Variation of Adult Heights and Weights in India: State & Zonewise Analysis

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ABSTRACT

Objectives: In India, gender inequality in nutrition, from infancy to adulthood, is a common phenomenon. Women never reach their full growth potential due to nutritional deficiency. Height and weight reflects nutritional deficiency. Knowledge of inter-state variations in adult height and weight can help us to explain the differences due to socio-cultural and economic factors like poverty, illiteracy, cultural barriers, concentration of multiple ethnicity, physical geography etc. The main objective of this study is to see the variation of adult height, weight and BMI along with gender differences in the states of India.

Methods: This study is based on a sample of 64984 male and 118781 female of 15-49 age groups. Data are obtained from the National Family Health Survey, 3rd round (NFHS-3) conducted by International Institute of Population Sciences (IIPS), during the period of 2005 to 2006. Descriptive studies and logistic regression analyses were conducted to examine the variations in the difference of height, weight and BMI of adult male and female in India.

Results: There is a clear positive relation of height with the economic level reflected through wealth index. Education level also has strong positive effect on height. It is found in this study that mean male height is the highest in north zone followed by west and south zone. The lowest mean height is seen in north east zone. Similar results in case of mean weight are also found in those zones but in case of mean BMI south zone show the highest position where east and central zones follow. The intensity of mean height, weight and BMI for adult females varies more than that of males but the variation pattern is similar for both males and females.

Conclusions: Socio-cultural differences including differences in economic pattern may be the leading causes in the variation of height weight distribution in the states of India. In this context, level of living and education need to be given proper attention because these two seem to be the most influential factors in improving the health and nutritional status as reflected through height, weight and BMI.

Keywords: Adult, Male, Female, States of India, Height, Weight, BMI, Socio-economic factors.

INTRODUCTION

Gender differences in height and weight are common features. But the pattern of variation of height and weight of adult males and females may give his important indications about the influential factors behind the variations. The influential factors may be local, regional or global. The local factors that influence stature include heterosis (Billy 1975, 1979), socio-economic status (Palsson and Schwidezky 1973), diet and nutrition etc (Lasker 1946). Indian subcontinent presents diverse climatic conditions in different regions. It contains diverse human populations but with a unique population structure (for the majority of its population) of hierarchical caste system. Each of several religious and migrant ethnic groups maintains high degree of endogamy and cultural identity in wide geographical regions with varying climatic conditions.

Height is a retrospective measure of an individual's health and biological standard of living and almost determined before the person reaches the age of twenty (Komlos and Baton 1998). Therefore, height is the combination of genetic and environmental factors. Heights, between populations may differ due to genetic factor but within population differences are mainly due to several socio-economic, nutritional and health oriented factors. In developed countries environmental variation is less than developing countries. In poor environment, socio-economic status creates a gap in height differences. There must be some exception like Africa where in spite of low economic positions; their average heights are higher than in several other developing countries. Height, weight and Body Mass Index are the measure of nutritional status but the variation in height seems to be more genetic as it is a long-term indicator and it reflects the net gain in nutrition over the growth period and cannot be altered in the later stages of growth. Prominent changes in height may take a long period and therefore it is more influenced by genetic factors as inherited from the parents. On the other hand, weight and Body Mass Index (BMI) are the reflection of short-term measure of nutritional status. Changes in a short time may occur due to inadequate or excess amount of food intake. For India, published data show that increased mortality is associated with low as well as high BMI (National Institute of Nutrition 1991, Shukla et al 2002, Sauvaget et al 2008, Karthrotia et al 2010).

In Indian situation, in view of endogamy, the variation of stature is perhaps more influenced by population structure and less by climate and geography. This is because nearly eighty percent of stature is genetically regulated and non-genetic factors such as climate, nutrition and socio-economic factors together account for remaining twenty percent. In India very little work has been done relating to height data. Variations in the adult male height of a variety of population groups are shown by Bharati et al (2010). The local factors that influence stature include socioeconomic status (Sharma 2008), age (Bhalotra 2009), diet and nutrition (DeRose et al. 2000), income inequality (Deaton 2008). Sexual dimorphism in height is increasing in some states (Andhra Pradesh, Orissa and Tamil Nadu) while decreasing in some other states (Gujrat, Kerala, and Maharastra) in India (Guntupalli and Moradi, 2009).

