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A Cross-sectional Study on the Prevalence of Obesity in Three Endogamous Populations of Andhra Pradesh

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ABSTRACT To investigate and compare the prevalence of different types of obesity, the researchers recruited the Reddy, Golla, and Madiga caste populations of Chittoor District, Andhra Pradesh. Three hundred participants were included from each caste in this cross-sectional study. The researchers found a significantly higher prevalence of obesity (general, abdominal, and combined obesity) in women than in men ($p<0.05$). Golla showed a significantly higher prevalence of overweight than the Reddy population ($p<0.01$). Both Reddy and Golla caste populations showed significantly higher percentages of general, abdominal, combined, and isolated abdominal obesity than the Madiga caste population ($p<0.01$). Reddy showed higher odds of developing general, combined, and isolated general obesity than Golla whereas Golla had higher odds of developing abdominal and isolated abdominal obesity and overweight than the Reddy population ($p<0.01$). Predictors of different measures of obesity were found to vary in caste populations.

INTRODUCTION

Obesity is a chronic, relapsing and multifactorial disease (International Statistical Classification of Diseases and Related Health Problems 2019). Obesity is a significant risk factor for non-communicable diseases such as cancer, heart disease, and diabetes. Obesity develops early in life and rises fastest in developing countries and is contributed by various factors such as genetic, biological, socio-cultural, economic, equity, health care access, mental health, commercial, environmental and ultra-processed foods (World Obesity Atlas 2022). As per WHO (2016), globally obesity increased three-fold during the period 1975 to 2016. Thirteen percent of adults aged >18 years were found to be obese in 2016. A nationwide randomized cluster sample survey involving 1,00,531 adults from 29 states/union territories reported a 40.3 percent prevalence of obesity in India and the prevalence of obesity was found to vary by zone, gender, education, geography, age, and physical activity (Venkatrao et al. 2020). Analysis of data from National Family Health Surveys conducted during 2005-06 and 2005-16 in India revealed a wide variation in the prevalence of obesity across the regions (Verma et al. 2021). It is predicted that more than one billion people will be obese globally by 2030 (World Obesity Atlas 2022), and estimated that the prevalence of obesity will increase three-fold in the age group of 20-69 years by 2040 (Luhar et al. 2018). The prevalence of obesity (general, abdominal, and combined) was not found to be the same in the heterogeneous populations of four states in India (Pradeepa et al. 2015). A pan-Indian based study showed that Sikhs (both sexes) and Muslims (females) were more predisposed to higher obesity than Hindus (Siddqui and Donato 2016). Of late, it has been realised that apart from individual level behaviour there is a need to study the social-cultural influences on the spread and social clustering of obesity in India (Siddqui and Donato 2016).

Indian population is segmented into 4635 anthropologically defined populations (Singh 1993). Malhotra (1984) reported that the Indian populations comprised 40,000 endogamous populations including 37,000 castes, 3000 tribes, and religious populations. These populations mostly choose mates within their community only.

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Studies on the prevalence of obesity among caste populations in India are available up to the year 2020 and most of them reported on the prevalence of either general or central obesity (Reddy 1998; Venkatramana and Reddy 2002; Gupta et al. 2004; Gupta and Kapoor 2010; Hazarika and Sengupta 2015; Kumari et al. 2019; Gogoi and Saraswathy 2020) in single caste population. The predominance of general and abdominal obesity was found in Khatris of Delhi than the Ezhava caste population of Kerala (Mungreiphy et al. 2012). To the best of the researchers' knowledge, no study in India ever attempted to study the prevalence and predictors of different measures of obesity such as combined, isolated general, and isolated abdominal obesity in caste populations. Comparative studies of caste populations may reveal whether the prevalence and predictors of different measures of obesity are the same or not and suggest whether uniform or specific measures are required to reduce the prevalence of obesity in India given the presence of diverse social groups. Therefore, in this study, an attempt was made to study the prevalence and predictors of different measures of obesity involving three caste populations such as Reddy, Golla, and Madiga.

Objectives

1. To determine the prevalence of different measures of obesity in three caste populations.
2. To investigate the predictors of different measures of obesity in three endogamous populations.

METHODOLOGY

A total of 900 participants belonging to the Reddy, Golla, and Madiga caste populations were recruited from the Chittoor district of Andhra Pradesh, India. The age of the participants ranged from 20-80 years. In each caste population, 150 unrelated participants of each sex (total=300) from urban and rural areas were included in the study. No sampling method was employed in this study. The selection of the study areas was done based on the availability of the participants representing the selected caste populations. The participants represent the city of Tirupati and eight villages (Ramapuram, Nadimuru, Diguvaramapuram, Diguvaramapuram Harijanawada, Kampalli Harijanawada, Gollapalli, Venkataramapuram, and Panakam) of Chittoor district, Andhra Pradesh. The categorisation of cities and villages was done based on the administrative criteria. The participants were explained the objectives of the study and those who volunteered were recruited for the study. The effect of variables such as residence (urban-rural) on anthropometric variables and their indices (height, weight, body mass index, and waist circumference) ranged from 0.4 percent-6 percent in the two-way multivariate analysis of variance in this study, therefore, the urban and rural data were clubbed within the caste populations and are presented in the present study.

Data were collected by visiting the houses of participants and in some cases, the researchers requested the participants to come to a convenient place such as community halls/schools for the same purpose. A brief description of the investigated caste populations is given in the following paragraphs.

Reddy: The Reddy caste is an upper caste in the state of Andhra Pradesh and is also known as 'Kapu' in Rayalaseema. The term 'Reddy' originated from the word 'Ratt' meaning King. There are 88 sub-castes under this caste group. For the present study, the researchers collected data on Akutota Reddy. The word 'Akutota' means betel garden. The forefathers of the Reddy caste might have engaged in the cultivation of betel leaves. The Reddies are found in the Chittoor, Nellore, and Kadapa districts of Andhra Pradesh. They speak and write in Telugu. The Reddies are farmers and produce Paddy, Sugarcane, Ragi (finger millet), and vegetables. For livelihood, these caste populations are also engaged in agriculture, cattle herding, business, and government jobs. Women look after domestic chores and assist men in cattle herding. They worship deities such as Desamma, Gangamma, Polerамma, and Ankalamma on special days. Women sing songs during rituals and festivals.

