

**Title: Overweight, Obesity and Socio-economic Change among
Tangkhul Naga Tribal Women of Manipur, North East India**

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Abstract

Background: The prevalence of overweight and obesity is increasing worldwide at an alarming rate. Although in countries like India, which is multi-ethnic having multi socio-economic levels, is typically known for high prevalence of under nutrition, significant proportions of overweight and obese now coexist with the undernourished.

Objectives: The study aims to find the prevalence of overweight and obesity, and its association with socio-economic change among Tangkhul Naga women of Manipur, North East India and also to compare with other female populations of India.

Methods: A cross-sectional study was carried out among 346 Tangkhul Naga tribal women of Manipur, age ranging from 20 to 70 years, divided into five different age groups with ten years interval each.

Results and conclusions: Mean BMI was found to be lowest among the youngest age group and it increased with age till fifty nine years and then declined. BMI was assessed using recommended cut-off points for Asians and the prevalence of overweight and obesity among the Tangkhul Naga women was found to be 27.1%. When BMI was assessed using the WHO International Classification of adult overweight and obesity, the prevalence percentage was 9.8. Though the prevalence of obesity among Tangkhul females (2.0%) was low when compared to Indian non-tribal female populations the prevalence of overweight (25.1%) was not far behind. Tangkhul Naga is a population

where majority of them were believed to be thin traditionally owing to difficult hilly terrain habitation and physically active lifestyle. With urbanization and economic development, a nutritional transition characterized by improved dietary habits, improvement in socio-economic status and increasingly sedentary lifestyle has been observed which has contributed to the increasing prevalence of overweight and obesity among the Tangkhul Naga tribal women.

Keywords: Tangkhul Naga; females; overweight/obesity; socio-economic change

Introduction

Obesity is one of the biggest health problems today, which affect a person not only physically but psychologically as well. Although a topic of some medical concern for centuries, obesity has gradually progressed from being an amusing curiosity to a major public health issue as well as a theme for sophisticated physiologic and behavioral research.

Once considered a problem related to affluence, obesity is now fast growing in many developing countries and in poor neighborhoods of the developed countries.^{1, 2} Even in countries like India, which are typically known for high prevalence of under nutrition, significant proportions of overweight and obese now coexist with the undernourished.³ Obesity is a complex, multifactorial disease that develops from the interaction between genotype and the environment. Our understanding of how and why obesity occurs is incomplete; however, it involves the integration of social, behavioral, cultural, physiological, metabolic, and genetic factors.⁴ Obesity is the excessive accumulation of adipose tissue to an extent that health is impaired. Obesity is a condition in which the fat stores are excessive for an individual's height, weight, gender and race, and produces adverse health outcomes. Excessive adiposity results from an imbalance in energy i.e., energy intake either has been or is greater than energy expenditure.⁵

The prevalence of overweight and obesity is increasing worldwide at an alarming rate. Both developed and developing countries are affected. In developing countries, obesity is more common in middle-aged women, people of higher socio-economic status and those living in urban communities. In more affluent and developed countries, obesity is common not only in the middle-aged, but is also becoming increasingly prevalent

among younger adults and children. Furthermore, it tends to be associated with lower socio-economic status, especially in women, and the urban–rural differences are diminished or even reversed. Obesity has very high costs for societies, as the resulting disabilities and diseases create huge burdens for families and health systems. The experience of developed countries clearly demonstrated that the cost of morbidity and mortality associated with increasing obesity and related noncommunicable diseases would be overwhelming for them.² Rapidly changing diets and lifestyles are fueling the global obesity epidemic.¹

Previous research on obesity in India has found the prevalence of obesity to be higher among women⁶⁻¹⁰ and among economically better off persons.¹¹⁻¹³ National Family Health Survey-2 & 3, India,^{14,15} shows that the prevalence of both overweight and obesity increases in each age group from 15 years of age to 49 years. According to National Family Health Survey-3, the prevalence of overweight (BMI \geq 25 kg/m²) and obesity (BMI \geq 30 kg/m²) among Indian females as estimated from 15 years to 49 years of age were 12.6% and 2.8% respectively. In the Indian Women’s Health Study¹⁶ the overall prevalence of central obesity among women between 25-64 yr ages was 55 percent. BMI, sedentary lifestyle, family history of excess fat intake were found to be significant risk factors for central obesity.