In India, some studies have been conducted on BMI of adult population. Body Mass Index (BMI) is widely accepted as one of the best indicators of nutritional status of adult individuals (Shetty and James 1994, Gautam et al 2006). It is also considered that the BMI may be more nutritional than genetic (Rolland-Cachera 1993), despite a wide variation between human populations in weight and height (Eveleth and Tanner 1990). In India, some work was done in North East (Khongsder 2001, Bharati 1989) and South (Reddy 1998) zones.

India is specialized with variety of ethnic populations, Scheduled Tribes, Castes, Other Backward Classes in one hand and General Castes and other communities like Muslims, Christians, Sikhs on the other hand. States are different with respect to socio-cultural context, economic condition, caste rigidity, difference in food pattern, strong gender inequality and so on. Thus the variations in height weight differences are likely to be conspicuously observed in India. Mahalanobis (1927) and Olivier (1963) observed positive relationship between caste hierarchy and stature from a single geographical or climatic zone; the inter-ethnic relationship is also highly correlated. However, based on a large sample size drawn from different regions and wide ethnic groups, the study (Bharati et al 2005) showed that all the three factors are associated with the variation of mean stature. With this background, the present study will try to find the variation in adult height, weight and BMI in different states of India, for both males and females to know the reasons of these differences, if any. As the states are not equal in terms of development, caste community concentration or socio-cultural context, therefore height

weight variation among the adults for both males and females is important to understand the deprivation in different regions of the country.

The main purpose of this study is to see the factors that differs adult height, weight and BMI along with gender differences in different states of India.

MATERIALS AND METHODS

The present data were taken from National Family Health Survey-3 (NFHS-3) during the year 2005-06. It was a nationwide cross section survey which gathered information on population's socio-economic, demographic, anthropometric and other characteristics along with other relevant information. In this study, only non-pregnant women were considered. Height is measured in centimetre, weight is measured in kilogram and BMI is measured in weight (kg)/height^2 (m^2). The covariates that have been taken here are place of residence i.e., whether rural or urban, age group of male and female from 15 to 49, ethnicity like Muslim, Christian, Hindu SC, ST, other Hindu category and 'others including other religion'. To measure economic status, the data use Wealth Index, which is based on the 33 assets and housing characteristics like household electrification, type of windows, source of drinking water, type of toilet facility, type of flooring, material of exterior wall, type of roofing, cooking fuel, house ownership, number of household members per sleeping room, ownership of a bank or post office account, and ownership of mattress, pressure cooker, chair, cot/bed/, table, electric fan, radio/transistor, black and white television, colour television, sewing machine, mobile phone, any other phone, computer, refrigerator, watch or clock, bicycle, motorcycle, or scooter, animal drawn cart, car, water pump, thresher and tractor. Each household asset has been given a weight, generated through principal component analysis and the resulting asset scores are standardized in relation to a normal distribution with a mean of zero and standard deviation of one (Gwatkin et al, 2000). Each household is then assigned a score for each asset, and the scores were summed for each household; individuals are ranked according to the score of the household in which they reside. The sample is then divided into quintiles i.e. five groups with an equal number of individuals in each. To establish strong relationship between dependent and independent variables, ANOVA test and multivariate linear regression analysis is performed. For regression analysis, height, weight and BMI

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separately has been considered as dependent variable and socio-economic variables are taken as independent variables. The statistical package for the social sciences (SPSS) has been used for all the analysis. Level of significance of $p < .01$ and $.05$ were considered.