Golla: The members of this caste group are involved in pastoralism. Golla is a backward caste as per the Central list of other backward castes for the State of Andhra Pradesh 2022 (http://www. ncbc.nic.in/user_panel/Gazette Resolution. asp x?Value= mPICjsL1aLvYBtdZSr P4uO

% 2bploAhiJHMAL WmHIwbzS8Il37YLL3 Fb0 FHfWDHzP7c). The name 'Golla' is believed to be the short form of Gopala meaning 'the protector of cows'. The Gollas trace their descent from Lord Krishna, a Hindu pantheon. The members of this caste group are spread throughout India and are known by different names. Each of the sub-castes of Gollas (Erra, Ala, Pooja, Gangeddu, Gauda, Karma, Pakanati, Racha, Peddeti, and Krishna) acts as an endogamous unit. Of late, inter sub caste marriages among the younger generation have started. Consanguineous marriages (cross-cousin) and village endogamy are common among them. The subcastes differ in occupation, marriage rituals, and dress patterns. The present study participants belong to Krishna Gollas. They speak and write in Telugu and follow Hinduism. Traditionally this caste population was engaged in sheep and cattle herding, and dairy activities, but now have taken up agriculture, government jobs, and business. The Gollas celebrate 'Gokulastami' with fervor and pomp.

Madiga: They are scheduled caste groups in Andhra Pradesh. The name 'Madiga' originated from the word 'Madiguvaru' meaning 'people next to us' which later became Madiga with time. The Madiga is also found in some parts of the states of Tamil Nadu, Odisha, Pondicherry, and Karnataka. They trace their descent from Jambavanta, the first creation of God (*Narayana*). There are 25 sub-castes in the Madiga. For the present study data on the Telugu Madiga subcaste were collected. They speak and write in Telugu and follow Hinduism. Some Madiga has embraced Christianity. They consume Korra (Italian Millet), *jowar, ragi* (finger millet), rice, and wheat. The Madiga sub-caste is engaged in agriculture labour, drum beating, disposing of corpses, leatherwork, and business and government jobs. The Madiga also prefer consanguineous (cross-cousin and uncle-niece) marriages.

Data Types

Data on age, household income, educational and occupational status, and physical activity of the participants were collected. Physical activity levels were divided into sedentary (persons unable to work such as pensioners or elderly), light (involved in sitting/standing/walking activities as government employees, self-employee /vendors), medium/moderate (regular walkers, housewives, painters, and those involved in moderate agriculture activities such as weeding and sowing seeds) and heavy (agriculture labourers, washermen, rickshaw pullers, carpenters, manual labour, ploughing and tilling) following the modified Ramachandran et al. (2004). The annual income of total study participants ranged from Rs.6000-250000. Quartile values were estimated and participants were categorized into different groups in each caste and presented. Data on other lifestyle factors influencing obesity such as dietary habits, television watching, sleeping, smoking, and alcohol intake were not collected.

Anthropometric Measurements

To estimate the prevalence of different measures of obesity the following measurements were made. Height and weight were measured using standard (Singh and Bhasin 1989) protocol. Body mass index (BMI) was calculated following the formula (weight (Kg)/height (m^2). Waist circumference was measured using non-elastic tape at minimum horizontal girth between coastal margins and the iliac crest at the end of expiration (Pradeepa et al. 2015). The following criteria were used to define the different measures of obesity: *Overweight* (for both genders BMI of ≥23 - <25 kg/m2), *general obesity* (for both genders BMI ≥25 kg/m2), *abdominal obesity* (men: ≥ 90 cm, women: ≥ 80 cm of waist circumference (WC), *isolated general obesity* (BMI ≥25 kg/m2 with WC of <90 cm in men and < 80 cm in women) and *isolated abdominal obesity* (WC of ≥90 cm in men and ≥ 80 cm in women with BMI for both genders <25 kg/m2) and *combined obesity* (General + abdominal obesity) following Pradeepa et al. (2015).

Statistical Analyses

Continuous variables in the mean and standard deviation of mean and categorical variables in number and percent are presented. Differences and variance of mean were tested using student's independent 't-test and one and two-way analysis of variance followed by post-hoc test "Tukey". The researchers used Chi-square and

Fisher exact tests (for cells containing a count <5) for testing the association of categorical variables. Association between independent (age, sex, income, education, occupation, and physical activity) and dependent variables (general, abdominal, combined, isolated general, and isolated abdominal obesity and overweight) were investigated by employing logistic regression analyses. Predictors of general, abdominal, combined, isolated general, and isolated abdominal obesity and overweight were analyzed using logistic regression analyses. The researchers investigated all methods of logistic regression (enter, forward conditional, forward likelihood ratio, forward Wald, backward conditional, backward likelihood ratio, and backward Wald) to identify independent variables. Among all methods tested, the backward conditional method gave higher Nagel-KerkeR^2. Therefore, the researchers used this method for all logistic regression analyses. In the logistic regression analyses, the researchers entered variables such as age, gender, occupation, education, income, and physical activity in the final equation. Among the independent variables investigated in the present study, only age is continuous whereas variables such as sex, income, education, occupation, and physical activity were categorical. Exact P values obtained in the analyses were included in the Tables and no cut-off values were used for the determination of statistical significance.

RESULTS

Comparative mean age, body mass index (BMI), and waist circumference (WC); distribution of physical activity, occupation, education, and annual income, and different measures of obesity between two sexes in three endogamous populations are presented in Tables 1-3 and in Table 4, predictors of different of measures of obesity for total participants (men + women) in three endogamous populations are shown.

A comparison of total (men + women) mean BMI and WC in different caste populations showed significantly lower BMI and WC in Madiga than the Reddy and Golla caste populations ($p<0.01$). Comparison of mean age, BMI and WC between sexes within caste populations revealed significantly higher mean age in women than men in Reddies only **(**$p<0.01$); higher mean WC in men than women ($p<0.01$) in all caste populations whereas significantly higher mean BMI in women than men in Reddies only ($p<0.01$) (Table 1).

Comparison of total (men+ women) percent distribution of participants in different categories of physical activity, education, occupation and family income between three caste populations showed significant difference ($p<0.001$). When compared for percent distribution of participants in different categories of physical activity, education, occupation, and family income between men and women separately in three caste populations revealed a significant difference for variables of physical activity, education, occupation and family income in men whereas only for physical activity, education and family income ($p<0.01$) (Table 2) in women.