The importance of body fatness and its distribution lies in the epidemiological studies and as a clinical marker of health risk among populations. Fat distribution pattern has been extensively studied for decades,^{17-20, 10} on ethnic variation in fat distribution²¹⁻²³ and on level of physical activity and fat distribution pattern.²⁴⁻²⁷ It has become apparent that the fat distribution pattern is population, sex and age specific along with increase in

obesity level. The pattern of fat distribution must be evaluated to assess the risk associated with weight gain, as the risk is higher if the fat distribution is already central.²⁸⁻³⁰ The fat mass of body increases with age and also re-distribution of fat in body takes place in later age resulting in centripetal adiposity.^{31, 32}

According to WHO (2002)³³ obesity has reached epidemic proportions globally, with more than 1 billion adults as overweight - at least 300 million of them clinically obese - and is a major contributor to the global burden of chronic disease and disability. Often coexisting in developing countries with under-nutrition, obesity is a complex condition, with serious social and psychological dimensions, affecting virtually all ages and socio-economic groups. Increased consumption of more energy-dense, nutrient-poor foods with high levels of sugar and saturated fats, combined with reduced physical activity, have led to high obesity rates.

The proportion of the population that is obese increases steadily with each decade of life until about the age of 60 years in Western countries. Thus, people can gain body mass and become obese at almost any age. However, it is also evident that a substantial proportion of obese adults were already overweight early in life. Early-onset obesity, together with parental obesity, is responsible for a disproportionate fraction of cases of obesity in adulthood, and this fraction appears to increase with the severity of obesity.³⁴

Obesity is usually determined using body mass index (BMI), calculated as the weight in kilograms divided by the square of the height in meters (kg/m^2). A BMI over 25 kg/m^2 is defined as overweight, and a BMI of over 30 kg/m^2 as obese. These markers provide common benchmarks for assessment, but the risks of disease in all populations can increase progressively from lower BMI levels.⁵

In Asian subjects, the risk associated with diabetes and cardiovascular diseases occurs at lower levels of BMI when compared with the white population.^{35,36} This is attributed to body fat distribution; Asian Indians tend to have more visceral adipose tissue, causing higher insulin resistance, despite having lean BMI.^{36,37} The WHO also advocated a lower limit of normal BMI in Asian Indians. A WHO expert consultation (2004)³⁸ addressed the debate about interpretation of recommended body-mass index (BMI) cut-off points for determining overweight and obesity in Asian populations, and considered whether population-specific cut-off points for BMI are necessary. They reviewed scientific evidence that suggests that Asian populations have different associations between BMI, percentage of body fat, and health risks than do European populations. The consultation concluded that the proportion of Asian people with a high risk of type 2 diabetes and cardiovascular disease is substantial at BMIs lower than the existing WHO cut-off point for overweight (≥ 25 kg/m²).

For many Asian populations, additional trigger points for public health action were identified as 23 kg/m² or higher, representing increased risk, and 27.5 kg/m² or higher as representing high risk. The suggested categories are as follows: less than 18.5 kg/m² underweight; 18.5–23 kg/m² increasing but acceptable risk; 23–27.5 kg/m² increased risk; and 27.5 kg/m² or higher high risk. The consultation identified further potential public health action points (23.0, 27.5, 32.5, and 37.5 kg/m²) along the continuum of BMI, and proposed methods by which countries could make decisions about the definitions of increased risk for their population.³⁸

The Tangkhul Naga Tribe has undergone a lot of changes in the past one century in every sphere of their lives, in terms of occupation, religion, traditional practices and

overall lifestyle. The socio-economic development has created changes in dietary intake, food consumption patterns and physical activity levels. This transition has brought about changes in their body composition, physiological functions and also health among others. It has also contributed to the problem of increasing overweight and obesity in Tangkhul population, especially among women. In the present study an attempt has been made to find the prevalence of overweight and obesity, and its association with socio-economic change among Tangkhul Naga women of Manipur, North East India and also to compare with other non-tribal female populations of India.

Subjects and Methods

A cross-sectional study was carried out among 346 Tangkhul Naga women of Manipur age ranging from 20 to 70 years during the period November 2005 to March 2006, to study the prevalence of overweight and obesity. The subjects were divided into five different age groups viz., 20-29 yr, 30-39 yr, 40-49 yr, 50-59 yr, 60-70 years of age with ten years interval each.