RESULTS

Table 1 shows the mean height, weight and BMI among the adult males in different states of India. It is found that mean height is the highest in Punjab (168.33) followed by Haryana (167.98) and the lowest mean is found in Meghalaya (157.30) and Sikkim (159.83). This mean height of Meghalaya is far below the national average (164.48). For weight distribution Punjab also is in leading position (62.56) followed by Kerala (60.09) and lowest mean is seen in Tripura (51.32). The reset lowest mean weight is found in Meghalaya (52.33) followed by Jharkhand (52.68), Chattisgarh (52.89). The states with lower mean weight than the national mean weight are Uttaranchal, Rajasthan, Arunachal Pradesh, Nagaland, Assam and all the states of east and central zone. It is also found that very few states show higher than national average. This reflects the skewness in distribution. In case of BMI also the mean is highest in Punjab and Delhi. For BMI, majority of states show higher mean than India. The states with mean BMI lower than the all India mean BMI are Rajasthan, Tripura, Assam, Jharkhand, and Chattisgarh. Considering zonal variation, it is found that for height and weight North zones are in the leading position and the bottom positions are captured by north east and east zones. So far as the top position is concerned the picture is slightly different for BMI since south zone with mean BMI (21.09) has the highest value (21.09) and lowest is in Central (20.18).

Table 2 shows the similar mean height, weight and BMI among the adult females in the states of India. It is not necessary to mention that female mean height is far lower than male mean height. It is observed from the table that overall north zone states have higher mean height and the opposite is the case with north east zone states. The state with highest mean height is found to be Haryana (154.89) followed by Punjab (154.71) and the lowest mean is found in Meghalaya (148.94) followed by Tripura (149.71). Mean female weight is the highest in Punjab (54.84) followed by Delhi (53.35) and the lowest in Jharkhand (44.44) and Bihar (44.83). The result shows a similar pattern of height and

weight in the states both for males and females. In all the states of east zone, BMI is lower than national average.

Caste and community wise distribution of mean height is shown in Tables 3 and 4. It is found that mean height is the highest in the 'other religion groups' than Muslim, Christian and Hindu groups. It is the highest in the north zone (170.0) and the lowest in the north east and east zone (161.5) in case of males. In case of female, similar trend, though to some in lower extent, is seen. The highest and the lowest cases are North zone (155.8) for other religion group and 149.9 for east zone. The table also shows that mean height is consistently poor in all the zones in case of Hindu ST Groups for both males and females. Male heights among the Tribal is low in all the zones. The mean height is very low in North East and Eastern regions. The better picture in heights is seen in North and South region which is also seen from the previous Table. The height trends of General Hindu are almost same in the zones but it is different in 'other religion group' and shows a variation over the zones. In North zone, mean height is the maximum and the lowest in North East zone, though mean height of SCs is seen to be better here in comparison to other zones. In Table 4 it is found that ST females are poor in height in all the zones except for North zone. Muslim heights are higher in North zone.

Tables 5 and 6 show the mean weight of different castes and communities in the zone of India. It is found from the table that mean weight is high among the Christians and 'Other religion groups' in North zone and it is the lowest in the north zone in case of males. Muslims in the South zone show a high mean weight indicating a better nutritional status. South zone also shows higher mean weight among Hindu other group for males. The worst mean weight is seen among the Hindu ST groups for both males and females. Mean weight is also poor among the Muslims in North east and east zone.

Mean BMI is shown in Tables 7 and 8. BMI is very low among ST groups in comparison to other ethnic categories, though among ST groups, males are in better condition than females except for North and North East region. The mean BMI among SC category is higher among the females in the zones except for central and western regions.

Table 9 shows the results of the linear regression of height, weight and BMI on social, economic and demographic characteristics of the adult male and females of 15-49 age

groups. Regression analysis confirms the residence, zone, education, and wealth index have significant role in determining the heights for both males and females. It is found that caste and religion are significant only for females. Age has no significant effect on female height but it is significant for males. The table also confirms that like height all the independent variables have significant effect on weight both for males and females. In case of BMI, all the variables have significant influences with the only exception of males in which zone fail to have any significant effect on BMI.

