vs 58.5 kg), waist circumference, and waist-Hip-Ratio was significantly higher compared to females. Systolic and Diastolic blood pressure of males was higher than their counterpart females. Whereas, mean systolic blood pressure was significantly higher among male participants compared to female participants (SBP: 130.70 mmHg vs. 121.89 mmHg; DBP: 96.31mmHg vs. 85.36 mmHg) (Table 1).

Data collected on the socio-economic condition of participants show that 29.9 % of participants are upper class based on the Kuppuswamy scale. Whereas, 66.86% of people were in the upper-middle class. Middle classes were 3.43% of the total sample population and only 0. 57 % belong to an upper lower class of the sample population. On the dietary data, all participants were vegetarian. No participants had alcohol and smoking consumption records.

Table 2. Distribution of obesity and hypertension across gender

Variables		Males	Female	Total
		N (%)	N (%)	N (%)
Body mass index	Normal	56(64.36)	56(63.63)	112(64)
	Overweight	22(25.3)	23(26.1)	45(25.71)
	Obese	9(10.3)	8(9.1)	17(9.71)
Waist Hip Ratio	Healthy	36(41.1)	44(50)	80(45)
	At risk	51(58.25)	44(50)	95(54.28)
Waist-Height Ratio	Healthy	60(69)	29(33)	89(50.85)
	At risk	27(31)	59(67)	86(49.14)
Blood Pressure	Normal BP	42(48.27)	61(69.31)	103(58.85)
	Hypertension	45(51.72)	27(30.68)	72(41.14)

The prevalence overall prevalence of overweight and obesity was found to be 25.71% and 9.71%, respectively. Females were more overweight (26.1% females, 25.3% males) but males had higher prevalence of obesity (10.3% males, 9.1% females). Central obesity calculated based on Waist-to-Hip Ratio was higher percentage of Jain males (58.5%) than females (50 %). As per, waist-to-height ratio, higher percentages of females were at risk (67% females, 31% males). (Table 2)

Table 3. Association of various obesity indicators and gender with hypertension

S. No	Variable		Normal BP (N-103)	Hypertension (N-72)	Chi-square(P-value)
1	Body Mass Index				
		Normal	76 (73.78%)	36(50%)	**0.003***
		Over weight	21 (20.38%)	24 (33.34%)	
		Obese	6 (5.82%)	12 (16.67%)	
2	Waist-Hip-Ratio	Normal	49 (47.57%)	31 (43.06%)	0.555
		At Risk	54(52.42%)	41 (56.94%)	
3	Waist-Height-Ratio	Normal	55 (53.39%)	34 (47.23%)	0.421
		At Risk	48 (46.60%)	38 (52.77%)	
4	Gender	Females	61 (59.23%)	27(37.5%)	**0.005***
		Males	42(40.78%)	45(62.5%)	

*Significance at p-value ≤ 0.05

The Chi- square test revealed that the Body Mass Index and gender were significantly associated with hypertension. The association of obesity indicator and gender reveals that participants with normal BMI were more normotensive (73.78%), participants with overweight and obesity have higher prevalence of hypertension (33.34% overweight, 16.67% obese). Higher number of female participants were normotensive (59.23%) but males had higher prevalence of hypertension compared with females (62.5% males, 37.5% females). (Table 3)

The result of Pearson correlation of various Anthropometric variables and demographic variables with Systolic blood pressure & Diastolic blood pressure shows that Waist circumference, Hip circumference, waist-hip-ratio & waist-height-ratio as indicators of central obesity & Body Mass Index as indicator of general obesity has found to be significantly positively correlated to systolic and diastolic blood pressure. Other variables like socioeconomic

status, education of participants, and family income were significant negatively correlated with systolic and diastolic blood pressure. All the variables had comparative strong correlation with SBP compared to DBP (Table 4).

Table 4. Correlation between various Somatometric and demographic variables with systolic and Diastolic Blood pressure.

VARIABLES	SBP[1]	DBP[2]
Waist circumference	.459**	.252**
Hip circumference	.319**	.201**
Waist-Hip ratio	.253**	.103
Waist-Height ratio	.215**	.057
Body mass index	.379**	.273**
Education of participants	-.163*	-.176*
Family income	-.163*	-.007
Socio economic status	-.185*	-.011

** Correlation is significant at the 0.01 level (2-tailed) *correlation is significant at the 0.05 level (2-tailed); 1= systolic Blood Pressure; 2 = Diastolic Blood Pressure.

Table 5. Logistic regression analysis of various obesity indicators and gender

S. No	Variables	Crude Odds Ratio (95% CI)	P-value
1	Body Mass Index (BMI)	3.15 (1.12 ± 8.827)	0.02*
2	Waist-Hip-Ratio (WHR)	1.38(0.751 ± 2.528)	0.30
3	Waist-Height-Ratio (WHtR)	1.55 (0.822 ± 2.914)	0.17
4	Gender	1.97 (1.069 ± 3.619)	0.03*

* Significance at p-value ≤ 0.05

Binary logistic regression analysis was performed to calculate crude odds ratio for hypertension. The crude ORs (95% CIs) for the association between BMI and hypertension was 3.15 (P <0.05; 95% CI 1.12 – 8.827), its shows that participants with higher BMI were 3.15 times more likely to develop hypertension. Gender of participants also had significant increased risk for hypertension with ORs 1.97 (P< 0.05; 95% CIs 1.069- 3.619) (Table 5).