Comparison of total (men+ women) percent distribution of participants in different categories of physical activity, education, occupation and family income between two caste populations showed a significantly higher proportion of Golla participants had moderate and heavy ($p<0.01$) than the light physical activity of Reddies. Higher percent of Reddy participants were belonging to a higher income group than the Golla population ($p<0.01$). A higher proportion of Madiga had heavy physical activity, engaged in labour, were illiterate, and belonged to the low-income group when compared to the Reddy participants ($p<0.01$). A higher proportion of Madiga had heavy physical activity, were illiterate, unemployed and belonged to the low-income group than the Golla participants ($p<0.01$) (Table 2).

Percent distribution of participants in different categories of physical activity, education, occupation and family income when compared between sexes within caste population showed significant difference only in the variables of physical activity, education, occupation ($p<0.01$) (Table 2).

Comparison of total (men + women) distribution of participants for the prevalence of general, abdominal, combined, isolated general, and isolated abdominal obesity and overweight between three caste populations showed significant difference ($p<0.01$) (Table 3).

Table 1: Mean and standard deviation of age and anthropometric variables

Variable	*Reddy*			*Golla*			*Madiga*		
	Male (n=150)	*Female (n=150)*	*P value*	*Male (n=150)*	*Female (n=150)*	*P value*	*Male (n=150)*	*Female (n=150)*	*P value*
Age (years)	38.76 ±11.76	42.80 ± 13.46	0.006	41.30 ± 11.51	40.46 ± 10.84	0.516	36.31 ± 12.60	36.03 ± 11.20	0.839
Weight (Kg)	61.42 ± 9.43	53.44 ± 9.78	0.000	61.55 ± 7.82	52.81 ± 7.36	0.000	54.33 ± 9.10	47.85 ± 9.11	0.000
Height (cm)	161.19 ± 5.40	152.19 ± 5.57	0.000	166.71 ± 4.74	151.62 ± 4.95	0.000	164.96 ± 5.13	152.25 ± 4.52	0.000
WC (cm)	80.25 ± 8.37	77.37 ± 7.49	0.002	80.43 ± 7.56	76.00 ± 7.00	0.000	75.37 ± 8.27	72.43 ± 8.57	0.003
BMI (Kg/m^2)	21.95 ± 3.04	23.04 ± 3.86	0.007	22.39 ± 2.52	22.98 ± 3.15	0.076	19.94 ± 3.13	20.62 ± 3.71	0.086

WC: Waist circumference; BMI: Body mass Index; Kg: Kilograms; cm: centimetres; m2: meters in square

Source: Authors

Table 3: Distribution of type of obesity in males and females among endogamous populations

Variable	*Reddy*			*Golla*			*Madiga*		
	Male (n=150) Count (%)	*Female (n=150) Count (%)*	*P value*	*Male (n=150) Count (%)*	*Female (n=150) Count (%)*	*P value*	*Male (n=150) Count (%)*	*Female (n=150) Count (%)*	*P value*
General obesity	23(15.33)	41(27.33)	0.012	20(13.33)	33(22.00)	0.04	8(5.33)	20(13.33)	0.017
Abdominal obesity	18(12.00)	53(35.33)	0.00	19(12.66)	56(37.33)	0.00	7(4.66)	27(18.00)	0.00
Combined obesity	14(9.33)	31(20.66)	0.006	11(7.33)	22(14.66)	0.04	4(2.66)	12(8.00)	0.04
Over-weight	12(8.00)	25(16.66)	0.02	38(25.33)	34(22.66)	0.58	14(9.33)	12(8.00)	0.68
Isolated general obesity	10(6.66)	10(6.66)	1.00	10(6.66)	10(6.66)	1.00	4(2.66)	6(4.00)	0.52
Isolated abdominal obesity	18(12.00)	20(13.33)	0.72	5(3.33)	34(22.66)	0.00	2(1.33)	15(10.00)	0.00

Source: Authors

Table 2: Distribution of participants based on physical activity, occupation and education

Variable	*Reddy*			*Golla*			*Madiga*		
	Male (n=150) Count (%)	*Female (n=150) Count (%)*	*P P value*	*Male (n=150) Count (%)*	*Female (n=150) Count (%)*	*P values*	*Male (n=150) Count (%)*	*Female (n=150) Count (%)*	*P P value*
Physical Activity									
Sedentary	(0)	(0)	0.004	1	2	0.000	(0)	(0)	0.000
	(0)	(0)		(0.66)	(1.33)		(0)	(0)	
Light	75	95		42	93		23	69	
	(50)	(63.33)		(28)	(62)		(15.33)	(46)	
Moderate	40	18		61	13		63	9	
	(26.66)	(12)		(41.66)	(8.66)		(42)	(6)	
Heavy	35	37		46	42		64	72	
	(23.33)	(24.66)		(30.66)	(28)		(42.66)	(48)	
Occupation									
Labour	24	(0)	0.000	33	(0)	0.000	52	1	0.000
	(16)	(0)		(22)	(0)		(34.66)	(0.66)	
Farmer	12	(0)		9	(0)		1	(0)	
	(8.000)	(0)		(6)	(0)		(0.66)	(0)	
Business	19	(0)		24	(0)		31	1	
	(12.66)	(0)		(16)	(0)		(20.66)	(0.66)	
Private jobs	26	1		24	2		8	1	
	(17.33)	(0.66)		(16)	(1.33)		(5.33)	(0.66)	
Government jobs	36	6		33	4		23	3	
	(24)	(4)		(22)	(2.66)		(15.33)	(2)	
Unemployed	33	143		27	144		35	144	
	(22)	(95.33)		(18)	(96)		(23.33)	(96)	
Education									
Non-literate	11	50	0.000	17	50	0.000	46	91	0.000
	(7.33)	(33.33)		(11.33)	(33.33)		(30.66)	(60.66)	
Primary	13	39		13	27		24	24	
	(8.66)	(26)		(8.66)	(18)		(16)	(16)	
Secondary	42	46		50	57		43	33	
	(28)	(30.66)		(33.33)	(38)		(28.66)	(22)	
College and above	84	15		70	16		37	2	
	(56)	(10)		(46.66)	(10.66)		(24.66)	(1.33)	
Income Annually									
Rs.6000-18000 (25 percentile)	13	25	0.01	38	54	0.2	79	76	0.86
	(8.66)	(16.66)		(25.33)	(36)		(52.66)	(50.66)	
Rs.18001-30000 (50 percentile)	36	43		30	30		27	32	
	(24.00)	(28.66)		(20.00)	(20.00)		(18.00)	(21.33)	
Rs.30001-54000 (75 percentile)	32	40		32	32		24	25	
	(21.31)	(26.66)		(21.33)	(21.33)		(16.00)	(16.66)	
>54000	69	43		34	34		20	17	
	(46.00)	(28.66)		(22.66)	(22.66)		(13.33)	(11.33)	