For the assessment of overweight and obesity, height and weight measurements were taken on each subject using standard protocols given by Weiner and Lourie (1981).³⁹ The data collected were analyzed using SPSS 10.0 (Statistical Package for Social Sciences) which is among the most widely used programs for statistical analysis in social science. The parameters taken were analyzed statistically to find out the mean, standard deviation and standard error of mean for the anthropometrics measurements. In order to test the level of significance of the differences between the groups, t-test was applied. The value of BMI was calculated for each subject and summarized age group

wise. In order to assess overweight and obesity both WHO International standard and recommended cut-off points for Asians were used.

Subjects

Tangkhul Naga is one of the sub-tribe of Naga tribe. Tribes are social groups occupying specific geographic territories and having their own socio-cultural, economic and political milieus, independent of or having little contact with the dominant national society of the country. Usually they live in isolated pockets on the periphery of the dominant national society.⁴⁰ The Nagas inhabit in North East region of India and also in the Western parts of Myanmar. In India they are found in Nagaland, Manipur, Assam and Arunachal Pradesh which are largely hilly areas. North East India in the context of India occupies a distinctive place due to its geographical, historical, social, cultural, and political features. The north eastern region is surrounded by foreign territories like Bhutan, Tibet-China, Burma, and Bangladesh on the north-south and the east except for a long narrow passage in the west which connects the region with West Bengal and the rest of India. North East India is the homeland of a large number of ethnic groups who came from different directions at different historical times. This region has been inhabited by both tribal and non-tribal groups. These groups belong to different racial stocks, speak different languages and have varied socio-cultural traditions. This region has been occupied mostly by different streams of the Mongoloid people who came from the north and the east at different periods. The Nagas belong to the Mongoloid stock and linguistically, they belong to a language family called Sino-Tibetan, within that family to the sub-family Tibeto-Burman.

Tangkhul Nagas constitute the major bulk of the population of Ukhrul district of Manipur, the Northeastern most part of India, which is a mountainous region and isolated from the neighboring States by a chain of hill ranges. Manipur is one of the most beautiful spots with its charming physical feature, tradition, art and history. The area of Manipur is 22,327 sq.km with total Population of 2,388,634 (2001 census). It is located between Latitude 23.830N to 25.680N and Longitude 93.030E to 94.780E. There are nine districts in Manipur and it is geographically divided into the hills and the centrally situated valley.

Manipur is inhabited by different ethnic groups which include Meiteis, Meitei Pangals, 33 scheduled tribes and 7 scheduled castes. Scheduled tribe constitutes 34% of the state total population. These are the people whose folklore, myths and legends, dances, indigenous games and martial arts, exotic handlooms and handicrafts are infested with the mystique of nature. Tangkhul Naga population is squarely concentrated in the Ukhrul district though sizable populations are also found in Senapati district and Imphal valley which also have their origin from Ukhrul District. Tangkhul Naga, the tribe on which the present study was taken up is one among the major tribes of Manipur.

Scheduled Tribes are spread across the country mainly in forest and hilly regions. The tribal population of India, as per the 2001 census, is 8.43 crores, constituting 8.2% of the total population. The population of tribes had grown at the rate of 24.45% during the period 1991-2001. In Manipur, Tangkhuls are the second largest tribe according to the census 2001. The population of the ukhrul district is 140,946 which constitute 73,413 males and 67,533 females with a population density of 31 per sq. km. The male to female ratio is 1000: 920 with a decennial growth rate of 28 %. The total population of the

district constitutes 5.9 % of the total population of the state, spread over about 230 villages and literacy rate is 69 % (Census of India, 2001).⁴¹

The Tangkhuls as also other Naga tribes came to Manipur, Nagaland, Assam and Arunachal Pradesh through Myanmar. Some of them also settled down in Myanmar and did not venture further. However, their movement over Myanmar and into India was spread over a period of time. They entered the present habitat in waves following one another and in some cases in close succession. It is an accepted fact that the Tangkhuls come from Mongoloid Stock and is strongly believed that they came from the Far East land like Mongolia and China because of their similarities in features, stature and complexions and also from other sources like folk songs, folk tales, words used while worshiping and legendary stories brought down from generation to generation. History of people lives through the ages in their Folk Lore and Songs. The traditions and folk tales expressed in the form of poetries unlock the mysteries and glories of the Tangkhuls.