Discussion

Present study was conducted to examine the prevalence of obesity, hypertension and its association with each other among Jain adults. The study measures general obesity using BMI and abdominal obesity using waist circumference, hip circumference, waist-hip-ratio, and waist-height-ratio. Since, the Jain Diet has significantly restrictive vegetarian dietary plan, based on the principle of nonviolence. The main reason for adhering to this diet has to be ethical. There is also a growing body of literature suggesting that a vegetarian diet cuts the risk of developing obesity (Barnard et al., 2015; Huang et al.,2015). Therefore, this provides the rationale to conduct this study among Jain adults of Khurai town (Sagar district) of Madhya Pradesh.

In the Present study, it was found that male participants were heavier and taller compared to females, similar finding was presented by Panda et al (2017) and Datta (2022). Whereas, waist circumference, hip circumference and waist-to-hip ratio were also significantly higher among males compared to females, similar finding was reported by study conducted among Jain adults of Delhi (Dhall et al., 2011). The higher prevalence of abdominal obesity among males could be explained by higher production of chylomicrons that leads to deposition of abdominal visceral fat, further result into apple-shaped body (Nauli and Matin., 2019). The mean value of all the variables was higher in males compared to females except weight-to-height ratio. These findings are similar to that of the study done by Saxena and Prakash (2014).

In our study, prevalence of overweight was reported to be 25.71% and obese was 9.71%, respectively. This prevalence of overweight and obesity was similar with study conducted among Limbu's of Darjeeling (Datta, 2014) and among Jabalpur adults (Suresh et al., 2022). In terms of blood pressure, systolic blood pressure and diastolic blood pressure were reported to be higher among males, similar finding was reported by other studies (Singh et al., 2017; Panda et al., 2017, Noor et al., 2023; Asemu et al., 2021).

In the present study, 58.85% participants had normal blood pressure, and 41.14% had hypertension. The prevalence of hypertension was found more among males compared to females, this finding was similar to study conducted among Varanasi adults (Singh et al., 2017), Angami Naga of Nagaland (Peseyie et al., 2022), NFHS -5 (Sagar district), and LASI study (Das et al., 2023). The prevalence of hypertension in this study was almost similar to the prevalence reported by LASI study (Das et al., 2023). The higher prevalence of hypertension among males could be due to biological and behavioural factors (Sandberg & Ji., 2012). As, various factors such as chromosomal difference, sex hormone and other biological sex difference that might play as protective role against women hypertension (Vitale et al.,2009; Vitale et al., 2010; Sandberg & Ji., 2012). Also, the prevalence of hypertension among Jain males was higher to the finding of NFHS- 5 (Sagar District). This could be due to social and cultural differences, and lifestyle factors such as occupation, as most of the participants were doing business as occupation, might be due to the presence of business competition, long sitting hours and lack of physical activity could lead to higher prevalence of obesity and hypertension (Singh et al., 2017; Dhall et al., 2011).

In this study, the obese (general and abdominal) participants had higher prevalence of hypertension and it was found that anthropometric variables and indices were positively associated with systolic and diastolic blood pressure ($p \leq 0.01$). Similar findings were presented by Thanglen & Maheo (2022), Panda et al (2017), Dhall et al (2011), and Agrawal et al (2008). This negative correlation of the education of participants, family income, and socioeconomic status of participants with systolic blood pressure was found to be consistent with finding of Wang et al. (2006) and Dun et al (2021). This indicates that with increase in education and family income of participants, there is decrease in systolic and diastolic blood pressure. This could be possible with increase of education and family income; they are more likely to get aware of hypertension and its preventive measures. Despite being vegetarian community, Bundelkhand Jain adults reported higher prevalence of hypertension, similar finding was reported by study in Bihar (Singh et al., 2013).

Since, one of the main risk factors for hypertension is obesity, which is typically measured by BMI (Kuwabara et al., 2018; Kapetanakis et al., 2014). The prevalence of hypertension increases as BMI rises (Lee et al., 2016; Crawford et al., 2010). In the present study also, BMI was found to impose a greatest risk factor for high Blood pressure among Jain adults. Our finding are in congruence with studies conducted among Jain adults of Delhi (Dhall et al., 2011), Noor et al. (2023), Asemu et al. (2021), Singh et al. (2017) and Panda et al. (2017).

Conclusion

The prevalence of obesity and hypertension was found high in this community, despite of practising strict vegetarian diet and 'Anthau' (eating before sunset). Prevalence of general and abdominal obesity was high among males compared to females and body mass index impose the significant increase risk for hypertension. Since this study was limited to small sample size but looking at the finding of current study, there is an urgent need to conduct large-scale and community-based study while incorporating in- depth data on physical activity, diet and mental health that can help in improving the knowledge pertaining to obesity and hypertension of this community. That could further increase the awareness and educate them about non communicable disease. More such studies will help in developing community-based intervention programs in the management of obesity and hypertension.

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Acknowledgements
We thank the participants of Jain community of Khurai town (Sagar District) Madhya Pradesh, India for taking part in our study.

Funding
The authors received no financial support for the research.

Conflicts of Interest
The authors declared no conflicts of interest.

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