When two caste populations were compared for the total (men + women), prevalence of different measures of obesity showed a higher prevalence of overweight in Golla than the Reddy participants ($p<0.01$); higher prevalence of general, abdominal, combined and isolated abdominal obesity in Reddy than the Madiga ($p<0.01$) caste population; and significantly higher prevalence of general, abdominal, combined and isolated abdominal obesity and overweight ($p<0.01$ in Golla than the than Madiga (Table 3).

Sex-wise comparison of the prevalence of different measures of obesity in three caste populations revealed a higher prevalence of overweight in Golla than Reddy men ($p<0.01$) in contrast the prevalence of isolated abdominal obesity was significantly higher in Reddy against Golla men ($p<0.01$). The prevalence of general, abdominal, and isolated abdominal obesity was significantly higher in Reddy and Golla when compared to the Madiga men ($p<0.01$) (Table 3).

The prevalence of isolated abdominal obesity was significantly higher in Golla when compared to the Reddy women ($p<0.005$). The prevalence of general, abdominal and combined obesity ($p<0.001$) and overweight ($p<0.05$) was significantly higher in Reddy against Madiga women. Madiga women showed a significantly lower prevalence of general ($p<0.05$), abdominal, and isolated abdominal obesity, and overweight ($p<0.01$) than Golla women (Table 3).

The prevalence of general, abdominal, and combined obesity was significantly higher in women than men in all caste populations. Prevalence of overweight was significantly higher in women against men in Reddies only ($p<0.05$). Only in Golla and Madiga participants, a significantly higher prevalence of isolated abdominal obesity was found in women when compared to men ($p<0.01$) (Table 3).

The variables which showed significant association with each measure of obesity in each caste population are presented in Table 4.

General Obesity

Variables such as male gender and farming, in Reddy; age, lower educational levels (primary and secondary) in Golla and low income in Madiga were associated with general obesity in logistic regression analyses. These risk factors were found to account for 25.2 percent variation in Reddy, 31.8 percent in Golla and 27.3 percent in Madiga, variation in the dependent variables, that is, general obesity as shown by Nagel-Kerke R^2.

Abdominal Obesity

Male gender was found to be the common predictor for abdominal obesity in all caste populations. Along with the male gender, low income level in Reddy; age in Golla and age and low income in Madiga were found to increase the risk of abdominal obesity in the investigated participants.

Combined Obesity

In Madiga (29.2%) participants, age; age, and middle income levels (38.2%) in Golla, whereas the male gender in Reddy (27.2%) were associated with combined obesity and these variables contributed to variation in combined obesity as shown by Nagel-KerkeR^2.

Isolated General Obesity

None of the variables were found to be significantly associated with isolated general obesity in Madiga. Age in Reddies and primary and secondary educational status in Gollas were found to be significantly associated with isolated general obesity. Age (25% in Reddies) and primary and secondary education in Gollas attributed to 27 percent variation in the dependent variable (isolated general obesity) (Table 4).

Isolated Abdominal Obesity

None of the variables were found to be significantly associated with isolated abdominal obesity in Reddies. Male gender in Golla and male, sedentary lifestyle and income group of Rs. 6000-18000 in Madiga were significantly predicted isolated abdominal obesity.

Overweight

Age in Madiga; sedentary life style in Reddies and income group of Rs.18-30,000, business and government occupational groups were

Table 4: Predictors of general, abdominal obesity and combined obesity in total Reddy, Golla and Madiga participants analyzed by backward conditional logistic regression

Reddy					
		General obesity			
Variable	*B*	*S.E.*	*Wald*	*Odds ratio, 95%CI, P value*	*Nagel-Kerke R2*
Male gender	-1.401	0.542	6.695	0.246 (0.085-0.712),0.01	0.252
Farming	2.198	0.907	5.875	9.007(1.523-53.269), 0.015	
		Abdominal Obesity			
Male gender	-1.358	0.555	5.997	0.257(0.087-0.762), 0.014	0.234
Income group of Rs.30001-54000	-1.529	0.666	5.261	4.612 (1.249-17.029), 0.022	
		Combined Obesity			
Male gender	-1.417	0.62	5.215	0.242(0.072-0.818),0.022	0.272
Isolated General Obesity					
Age	0.034	0.016	4.619	1.034(1.003-1.0660, 0.032	0.253
Overweight					
Sedentary	-1.369	0.585	5.47	0.254(0.081-0.801),0.019	0.122
		Golla			
		General Obesity			
Age	0.046	0.017	7.647	1.047(1.013-1.082),0.006	0.318
Primary school education	1.195	0.539	4.918	3.303(1.149-9.496),0.027	
Secondary school education	0.89	0.426	4.371	2.436(1.057-5.613), 0.037	
		Abdominal Obesity			
Age	0.036	0.016	5.204	1.037(1.005-1.069),0.023	0.272
Male gender	-1. 259	0.614	4.203	0.284(0.085-0.946),0.040	
		Combined Obesity			
Age	0.06	0.022	7.211	1.061(1.016-1.109),0.007	0.382
		Income level of Rs.18000 -30000			
Isolated General Obesity	1.291	0.644	4.019	3.637(1.029-12.849), 0.045	
Primary education	2.187	1.088	4.037	8.906(1.055-75.188),0.045	0.277
		Secondary education			
Isolated Abdominal Obesity	1.785	0.82	4.736	5.960(1.194-29.749),0.030	
		Male gender			
Overweight	-3.131	1.083	8.362	0.995(0.957-1.035),0.004	0.259
Businessmen	1.613	0.678	5.654	5.019(1.328-18.971),0.017	0.175
Government employee	1.915	0.627	9.32	6.790(1.985-23.22)	
Income group of Rs.18-30,000	1.224	0.51	5.941	3.468(1.276-9.427),0.015	
		Mediga General Obesity			
Income level of Rs. 6000-18000	-2.024	0.652	9.638	0.132(0.037-0.474), 0.002	0.273
		Abdominal Obesity			
Male gender	-0.2635	0.996	7.002	0.072(0.010-0.505), 0.008	0.296
Age	0.084	0.023	12.692	1.087(1.038-1.138)	
Income level of Rs.6000-18000	-2.142	0.815	6.902	0.117(0.024-0.580)	
		Combined Obesity			
Age	0.078	0.031	6.394	1.081(1.018-1.148)	0.292
		Isolated Abdominal Obesity			
Male gender	-6.923	2.439	8.054	0.001(0.000-0.117),0.005	0.33
Sedentary	-2.671	1.191	5.025	0.069 (0.007-0.715),0.025	
Income group of Rs.6000-18000	-3.373	1.373	6.03	0.034 (0.002-0.506), 0.014	
		Overweight			
Age	0.036	0.018	4.083	1.036 (1.001-1.073),0.043	0.121