DISCUSSION

The results show a variety of height weight differences in the states of India. In North Indian states, the average male height is higher, except for Uttaranchal, than other parts of India, which was also observed by Guntupalli and Baten (2006). This may be due to stress in mobilization. Rapid population growth has accelerated pollution, and Himalayan streams are now more polluted. For North Indian states where high values of height, weight and BMI are seen are the states of Punjab and Haryana. These two states are very important for agricultural fields and mostly fertile since very beginning. Therefore, food supply may not be barrier for growth purpose which other states may be facing. It is unclear why Rajasthan females are better in mean BMI than male, as the state is known for oppressive measures on female. The higher average height or weight or BMI of females may be attributed to cheap but nutritionally complete diet pattern.

It is seen from the result that in Central and Eastern regions, the mean height and weight are low for both males and females which may be due to high Tribal concentration. This is further supported by lower mean of Tribal groups (Table 3-8). Lean and thin body with a low weight to surface area ratio is one of the general characteristics of the people living in tropical and subtropical climates (Schreider, 1968). This may be one of the reasons in the populations inhabiting in Eastern region like Orissa, Bihar and Jharkhand states, which is also mentioned in the work of Adak et al (2006). Accordingly, a positive association between caste hierarchies was studied in some regional populations (Mahalanobis 1927, Olivier 1963), where it has been observed that general caste populations are, on an average, taller compared to Scheduled Castes and Scheduled Tribes.

Buchi (1968) had observed geographical gradients of stature from northwest to east and south position. This may be explained through climatic variations, food habits etc. which have not been considered in this paper.

It is well known that North East region was neglected for a long time. Recently a special drive has been taken by the Government to improve the overall situation of the states in North East region. The special drive may have led to short- term nutritional gain of that region which is reflected in BMI level.

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Table: 1 State-wise mean height, weight and BMI of males among different states of India

Region	N	Mean Height		ANOVA	Mean weight		ANOVA	Mean BMI		ANOVA
		Mean	SD		Mean	SD		Mean	SD	
J & Kashmir	953	166.75	7.60	120.13* (df 28)	56.57	9.80	69.86* (df 28)	20.37	3.99	52.41* (df 28)
Himachal Pradesh	941	165.50	6.87		56.80	10.21		20.71	3.44	
Punjab	1206	168.33	7.01		62.56	13.99		21.98	4.30	
Uttaranchal	863	164.65	6.54		55.57	9.64		20.46	3.14	
Haryana	1010	167.98	6.60		57.87	10.91		20.47	3.47	
Delhi	921	165.08	6.84		59.35	11.28		21.82	4.42	
Rajasthan	1364	166.71	6.78		55.19	10.13		19.81	3.14	
North Zone	**7258**	**166.55**	**7.02**		**57.75**	**11.31**		**20.79**	**3.81**	
Sikkim	745	159.83	7.40		56.01	8.53		21.93	3.03	
Arunachal Pradesh	659	161.36	6.38		54.63	8.22		21.06	3.96	
Nagaland	3616	162.63	6.31		55.64	8.23		21.00	2.65	
Manipur	3458	163.21	5.97		56.35	9.15		21.14	3.25	
Mizoram	628	162.02	6.21		56.49	8.37		21.48	2.68	
Tripura	637	161.50	6.01		51.32	8.72		19.63	2.89	
Meghalaya	595	157.30	7.09		52.33	7.28		21.13	2.54	
Assam	1172	163.09	6.91		53.16	9.42		19.92	2.91	
N.E. Zone	**1151**	**162.22**	**6.53**		**55.20**	**8.78**		**20.96**	**3.04**	
Bihar	1096	163.63	6.79		53.81	10.11		20.02	3.10	
West Bengal	2352	163.50	6.56		55.07	10.24		20.54	3.29	
Jharkhand	879	162.83	6.62		52.68	9.36		19.80	2.93	
Orissa	1388	163.00	6.40		53.45	10.21		20.04	3.19	
East Zone	**5715**	**163.30**	**6.58**		**54.07**	**10.11**		**20.21**	**3.19**	
Uttar Pradesh	1005	164.42	6.76		54.96	11.09		20.28	3.77	
Chhattisgarh	1286	163.43	6.48		52.89	9.60		19.73	2.97	
Madhya Pradesh	2549	165.32	6.76		54.81	9.61		20.01	3.07	
Central Zone	**1388**	**164.49**	**6.75**		**54.74**	**10.71**		**20.18**	**3.59**	
Goa	996	164.55	6.92		57.48	11.69		21.15	3.70	
Gujarat	1300	165.36	6.93		55.60	11.56		20.35	4.39	
Maharashtra	7451	165.18	6.99		56.33	11.68		20.59	3.89	
West Zone	**9747**	**165.14**	**6.98**		**56.35**	**11.67**		**20.62**	**3.95**	
Andhra Pradesh	6195	165.38	6.82		58.61	12.55		21.36	4.16	
Karnataka	4579	164.95	7.08		55.60	11.17		20.46	4.44	
Kerala	980	166.65	6.89		60.09	11.52		21.59	3.69	
Tamil Nadu	5112	164.70	6.76		57.59	11.71		21.21	4.13	
South Zone	**1686**	**165.13**	**6.89**		**57.57**	**11.95**		**21.09**	**4.23**	
India	**6498**	**164.48**	**6.92**		**56.07**	**10.99**		**20.69**	**3.74**	