Kinship plays a very important role among the Tangkhul Nagas. They are patrilineal by descent and patrilocal by residence. Descent is traced through the father's line. They have very close ties among kin groups. Nuclear family is the most common type of family found, though there are a few joint and extended family. The Tangkhuls practice mostly tribe endogamy and clan exogamy. Mother's brother's daughter cross cousin marriages system is found among the Thangkhuls and is a favored form of marriage by tradition but is practiced by few now.

The traditional religion of Tangkhul known as 'Hao Religion', is a monotheistic religion and they worshiped with reverential awe the 'Kazing Ngalei Kasa Akhava' - the God, creator of Heaven and Earth. To this God, they have different titles of addressed

corresponding to the theme and object/place of worship. Now, the Tangkhuls had left their traditional religion to embraced Christianity. Ukhrul district, the home of the Tangkhuls is the birthplace of Christianity and Western education in Manipur state, brought as early as 1896 by a Baptist Missionary called Rev. Pettigrew. The main Christian sects are Baptist Church, Catholic Church, Seventh Day Adventist Church and Church of Christ. The advent of Christianity among the Tangkhul Nagas played a major role in the transformation of their belief system, traditional practices, worldview and education (the literacy rate now being 69%), which is the key to development and socio-economic changes among them.

Traditionally the main occupation of the Tangkhuls was farming and the sources of income of the people were agriculture in which both terrace and wetland farming are practiced along with small scale industries, animal husbandry, forest wealth and river wealth. Now with the advent of modern civilization, they are exposed to capitalistic trend of market competitions and urbanization and as a result many of them have now shifted their occupation and have taken up business and jobs in both public and private sectors, though some of them are still engaged in farming. With urbanization and economic development, a nutritional transition characterized by improved dietary habits and improvement in socio-economic status and life style has been observed among the Tangkhul Nagas.

Results

Table 1 displays the basic data of Tangkhul Naga women of Manipur in five different age groups. The mean value for height was found to be highest in 20-29 years

age group and lowest among 60-70 years of age group. Body weight increased with age till the age of 49 and decreased there after but the differences were statistically significant only between 50-59 yr and 60-70 yr age groups. Body weight was found to be lowest among 60-70 yr age group followed by 20-29 yr age group. The overall mean value of all the age groups for height and weight were 151.3 cm and 48.7 kg respectively.

Age group wise mean, standard deviation, standard error of mean, t-values with level of significance between the five different age groups for BMI is shown in Table 2. BMI was found lowest in 20-29 yr age group and it increased steadily with age till 59 years showing the accumulation of fat with age and declined there after. The differences in mean BMI was statistically significant between 30-39 yr and 40-49 yr and also between 50-59 yr and 60-70 yr age group where as the differences among the rest of the groups were statistically non-significant. The mean value of all the age groups for BMI was found to be 21.2 kg/m².

Table 3 shows the distribution of subjects on the basis of body mass index as assessed from Asian and International cut-off points. The prevalence of overweight and obesity were 25.1 and 2.0 percent respectively as assessed from Asians cut-off point. Out of 346 females, only 56 females (16.2%) were underweight, 196 (56.6%) were normal while 87 females (25.1%) were overweight and 7 (2.0%) were obese. When BMI was assessed using WHO International Standard the prevalence of overweight and obesity was found to be 9.2 and 0.6 percent respectively.

Table 4 shows age wise distribution of subjects in different BMI categories as assessed from Asian cut-off points and WHO International standard, and the same has been represented in Figure 1 and 2. The result shows that there were significant number

of overweight and obesity and the prevalence increased with age till fifty nine years and there was a sharp decline after sixty year. From both the standards, it was assessed that the percentage of subjects with normal BMI was highest among the youngest age group i.e. 20-29 yr and it decreased in each age group with advancing age showing the least among the oldest age group i.e. 60-70 yr. The prevalence of underweight was found to be highest among the age group 20-29 yr and lowest among 40-49 yr age group. The prevalence of overweight was found to be more among the middle three age groups i.e. 30-39 yr, 40-49 yr and 50-59 yr and were more or less evenly distributed. As assessed from Asian cut-off points, maximum percentage of obesity was found to be among 50-59 yr age group. The prevalence of obesity was found only in this age group when BMI was assessed using WHO International standard.