Source: Authors

found to be significantly associated with overweight (Table 4).

DISCUSSION

A significantly higher mean age in women than men was observed in Reddies. The age details were recorded after enquiring about the women participants. Age relevant documents were not verified to confirm their age. Among Reddies, 33 percent of women were non-literates. It is possible that they have informed their age details useful for administrative purposes as eligibility for most of the welfare schemes is based on the age criteria in Andhra Pradesh. Higher mean WC in men than women and higher mean BMI in women than men were observed in the present study also reported in earlier studies (Kumari et al. 2019; Gogoi and Saraswathy 2020; Shrestha et al. 2021).

The results of the present study showed no significant difference in the prevalence of different measures of obesity between Reddy and Golla caste populations. Significantly higher proportion of Golla (22.66%) showed overweight than Reddy (20%) and Madiga (8.3%) (P=0.000) participants. This may be due to the presence of higher percent of Golla (22.66%) participants in the BMI category of 23-25Kg/m^2. Lower prevalence of overweight in Madiga than Golla may be due to higher proportion of participants who were unemployed (60%) and belonged to lower income group (51.66%). Significantly higher prevalence of different types of obesity (general, abdominal, combined, and isolated abdominal obesity) was observed in Reddy and Golla caste populations when compared to the Madiga caste which may be due to higher BMI and WC, absence of heavy physical activity and higher income and suggest their higher risk of developing obesity. In the researchers' earlier study also significantly lower prevalence of abdominal obesity in Madiga when compared to the Reddy population was observed (Rao et al. 2018).

In developed countries, a higher prevalence of obesity was associated with low socioeconomic status whereas in developing countries positive association was observed between obesity and socio-economic status (Bhurosy and Jeewon 2014). Using National Family Health Survey data Corsi and Subrmanian (2019) showed that 70-90 percent of the population burden of obesity is distributed in higher socio-economic groups of India. In the present study also like in developing countries higher prevalence of different measures of obesity was noticed in both upper (Reddy) and backward (Golla) caste populations than the scheduled caste population (Madiga) which may be due to higher income and higher educational status in both upper and backward caste population than the scheduled caste population. It was reported that Indians belonging to high socio-economic groups consume high calories and fat rich diet and involve in less vigorous activity than people from low socio-economic groups leading to a higher prevalence of obesity (Siddiqui and Donato 2016). The researchers have not collected data on the dietary intake of the participants to justify this observation but the percentage of Madiga participants involved in heavy physical activity was significantly higher than the Reddy and the Golla populations.

A positive association between national income and obesity and overweight was observed (Mendez et al. 2005). In pooled populations (men + women) of all caste populations), a significant correlation of income with abdominal, isolated general, and isolated abdominal obesity ($p<0.01$) and combined obesity ($p<0.05$) was observed in bivariate correlation analyses. In Reddies, income was found to be significantly correlated with general, combined, and isolated general obesity ($p<0.01$). In Golla, income was correlated with overweight and isolated general obesity ($p<0.01$), whereas in Madiga, general, abdominal, and isolated general obesity ($p<0.01$) showed a significant association with income. These results suggest a differential association of income with different measures of obesity.

In low-income countries, positive association between education with obesity, whereas in high-income countries, this association was found to be reversed (Monteiro et al. 2004; Devaux et al. 2011; Cohen et al. 2013; Venkatrao et al. 2020). In pooled caste populations of the present study, education was found to be positively associated with overweight ($p<0.01$) and negatively associated with abdominal and isolated abdominal obesity ($p<0.05$) in bivariate correlation analyses. When the association of education with

different measures of obesity was analysed using bivariate correlation analyses in individual pooled caste populations, the following results were found. In Reddies, education was inversely associated with abdominal obesity ($p<0.05$) only. In Golla, education was positively associated with overweight ($p<0.05$) and inversely with abdominal and isolated abdominal obesity ($p<0.01$). In Madiga, no association of education with any measures of obesity was observed. With respect to education, both Golla and Reddy populations showed a negative association with abdominal and isolated abdominal obesity.

A lower likelihood of overweight and obesity with increased educational and income level was observed among women and in men, it was found to be reverse (Siddiqui and Donato 2016). In a nationwide randomized cluster sample survey, a higher percentage of obesity was observed in highly educated than non- educated (Venkatrao et al. 2020). In this study, in pooled populations (all caste populations) of men, the prevalence of general ($p<0.01$), combined and isolated general obesity ($p<0.05$) significantly increased from non-literates to secondary education in chi-square analyses. In the case of women, no such trend was observed.

In Reddies and Golla, neither in men nor in women, no significant association of education (lower or higher) with different measures of obesity was observed. In Madiga, general ($p<0.01$), combined, isolated general obesity ($p<0.05$), significantly increased with educational status in only men but not in women. In pooled populations and in Reddies, no significant association of income (lower or higher level) with different measures of obesity was observed. In Golla, abdominal obesity and overweight ($p<0.05$) significantly increased with increasing levels of income whereas in Madiga, general obesity, overweight, and isolated general obesity ($p<0.01$), significantly increased with increasing levels of income in men but not in women. These results also suggest a differential role of socio-economic status with different measures of obesity. Policy addressing obesity should incorporate the growing importance of socio-cultural and spatial contextual factors impacting health behaviours (Siddiqui and Donato 2016).