*Significant at 1% level

Table: 2 State-wise mean height, weight and BMI of females among different states of India

Region	N	Mean height		ANOVA	Mean weight		ANOVA	Mean BMI		ANOVA
		Mean	SD		Mean	SD		Mean	SD	
J & Kashmir	3087	154.58	5.93	217.54*	51.44	10.07	236.68*	21.50	3.94	150.74*
Himachal Pradesh	3124	153.84	5.59	(df28)	50.13	10.00	(df28)	21.17	4.02	(df28)
Punjab	3597	154.71	5.86		54.84	12.31		22.90	4.92	
Uttaranchal	2887	152.76	5.57		48.82	9.57		20.89	3.76	
Haryana	2748	154.89	5.78		50.37	10.57		20.98	4.16	
Delhi	2568	153.41	6.51		53.35	11.58		22.64	4.56	
Rajasthan	3860	154.52	5.96		48.16	8.97		20.18	3.74	
North Zone	**21871**	**154.15**	**5.92**		**50.98**	**10.72**		**21.44**	**4.27**	
Sikkim	2093	151.09	5.71		50.81	8.29		22.25	3.41	
Arunachal Pradesh	1635	150.70	5.54		48.20	7.78		21.17	2.91	
Nagaland	3807	152.68	5.49		49.14	7.65		21.05	2.91	
Manipur	4358	152.00	5.15		50.10	8.29		21.65	3.24	
Mizoram	1783	151.67	5.18		48.96	7.78		21.24	2.89	
Tripura	1884	149.71	5.71		45.18	8.90		20.16	4.21	
Meghalaya	1956	148.94	5.99		46.73	6.72		21.19	4.07	
Assam	3647	150.60	5.64		45.89	8.56		20.24	3.85	
N.E. Zone	**21161**	**151.18**	**5.63**		**48.28**	**8.28**		**21.11**	**3.50**	
Bihar	3726	150.47	5.58		44.83	8.23		19.79	3.52	
West Bengal	6634	151.05	5.54		48.11	10.52		21.03	4.16	
Jharkhand	2840	150.03	5.61		44.44	8.03		19.84	4.40	
Orissa	4387	151.00	5.47		45.54	8.85		19.97	4.00	
East Zone	**17587**	**150.75**	**5.56**		**46.18**	**9.40**		**20.31**	**4.07**	
Uttar Pradesh	11165	151.15	5.74		47.46	9.97		20.75	4.08	
Chhattisgarh	3776	151.51	5.74		45.33	8.42		19.78	3.99	
Madhya Pradesh	6397	152.83	5.70		47.56	9.65		20.35	3.95	
Central Zone	**21336**	**151.72**	**5.78**		**47.11**	**9.65**		**20.46**	**4.04**	
Goa	3325	152.49	6.27		49.92	11.53		21.50	5.06	
Gujarat	3687	152.65	5.72		48.61	11.10		20.90	5.00	
Maharashtra	8197	152.04	5.98		48.62	10.71		21.05	4.67	
West Zone	**15208**	**152.29**	**5.99**		**48.90**	**11.00**		**21.11**	**4.84**	
Andhra Pradesh	6755	152.26	5.95		50.63	11.91		21.85	5.10	
Karnataka	5562	152.60	6.04		48.24	10.64		20.76	4.82	
Kerala	3531	153.08	6.23		53.02	10.90		22.64	4.66	
Tamil Nadu	5780	152.50	6.14		51.26	11.87		22.06	5.23	
South Zone	**21618**	**152.54**	**6.08**		**50.58**	**11.53**		**21.75**	**5.03**	
India	**118781**	**152.15**	**5.94**		**48.75**	**10.29**		**21.05**	**4.34**	