Discussion

Height was found to be highest among the youngest age group and lowest among oldest age group showing a declining trend with advancing age. When the mean stature of these five different age groups was compared, a secular trend leading to increase in the mean stature was evident. Improvement in socio-economic conditions, better nutrition, knowledge and awareness could be the reason for the secular trend observed. Overall economic conditions of the world have improved in the last 100 years and there is tendency for children to become progressively larger at all ages. The trend has been operating since last many years and is still continuing in many parts of the world. The reason for decline in stature in advanced age could also be due to thinning of intervertebral discs as well as flabbiness of muscles, which changes the posture. The

decline in stature appear to be a common phenomenon and was also reported by Brahmam (1994),⁴² Tyagi and Kapoor (1999),⁴³ Kapoor and Tyagi (2002),⁴⁴ Bhardwaj and Kapoor (2007)⁴⁵. Aiken (1995)⁴⁶ reported that a loss of collagen between spinal vertebrae causes the spine to bow and the height to shrink. With advancing age the cartilage disc between vertebrae degenerates causing the vertebrae to come close together thus resulting in decrease in stature. However as mentioned earlier, a possibility of secular trend cannot be totally ruled out in the present sample as over the years the living conditions and medical facilities have improved in Manipur, the abode of present subjects.

Body weight increased with age till the age of 49 years and decreased after 50 years. Increase in body weight till middle age shows the accumulation of fat with age. It can be due to more appetite among the subjects in younger age groups leading to increased energy intake, fat rich diet and relatively less energy expenditure due to lesser involvement in physical activity. The decline in body weight in more advanced age may be attributed to the decrease in muscle mass in response to reduced amount of protein intake as well as decline in number and size of muscle fibers due to degenerative diseases associated with the advancing age. It may partly be due to bones becoming lighter because of gradual mineral mass loss.⁴⁷ The general tooth loss with age resulting in restricted food items in the diet of the elderly along with dietary restrictions due to degenerative diseases which occur with ageing may be important factor for reduced caloric intake, reduced absorption and hence loss in body weight in more advanced age group as was also reported by Tyagi et al (2005).⁴⁹ The Increase in body weight and

BMI with age and declining in advanced age has also been reported by Tyagi and Kapoor (1999),⁴⁵ Kapoor and Tyagi (2002)⁴⁴ and Tandon (2006).⁴⁸

The decline in BMI and weight among women in older age groups could also be attributed to the occupation of subjects who were mostly farmers, having being brought up in traditional family they have adopted physically active lifestyle through out their life. Being the most responsible persons in the family at their age they are more engaged in all types of physical activity including household chores. Although Tangkhul Naga society is patriarchal, women enjoy considerable freedom and play an important role in family, community life and economy both in the past and also at present. The traditional occupations of Tangkhul women revolve around agriculture, which is their main source of sustenance. Almost every woman knows weaving, which she pursues in her spare time. Women growing up in traditional lifestyle and also those who are still settled in villages worked hard to support their family and have little time to rest. They wake up at dawn and after collecting firewood, carried water and cooked lunch, they went to work in the fields for the whole day with little rest in between and came back in evening. Change, however, is sweeping among the Tangkhuls. The women of younger and middle age no longer depend on cultivation as their only means of sustenance and developed alternative means of livelihood like government or private jobs and business of their husbands for income leading to increasing sedentary lifestyle. The growing urbanization and socio-economic development which has created changes in dietary intake, physical activity levels and overall lifestyle, has brought about changes in their body composition and this transition could be attributed to the increased in mean BMI among middle age women and also increasing prevalence of overweight and obesity among them.

The present study shows that 27.1% of the Tangkhul Naga females were either overweight or obese when assessment of BMI was done using recommended Asian cut-off points. When BMI was assessed using WHO International Standard the prevalence of overweight and obesity was found to be 9.2% and 0.6% respectively, which means 9.8% of the Tangkhul Naga females were either overweight or obese. The prevalence of overweight and obesity increased with age and was found to be more among the subjects in middle age groups. The result also showed that subjects with normal BMI decreased with increase in age and the prevalence of overweight and obesity was found to be lowest among the youngest and oldest age groups. National Family Health Survey-2 & 3, India,^{14, 15} also showed that the prevalence of both overweight and obesity increased in each age group from 15 years of age to 49 years showing the accumulation of fat with increasing age.