Without regard to caste population, a higher prevalence of abdominal obesity than other types of obesity was observed in all caste populations and this may be due to their higher predisposition to abdominal obesity and accumulation of visceral fat as reported earlier in general populations of India (Pradeepa et al. 2015; Shrestha et al. 2021; Noopur et al. 2022) and observed in other caste populations (Hazarika and Sengupta 2015; Kumari et al. 2019; Gogoi and Saraswathy 2020). Similarly, a higher prevalence of isolated abdominal obesity was observed than isolated general obesity in all pooled (men + women) caste populations of the present study as observed in the available studies on general populations of India (Pradeepa et al. 2015; Deepa et al. 2009).

Studies conducted on heterogeneous general populations of India showed the prevalence of general obesity in 38.4 percent of men and 36.2 percent of women (National Family Health Surveys, 2005-2006, 2015-2016) (Verma et al. 2021) and 38.67 percent in men and 41.88 percent in women (Nationwide randomized cluster sample survey, Venkatrao et al. 2020). Prevalence of general and abdominal obesity ranged from 11.8 - 31.3 percent in men and 16.9 -36.1 percent in women in four state studies (Pradeepa et al. 2015). In the present study, general obesity ranged from 5 percent in Madiga; 13 percent in Golla, and 15 percent in Reddy men, and in females it ranged from 13 percent in Madiga; 22 percent in Golla and 27 percent in Reddy. The total general obesity ranged from 9 percent (Madiga), 21 percent (Reddy), and 22 percent in Golla while the total abdominal obesity ranged from 11 percent (Madiga), 24 percent in Reddy, and 25 percent in Golla. The rising obesity in India is attributed to the lower physical activity, rising urbanization, more use of mechanized transport, increased availability and consumption of processed, energy dense and nutrient poor diets, spending more time on watching television and urbanization of rural spaces (Pradeepa et al.2015; Siddqui and Donato 2016; Aiyar et al. 2021).

Male gender was found to be inversely associated with general, abdominal, and combined obesity in Reddy and with abdominal obesity in all caste populations of the present study. In all caste populations, a lower prevalence of general, abdominal, and combined obesity was ob-

served in men than women in the present and is in agreement with other studies (Pandey et al. 2013; Pradeepa et al. 2015; Reddy et al. 2019; Kumari et al. 2019; Gogoi and Saraswathy 2020). The higher prevalence of different measures of obesity in women than men may be due to the physiological changes at puberty, pregnancy, post-pregnancy and menopause, contraceptive use, different cut-off values used for abdominal obesity, diet, socio-economic factors, socio-cultural beliefs, degree of urbanization and low physical activity (Gouda and Prusty 2014; Al Kibriya et al. 2019; Prasad et al. 2020).

Analyses of predictors for different measures of obesity in caste populations showed common and specific factors for each type of obesity. Male gender was found to be inversely associated with general, abdominal, and combined obesity in Reddy, and with isolated abdominal obesity in Golla and Madiga and a common variable associated with abdominal obesity in all caste populations. Inverse association of male gender with different measures of obesity suggests either protection of this gender from general, abdominal, isolated abdominal obesity, and combined obesity or due to their higher percent the in non-obese category which needs to be confirmed in longitudinal studies.

Low income was found to be inversely associated with abdominal obesity in Reddy; with general, abdominal, and isolated abdominal obesity in Madiga, and middle income with combined obesity and overweight in Golla participants. Low educational levels in Golla with general and isolated general obesity and with farming in Reddy were found to be specific for general obesity.

Age was found to be the common risk factor for general, abdominal, and combined obesity in Golla; for abdominal and combined obesity and overweight in Madiga participants; and for isolated general obesity in Reddies. Four States study, carried out on heterogeneous populations of India by Pradeepa et al. (2015) reported that age was significantly associated with abdominal and combined obesity. Increased obesity with age was observed in other studies also (Das et al. 2019; Venkatrao et al. 2020; Sarvottam et al. 2020) Further, female gender, diabetes, hypertension, physical inactivity, and urban residence were found to be significantly associated with general, abdominal and combined obesity. In the present study, the researchers have not collected information on hypertension and diabetes from the participants. In contrast to Pradeepa et al. (2015), age was associated with general, abdominal, and combined obesity in Golla, with isolated general obesity in Reddies and in the case of Madiga with abdominal and combined obesity. The observations made in the present study are in agreement with an earlier study (Pradeepa et al. 2015). In the present study, age, gender and socio-economic (education, occupation, and income), and behavioral (physical activity) variables were found to be the significant predictors of different types of obesity. Vermal et al. (2021) in heterogeneous populations observed that older age, urban living, higher education, marital status, and richest wealth quantile, were the significant predictors of overweight/general obesity. In the present, only Golla age and lower educational levels and low income in Madiga were significantly associated with general obesity. Association of marital status with general obesity was not observed in any caste population like this study. To the best of the researchers knowledge, no new study is available on different measures of obesity except Pradeepa et al. (2015) therefore the researchers could not compare their results with any other study.

To know whether there is a differential susceptibility to different measures of obesity among caste populations, the researchers performed bivariate logistic regression analyses using each measure of obesity as the dependent variable and each caste population (men + women) as an independent variable. The results of the analyses revealed that higher Odds of developing general (standardized beta (B)= 0.969,Odds ratio (OR)= 2.632 Vs. B= 0.735, OR=2.08), combined ((B=0.991, OR=2.69 Vs. B=0.694, OR= 2.00) and isolated general obesity (B=0.991, R=2.69 Vs. B=0.626, OR=1.87) was observed among Reddies than Golla participants ($p<0.01$), in contrast, higher Odds of developing abdominal (B= 0.886, OR 2.60 Vs B=0.886,OR=2.42) and isolated abdominal obesity (B=0.880, OR 2.41 Vs B=0.517, OR=1.67) and overweight (B=1.17, OR=3.22 Vs. B=1.01, R= 2.75) (data not showed) was found among Golla than Reddies ($p<0.01$) in bivariate logistic regression analyses. These observations

Table 5: Prevalence of general and abdominal obesity in available caste populations of India