*Significant at 1% level

Table: 3 Caste/community wise mean height distribution of males in different zones of India

Zone	Muslim			Christian			Hindu SC			Hindu ST			Hindu other			Other religion			Total
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD.	N	Mean	SD	N	Mean	SD	(N)
North	1045	166.5	7.4	25	166.1	4.9	5162	166.0	6.7	168	165.8	7.7	37	164.3	6.2	819	170.0	6.8	7256
North East	1098	162.1	6.3	4673	161.9	6.4	4159	162.8	6.5	306	161.9	6.5	258	163.3	6.7	1015	161.5	6.7	11509
East	854	163.3	6.5	62	162.7	6.8	4120	163.6	6.5	467	161.4	6.1	124	162.5	6.8	83	161.7	6.5	5710
Central	2128	164.7	6.4	45	164.3	6.8	10800	164.5	6.8	698	162.6	6.2	1	162.6	.	215	167.4	6.7	13887
West	979	165.5	7.0	334	166.1	7.9	7090	165.3	6.9	465	162.7	6.4	88	165.2	6.7	791	164.3	6.6	9747
South	2064	166.3	7.0	852	165.7	6.7	13437	164.9	6.8	401	163.5	6.8	27	163.7	5.8	81	167.2	7.0	16862
India	8168	164.9	6.9	5991	162.7	6.7	44768	164.7	6.8	2505	162.6	6.6	535	163.5	6.7	3004	165.1	7.5	64971

Here N = 64971 instead of 64984 because 13 respondent's religion or caste is unknown.

Table: 4 Caste/community wise mean height distribution of females in different zones of India

Zone	Muslim			Christian			Hindu SC			Hindu ST			Hindu other			Other religion			Total
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD.	N	Mean	SD	N	Mean	SD	(N)
North	3212	154.6	6.0	96	153.3	6.0	15421	153.7	5.8	496	153.2	5.8	25	151.8	3.5	2619	155.8	5.8	21869
North East	1808	150.3	5.3	7927	151.5	5.5	7983	151.0	5.7	872	151.2	5.6	561	150.1	5.6	2005	150.9	5.5	21156
East	2891	150.8	5.3	219	151.2	5.8	12380	150.8	5.6	1315	150.0	5.4	423	150.7	5.5	358	149.9	5.3	17586
Cent.	2883	152.3	5.7	78	153.6	5.2	16027	151.5	5.7	1928	151.5	5.5	1	145.8	.	418	154.2	5.9	21335
West	1624	153.0	5.8	926	154.0	6.3	10665	152.2	5.9	690	151.1	5.8	312	152.0	6.1	990	150.7	6.2	15207
South	3173	153.0	6.0	1391	153.0	6.4	16531	152.4	6.0	411	151.5	6.1	37	153.7	5.3	73	152.8	7.2	21616
India	15591	152.5	5.9	10637	152.0	5.8	79007	152.1	5.9	5712	151.2	5.6	1359	150.9	5.7	6463	153.0	6.2	118769

Here N = 118769 instead of 118781 because 12 respondent's religion or caste is unknown.