It is apparent that the prevalence of overweight and obesity in the present study was not very high while comparing with other urban non-tribal female populations of India (Table 5 and 6). A high prevalence of overweight and obesity in high income groups was noticed. Satwanti et al. (1980)¹⁸ studied Punjabi females and found the prevalence of overweight to be 17.4%. Varanasi females⁵⁰ showed the prevalence of overweight to be 21.9% and the prevalence of overweight and obesity among Punjabi Khatri females⁴⁸ was reported as 30.9% and 23.1% respectively. Urban women of Delhi⁵¹ showed the prevalence of obesity to be 33.4%. Females belonging to high socio-economic status of Hyderabad⁵² were reported to be 36.3% obese. The prevalence of overweight and obesity among Punjabi urban females⁵³ was found to be 20% and 25.3%, respectively.

The observations from WHO, MONICA Study (1989)⁵⁴ regarding the European populations deduce that the prevalence of obesity and overweight was in the range of 50-70% in people aged between 35-64 years. The Punjabi Khatri female studied in 1980¹⁸ had 17.4% prevalence of overweight while among those studied in 2006⁴⁸ the prevalence of overweight was reported to be 30.9%. It reflects an increase of 13.5 points over a period of 26 years. It shows either more energy intake than expenditure or the physical activities undertaken are less than the energy consumption in the present time.

National Family Health Survey (NFHS-3)¹⁵ showed 2.8% obese women with BMI 30 or more and 12.6% overweight with BMI 25-30 among both urban and rural Indian female population. Though the prevalence of obesity (0.6%, as assessed from International cutoff point) among Tangkhul females was lower when compared to Indian female population, the prevalence of overweight (9.2%) was not far behind though it is a population where majority of them were believed to be thin traditionally owing to difficult hilly terrain habitation and physically active lifestyle. The figure was still higher when BMI was assessed using recommended cut-off points for Asians and the prevalence of overweight (25.1%) and obesity (2.0%) among the Tangkhul Naga women was found to be 27.1%. With urbanization and economic development, a nutritional transition characterized by improved dietary habits, improvement in socio-economic status and increasingly sedentary life style has been observed which has contributed to the increasing prevalence of overweight and obesity among the Tangkhul Naga tribal women.

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Note: All experiments were performed in accordance with relevant guidelines and regulations and informed consent was obtained from all subjects. The research described was compliant with basic ethical standards.

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Table 1 Basic data of the Tangkhul Naga women of Manipur

Age Group	HEIGHT (cm)						BODY WEIGHT (kg)				
	N	Mean	±SD	±SE	t' test	Level of sig	Mean	±SD	±SE	t' test	Level of sig
20-29	98	153.22	5.67	.57	1.780 0.006 2.069 3.507	ns ns .05 .001	48.20	6.57	.66	0.438 1.851 0.213 4.033	ns ns ns .001
30-39	88	151.85	4.70	.50			48.64	7.05	.75		
40-49	65	151.86	5.53	.69			50.87	7.79	.97		
50-59	53	149.88	4.67	.64			50.56	8.06	1.11		
60-70	42	146.56	4.48	.69			44.14	7.21	1.12		
Total	346	151.30	5.50	.30			48.68	7.48	.40		

Table 2 BMI among Tangkhul Naga women of Manipur

Age Group	BMI (kg/m ²)					
	N	Mean	±SD	±SE	t' test	Level of sig.
20-29	98	20.50	2.35	.237	1.519 2.087 .961 3.062	ns .05 ns .01
30-39	88	21.07	2.75	.293		
40-49	65	21.97	2.47	.306		
50-59	53	22.47	3.18	.437		
60-70	42	20.52	2.97	.458		
Total	346	21.23	2.78	.149		

Table 3 Distribution of subjects on the basis of body mass index as assessed from Asian and International cut-off points

Classification	BMI Assessment			
	Asian		International	
	Frequency	Percent	Frequency	Percent
Underweight	56	16.2	56	16.2
Normal	196	56.6	256	74
Overweight	87	25.1	32	9.2
Obesity	7	2	2	0.6
Total	346	100	346	100

Table 4 Age wise distribution of subjects in different BMI category as assessed from Asian cut-off points and WHO International standard