S. No.	*Caste*	*Place*	*Gender*	*General obesity criteria BMI (Kg/m2)*	*General obesity prevalence (%)*	*Abdominal obesity criteria*	*Abdominal obesity criteria*	*Reference obesity prevalence (%)*
1.	Reddy	Chittoor District, Andhra Pradesh	Men	BMI≥30	4.71*	NA	NA	Venkatramana and Reddy 2002
2.	Bhatia	Jaipur	Men	BMI>25	54	WC>102 cm	34.5	Gupta et al. 2004
	Bhatia	Jaipur	Women	BMI>25	69.4	WC>80 cm	55.6	Gupta et al. 2004
3.	Aggrawal Baniyas	Delhi	Men	BMI>30	20.7	NA	NA	Gupta and Kapoor 2010
	Aggrawal Baniyas	Delhi	Women	BMI>30	42.7	NA	NA	Gupta and Kapoor 2010
4.	Khatri	Delhi	Men	BMI>24.95	24	WHR>0.95	8	Mungreiphy et al. 2012
	Khatri	Delhi	Women	BMI>24.95	16	WHR>0.80	24	Mungreiphy et al. 2012
5.	Ezvah	Thiruvananthapuram District, Kerala	Men	BMI>24.95	8	WHR>0.95	0	Mungreiphy et al. 2012
	Ezvah	Thiruvananthapuram District, Kerala	Women	BMI>24.95	4	WHR>0.80	24	Mungreiphy et al. 2012
6.	Meiti	Manipur	Men	BMI≥30 BMI>27.5	105.12	NA	NA	Singh and Dkhar 2013
7.	Kaibarta	Lakhimpur District, Assam	Women	BMI>25	4.27	WC>72	46.45	Hazarika and Sengupta 2015
8.	Koch	Lakhimpur District, Assam	Women	BMI>25	10	WC>72	52	Hazarika and Sengupta 2015
9.	Meghawal	Udaipur	Men	BMI>25	1.20	WC Criteria NA	18.30	Gogoi and Saraswathi 2020
	Meghawal	Udaipur	Women	BMI>25	4.90	WC Criteria NA	27.0	Gogoi and Saraswathi 2020
10.	Gaur Brahmin	Delhi and NCR	Men	NA	41.42	WC, WHR Criteria NA	59.81 67.12	Kumari et al. 2019
	Gaur Brahmin	Delhi and NCR	Women	NA	49.46	WC, WHR Criteria NA	89.19 83.27	Kumari et al. 2019
11.	Reddy	Chittoor District, Andhra Pradesh	Men	BMI>25	15	WC>90 cm	12	Present study
	Reddy	Chittoor District, Andhra Pradesh	Women	BMI>25	27	WC≥80 cm	35.33	Present study
12.	Golla	Chittoor District, Andhra Pradesh	Men	BMI>25	13	WC>90 cm	12.66	Present study
	Golla	Chittoor District, Andhra Pradesh	Women	BMI>25	22	WC>80 cm	37.33	Present study
13.	Madiga	Chittoor District, Andhra Pradesh	Men	BMI>25	5	WC>90 cm	4.66	Present study
	Madiga	Chittoor District, Andhra Pradesh	Women	BMI>25	13	WC>80 cm	18.00	Present study

NA: Not available; WC: Waist circumference; WHR: Waist-Hip ratio; cm: centimetre; Kg: Kilogram; m^2: Meters in square; NA: Not available

Note: *Only starred reference includes urban + rural; NCR: National Capital Region

Source: Authors

suggest differential susceptibility of caste groups to different measures of obesity and no study is available to compare the results of the present study.

The prevalence of general and abdominal obesity in different caste populations of India is compared with the results of the present study in Table 5. The studies on the prevalence of obesity are available from 2002-2020. The prevalence of general obesity ranged from 1.20 – 54 percent in men and from 4-69.4 percent in women. Prevalence of abdominal obesity was determined using waist circumference (WC) and waist-hip ratio in earlier studies. Different criteria were used to determine abdominal obesity employing WC. The prevalence of abdominal obesity ranged from 0-34.5 percent in men and in women it was 18-55.6 percent. The results of the present study fall within the range of reported studies. Heterogeneity in the prevalence of general and abdominal obesity in caste populations of this study and reported evidence to suggest the prevalence of different measures of obesity vary in different populations. The difference in the prevalence of general and abdominal obesity in different studies may be due to differences in genetic composition, socio-economic status, and criteria used to determine obesity.

LIMITATIONS

No sampling method was employed in this study. The prevalence of different measures of obesity on caste populations in the present study is restricted to Chittoor District only due to time and financial constraints. Due to the lack of studies on different measures of obesity in the caste populations the researchers couldn't compare the results of their study with other studies.

CONCLUSION

A higher prevalence of different measures of obesity (general, abdominal, combined, and isolated abdominal obesity and overweight) was observed in women than in men. Susceptibility to different measures of obesity was found to be different in caste populations. The prevalence and predictors of different measures of obesity were found to vary in each caste population. Collecting the population specific obesity data may be a better choice than clubbing all populations as one unit because some predictors of obesity are found to be population specific.

RECOMMENDATIONS

Interventional measures need to be planned to reduce obesity in women. Prevalence studies on different measures of obesity need to be carried out in different caste populations of India to know whether the prevalence and predictors are the same or different. Factors other than socio-economic and behavioural factors causing obesity need to be explored in caste populations to address the obesity epidemic in India. Population-wise collection of data on obesity should be initiated in nationally representative studies conducted by the Government of India to prepare a policy to reduce the prevalence of obesity in India given its multi-ethnic composition. The results of this study suggest that interventions have to be planned using population specific measures than global measures to prevent and reduce obesity and its associated non-communicable disease burden in the country. As it is a cross-sectional study, predictors can be considered causal in nature which needs to be confirmed in longitudinal studies.

REFERENCES

Aiyar A, Rahman A, Pingali P 2021. India's rural transformation and rising obesity burden. *World Dev*, 138: 105258.

Al Kibria GM, Swasey K, Zabir Hasan MD et al. 2019. Prevalence and factors associated with underweight, overweight and obesity among women of reproductive age in India. *Global Health Research and Policy*, 4: 24.

Bhurosy T, Jeewon R 2014. Overweight and obesity epidemic in developing countries: A problem with diet, physical activity or socio-economic status? *Sci World J*, ID 964236: 7.

Central List of OBCs for the State of Andhra Pradesh 2022. From <http://www.ncbc.nic.in/user_panel/GazetteResolution.aspx?Value=mPICjsL1aLvYBtdZSrP4uO%2bploAhiJHMALWmHIwbzS8Il37YLL3Fb0FHfWDHzP7c> (Retrieved on 1 April 2022).