Table: 5 Caste/community wise mean weight distribution of males in different zones of India

Zone	Muslim			Christian			Hindu SC			Hindu ST			Hindu other			Other religion			Total
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD.	N	Mean	SD	N	Mean	SD	(N)
North	1045	56.69	9.43	25	64.28	9.55	5162	57.04	10.73	168	50.47	7.62	37	55.77	9.54	819	64.96	14.36	7256
North East	1098	53.28	8.58	4673	55.18	7.94	4159	55.52	9.67	306	54.98	8.51	258	54.82	9.44	1015	56.25	8.42	11509
East	854	53.59	9.81	62	53.81	9.04	4120	54.65	10.37	467	49.96	6.68	124	55.14	11.32	83	51.92	9.17	5710
Central	2128	55.24	10.69	45	55.24	11.32	10800	54.74	10.73	698	50.50	7.10	1	40.60	-	215	63.28	13.43	13887
West	979	56.89	11.69	334	61.02	13.61	7090	56.61	11.62	465	50.67	8.42	88	57.41	12.67	791	54.59	11.43	9747
South	2064	59.25	12.73	852	60.53	12.55	13437	57.24	11.77	401	53.37	9.97	27	59.04	11.32	81	57.76	12.08	16862
India	8168	56.20	11.09	5991	56.29	9.44	44768	56.12	11.13	2505	51.43	8.19	535	55.57	10.62	3004	58.61	12.39	64971

Here N = 64971 instead of 64984 because 13 respondent's religion or caste is unknown.

Table: 6 Caste/community wise mean weight distribution of females in different zones of India

Zone	Muslim			Christian			Hindu SC			Hindu ST			Hindu other			Other religion			Total
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD.	N	Mean	SD	N	Mean	SD	(N)
North	3212	51.29	9.29	96	53.17	10.57	15421	50.24	10.37	496	44.48	7.57	25	49.66	8.33	2619	56.11	12.43	21869
North East	1808	45.46	8.27	7927	48.55	7.32	7983	48.36	9.06	872	47.88	7.67	561	47.31	9.20	2005	49.85	8.04	21156
East	2891	45.62	8.91	219	46.38	8.57	12380	46.67	9.64	1315	42.14	6.31	423	48.82	10.35	358	45.50	9.49	17586
Cent.	2883	48.29	10.07	78	49.26	10.03	16027	47.17	9.66	1928	43.34	6.34	1	49.30	-	418	53.82	12.21	21335
West	1624	50.44	11.49	926	53.64	12.92	10665	48.75	10.74	690	43.38	8.05	312	49.22	11.21	990	47.37	10.52	15207
South	3173	53.75	12.54	1391	53.37	12.21	16531	49.86	11.15	411	45.31	9.04	37	53.85	14.35	73	48.12	12.41	21616
India	15591	49.41	10.78	10637	46.62	9.03	79007	48.59	10.31	5712	44.00	7.33	1359	48.44	10.26	6463	52.00	11.41	118769

Here N = 118769 instead of 118781 because 12 respondent's religion or caste is unknown

Table 7 Caste/community wise mean BMI distribution of males in different zones of India

Zone	Muslim			Christian			Hindu SC			Hindu ST			Hindu other			Other religion			Total
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD.	N	Mean	SD	N	Mean	SD	(N)
North	1045	20.48	3.93	25	23.31	3.49	5162	20.66	3.63	168	18.34	2.40	37	20.61	2.85	819	22.40	4.45	7256
North East	1098	20.25	2.87	4673	21.02	2.48	4159	20.96	3.64	306	20.94	2.81	258	20.51	3.02	1015	21.52	2.73	11509
East	854	20.01	3.06	62	20.26	2.75	4120	20.36	3.29	467	19.15	2.06	124	20.79	3.65	83	19.82	3.06	5710
Central	2128	20.30	3.47	45	20.40	3.53	10800	20.18	3.57	698	19.06	2.19	1	15.36	-	215	22.92	6.74	13887
West	979	20.74	3.83	334	22.19	5.98	7090	20.67	3.89	465	19.11	2.70	88	20.98	4.14	791	20.17	3.77	9747
South	2064	21.44	4.79	852	21.99	4.14	13437	21.01	4.15	401	19.93	3.35	27	21.93	3.39	81	20.60	3.85	16862
India	8168	20.63	3.88	5991	21.22	3.10	44768	20.65	3.81	2505	19.41	2.66	535	20.72	3.39	3004	21.43	4.06	64971