Age Groups	BMI (Assessed from Asian cut-off points) %				BMI (Assessed from WHO International Standard) %			
	Under weight	Normal	Over weight	Obesity	Under weight	Normal	Over weight	Obesity
20-29	5.20%	18.50%	4.30%	0.30%	5.20%	22.00%	1.20%	
30-39	4.90%	13.60%	6.60%	0.30%	4.90%	18.20%	2.30%	
40-49	0.90%	11.00%	6.60%	0.30%	0.90%	15.90%	2.00%	
50-59	1.40%	7.20%	5.50%	1.20%	1.40%	10.70%	2.60%	0.60%
60-70	3.80%	6.40%	2.00%		3.80%	7.20%	1.20%	
Total	16.20%	56.60%	25.10%	2.00%	16.20%	74.00%	9.20%	0.60%

Table 5 Prevalence of overweight in some populations of India (BMI > 25 kg/m²): A comparison.

Study groups	% Prevalence Of Overweight (BMI ≥ 25)	Investigators
Punjabi females	17.4	Satwanti et al, (1980) ¹⁸
Varanasi females	21.9	Asthana et al., (1998) ⁵⁰
Delhi urban females	45.6	NFI, (1991) ⁵⁵
Punjabi urban females	20	Sidhu et al., (2002) ⁵³
Punjabi Urban females	22.8	Sidhu et al., (2005) ⁵⁶
Khatri females (UP)	30.9	Tandon, (2006) ⁴⁸
Urban and rural Indian female populations	12.6 (BMI 25-30)	National Family Health Survey (NFHS-3, 2007) ¹⁵
Tangkhul Naga Female	9.8 27.1 (BMI ≥ 23)	Present Study

Table 6 Prevalence of obesity in some populations of India (BMI > 30 kg/m²): A comparison.

Study groups	% Prevalence Of Obesity (BMI ≥ 30)	Investigators
Delhi urban female	33.4	Gopinath et al., (1994) ⁶
Hyderabad Urban female	36.3	Rao et al., (1995) ⁵²
Varanasi	8.32	Asthana et al., (1998) ⁵⁰
Punjabi urban females	25.3	Sidhu et al., (2002) ⁵³
Punjabi urban females	21.1	Sidhu et al., 2005 ⁵⁶
Khatri females (UP)	23.1	Tandon, (2006) ⁴⁸
Urban and rural Indian female populations	2.8	National Family Health Survey (NFHS-3, 2007) ¹⁵
Tangkhul Naga Female	0.6 2.0 (BMI ≥ 27.5)	Present Study

Figure 1 Age wise distribution of subjects on the basis of body mass index as assessed from Asian cut-off points.

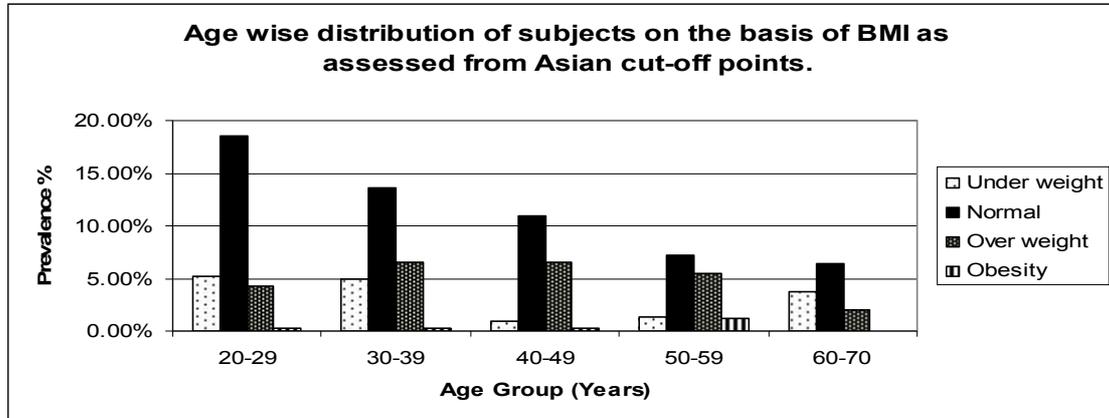


Figure 2 Age wise distribution of subjects on the basis of body mass index as assessed from WHO International cut-off points.