Cohen AK, Rai M, Rehkopf DH et al. 2013. Educational attainment and obesity: A systematic review. *Obes Rev*, 14: 989–1005.

Corsi DJ, Subramanian SV 2019. Socioeconomic gradients and distribution of diabetes, hypertension, and obesity in India. *JAMA Netw Open*, 2(4): e190411.

Das Gupta R, Haider SS, Sutradhar I et al. 2019. Association of frequency of television watching with over-

weight and obesity among women of reproductive age in India:Evidence from a nationally representative study. *PLoS ONE*, 14(8): e0221758.

Deepa M, Farooq S, Deepa R et al. 2009. Prevalence and significance of generalized and central body obesity in an urban Asian Indian population in Chennai, India (CURES: 47). *Eur J Clin Nutr*, 63(2): 259-267.

Devaux M, Sassi F, Church J et al. 2011. Exploring the relationship between education and obesity. *OECD J Econ Stud*, 2011(1).

Gogoi AJ, Saraswathy KN 2020. A study on obesity and hypertension among adults of Meghwal Community, Udaipur District, Rajasthan (India). *J Hum Ecol*, 7(1-3): 90-97.

Gouda J, Prusty RK 2014. Overweight and obesity among women by economic stratum in urban India. *J Health Popul Nutr*, 32(1): 79-88.

Gupta R, Sarna M, Thanvi J et al. 2004. Prevalence of multiple coronary risk factors in Punjabi Bhatia community: Jaipur heart watch-3. *Indian Heart J*, 56(6): 646-652.

Gupta S, Kapoor S 2010. Sex differences in blood pressure levels and its association with obesity indices: Who is at greater risk. *Ethn Dis*, 20: 370–375.

Hazarika J, Sengupta S 2015. Relationship between under nutrition, obesity and chronic diseases among two rural caste populations of Lakhimpur District, Assam. *Social Science Journal of Gargaon Collge*, 3: 1-10.

International Statistical Classification of Diseases and Related Health Problems 2019. 11th Edition. ICD-11. World Health Organization.

Kumari S, Sharma N, Mishra J et al. 2019. General obesity and cardiovascular diseases among Gaur Brahmin population of NCR/Delhi. *Diabetes Metab Syndr Clin Res Rev*, 13(2): 1335-1339.

Luhar S, Mallinson PAC, Clarke L et al. 2018. Trends in the socio economic patterning of overweight/obesity in India: A repeated cross-sectional study using nationally representative data. *BMJ Open*, 8: e023935.

Malhotra KC 1984. Population structure among the Dhangar caste-cluster of Maharashtra, India. In: JR Lukacs (Ed.): *The People of South Asia*. New York: Plenum Press, P. 295.

Mendez MA, Monteiro CA, Barry M Popkin BM 2005. Overweight exceeds underweight among women in most developing countries. *Am J Clin Nutr*, 81(3): 714–721.

Monteiro CA, Conde WL, Lu B et al. 2004. Obesity and inequities in health in the developing world. *Int J Obes Relat Metab Disord*, 28: 1181–1186.

Mungreiphy NK, Dhall M, Tyagi R et al. 2012. Ethnicity, obesity and health pattern among Indian population. *J Nat Sci Biol Med*, 3(1): 52–59.

Noopur N, Shashwat N, Niraj B et al. 2022. Study on prevalence of obesity using different scales and its association with hypertension among the elderly in a district of Gujarat. *J Family Med Prim Care*, 11(1): 162-169.

Pandey RM, Gupta R, Misra A et al. 2013. Determinants of urban-rural differences in cardiovascular risk factors in middle-aged women in India: A cross-sectional study. *Int J Cardiol*, 163: 157-162.

Pradeepa R, Anjana RM, Joshi SR et al. 2015. Prevalence of generalized & abdominal obesity in urban & rural India—the ICMR-INDIAB Study (Phase-I) [ICMR-NDIAB-3]. *Indian J Med Res*, 142(2): 139-150.

Prasad DS, Kabir Z, Revathi Devi K et al. 2020. Gender differences in central obesity: Implications for cardiometabolic health in South Asians. *Indian Heart J*, 72(3): 202-204.

Ramachandran A, Snehalatha C, Baskar AD et al. 2004. Temporal changes in prevalence of diabetes and impaired glucose tolerance associated with lifestyle transition occurring in the rural population in India. *Diabetologia*, 47(5): 860-865.

Rao PC, Latheef, SAA Venkatramana P 2018. Metabolic syndrome and its components: Endogamy and urban-rural differences. *J Hum Ecol*, 62(1-3): 41-46.

Reddy BN 1998. Blood pressure and adiposity: A comparative study of socio economically diverse groups of Andhra Pradesh, India. *Am J Hum Biol*, 10(1): 5-21.

Sarvottam K, Ranjan P, Yadav U 2020. Age group and gender-wise comparison of obesity indices in subjects of Varanasi. *Indian J Physiol Pharmacol*, 64(2): 109-117.

Shrestha R, Upadhyay SK, Khatri B et al. 2021. BMI, waist to height ratio and waist circumference as a screening tool for hypertension in hospital outpatients: A cross-sectional, non-inferiority study. *BMJ Open*,11(11): e050096.

Siddiqui MDZ, Donato R 2016. Overweight and obesity in India: Policy issues from an exploratory multi-levels analysis. *Health Policy and Plan*, 31: 582-591.

Singh LP, Bhasin MK 1989. *Anthropometry*. Delhi: Kamla-Raj Enterprises.

Singh KS 1993. People of India: The profile of national project (1985-92). *Curr Sci*, 64: 5-10.

Venkatrao M, Nagarathna R, Majumdar V et al. 2020. Prevalence of obesity in India and its neurological implications: A multifactor analysis of a nationwide cross-sectional study. *Ann Neurosci* 27(3-4): 153–161.

Verma M, Das M, Sharma P et al. 2021. Epidemiology of overweight and obesity in Indian adults – A secondary data analysis of the National Family Health Surveys. *Diabetes Metab Syndr Clin Res Rev*, 15(4): 102-166.

World Obesity Atlas 2022. A Report Prepared by World Obesity Federation. From <https://www.worldobesity.org/resources/resource-library/world-obesity-atlas-2022> (Retrieved on 6 April 2004).

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