Here N = 64971 instead of 64984 because 13 respondent's religion or caste is unknown.

Table 8 Caste/community wise mean BMI distribution of females in different zones of India

Zone	Muslim			Christian			Hindu SC			Hindu ST			Hindu other			Other religion			Total
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD.	N	Mean	SD	N	Mean	SD	(N)
North	3212	21.43	3.89	96	22.60	4.26	15421	21.22	4.13	496	19.11	4.71	25	21.49	3.31	2619	23.11	4.98	21869
North East	1808	20.06	3.29	7927	21.12	3.01	7983	21.18	3.94	872	21.01	3.99	561	20.93	3.63	2005	21.85	3.11	21156
East	2891	20.09	4.15	219	20.21	3.21	12380	20.49	4.05	1315	18.72	3.14	423	21.40	4.10	358	20.41	5.65	17586
Central	2883	20.82	4.33	78	20.83	4.03	16027	20.52	4.05	1928	18.86	2.48	1	23.19	-	418	22.60	4.87	21335
West	1624	21.58	5.06	926	22.64	5.62	10665	21.05	4.71	690	19.07	4.34	312	21.21	4.36	990	20.89	4.93	15207
South	3173	22.94	5.27	1391	22.84	5.78	16531	21.49	4.89	411	19.71	3.65	37	22.64	5.35	73	20.47	4.52	21616
India	15591	21.23	4.52	10637	21.47	3.86	79007	20.99	4.36	5712	19.27	3.54	1359	21.20	4.01	6463	22.17	4.60	118769

Here N = 118769 instead of 118781 because 12 respondent's religion or caste is unknown.

Table: 9 Results of Linear Regression of height, weight and BMI on independent variables

Independent Variables	Regression Coefficients	t – value	Regression Coefficients	t – value	Regression Coefficients	t – value	Regression Coefficients	t – value	Regression Coefficients	t – value	Regression Coefficients	t – value
	MALE HEIGHT		FEMALE HEIGHT		MALE WEIGHT		FEMALE WEIGHT		MALE BMI		FEMALE BMI	
Intercept	157.409*	812.877	148.493*	1220.801	38.365*	200.140	35.599*	277.161	16.146*	165.133	17.214*	209.355
Residence	0.602*	9.537	0.749*	18.626	0.285*	3.142	0.806*	12.839	0.238*	7.469	0.564*	20.749
Zone	0.213*	13.748	-0.106*	-10.888	0.161*	7.235	-0.066*	-4.315	0.007	0.903	0.014**	2.130
Education	0.780*	22.412	0.452*	21.522	1.706*	33.768	1.075*	32.638	0.411*	23.177	0.313*	22.079
Wealth index	1.076*	39.693	0.780*	45.157	2.646*	67.725	2.284*	84.519	0.712*	51.918	0.755*	64.616
Age-group	.037**	2.708	-0.005	-0.552	1.552*	78.755	1.402*	88.547	0.561*	81.078	0.633*	100.160
Caste & Religion	0.026	1.111	-0.126*	-8.660	-0.240*	-7.129	-0.468*	-20.699	-0.098*	-8.273	-0.167*	-17.061
R^2	0.064		.045		0.230		0.224		0.182		0.181	
F value	744.233*		932.165*		3240.043*		4909.140*		2406.106*		4377.868*	

*Significant at 1% level, **significant at 5% level