NUTRITIONAL STATUS OF ADULT SLUM DWELLERS OF MIDNAPORE TOWN, WEST BENGAL, INDIA

SUBMITTED BY

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TO WHOM IT MAY CONCERN

(1) This is to certify that **Miss Priyanka Da**s is a registered Ph.D. research scholar working under my guidance at Department of Anthropology, Vidyasagar University, West Bengal. She has been undertaking research work under my supervision since 2010 for her Ph.D. work entitled **"Nutritional status of adult slum dwellers of Midnapore town, West Bengal, India".**

(2) Miss Das personally carried out fieldwork in connection with her Ph.D. work. Her Ph.D. thesis is based on original data-set collected by her.

(3) I also certify that the content of the thesis has not been submitted to any other University/Institution for the procurement of Ph.D. Degree/any other Degree/Diploma/other academic award.

(4) Miss Das has incorporated all the recommendations/ suggestions/modifications forwarded by the Ph.D. committee in Anthropology for the improvement of the thesis.

(5) I am satisfied on her performance and progress of the Ph.D. work.

(6) I am recommending her thesis for submission for the procurement of Ph.D. Degree in Anthropology.

(7) Finally, I hope she will be awarded a Ph.D. degree and wish her all success in life after successful completion of her Ph.D.

Prof. Kaushik Sankar Bose

Ph.D. Supervisor

DECLARATION

Declaration is, hereby, put forward by the undersigned in connection with submission of the thesis entitled ***"Nutritional Status of Adult Slum Dwellers of Midnapore Town, West Bengal, India"*** For the fulfillment of degree of doctor of philosophy (science) in anthropology under the auspicious of Vidyasagar University, Paschim Medinipur, West Bengal, India, that,

(i) the concerned thesis is based on empirical data collected personally by the candidate himself and thus the candidate has the sole academic, material as well as moral right over the materials used for the construction of the thesis,

(ii) the content of the thesis has not been submitted to any other University / Institution for the procurement of Ph.D. Degree / any other Degree / Diploma / other academic award, however,

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Signature of the candidate

Dated : 11 .01. 2017

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11th January, 2017.

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ABBREVIATIONS

The following abbreviations are used in this thesis

ATSF	Anterior thigh skinfold
ANOVA	Analysis of Variance
BMI	Body mass index
BSF	Biceps skinfold
CC	Chest circumference
CI	Conicity index
CED	Chronic energy deficiency
FFM	Fat free mass
FFMI	Fat free mass index
FM	Fat mass
FMI	Fat mass index
HC	(Maximum) hip circumference
HT	Height
HTAC	Height acromion
MUAC	Mid-upper arm circumference
MCSF	Medial calf skinfold
MFI	Monthly family income
MFIG	Monthly family income group
MPCI	Monthly per capita income
MPCIG	Monthly per capita income group
PBF	Percent body fat
SD	Standard deviation
SHT	Sitting height
SUBSF	Subscapular skinfold
SUPSF	Suprailiac skinfold
Sum ALSF	Sum of allskinfolds
SumSFT	Sum of truncal skinfold
SumSFEx	Sum of extremity skinfold
SumSFLEx	Sum of lower extremity skinfold
SumSFUEx	Sum of upper extremity skinfold
TSF	Triceps skinfold
WC	(Minimum) waist circumference
WHO	World health organization
WHR	Waist-hip ratio
WHTR	Waist-height ratio
WT	Weight

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CHAPTER – I

INTRODUCTION

I

Introduction

1.1 THE BROADER DISCIPLINE:

Modern humans belong to a single species that exhibits considerable variation in behaviour, size, shape, and appearance. In modern usage, humans belong to the species Homo sapiens, a name coined by an 18th century botanist, Carl Linnaeus (1758). Anthropology is the scientific study of bio-cultural evolution and variation of man synchronically and diachronically. It encompasses the entire of humanity, past and present. Contemporary anthropology is generally divided into four broad categories viz;

•Physical anthropology, also known as biological anthropology, is the scientific study of human evolution and variation over time and space.

•Archaeology, the study of cultural variation over time, focuses on artifact, constructions, or other evidence of human activities. Its techniques are used to investigate prehistory, or to provide physical evidence of contemporary events such as establishing chronological constructions. Archaeological techniques of exploration, excavation and documentation are also sometimes used to recover evidence from a crime scene.

•Linguistics deals with the study of human communication systems. Its topics range from language to the dynamics of human relations &

•Cultural anthropology or socio-cultural anthropology deals with the study of human behaviour, especially human culture. Culture is the sum total of human behaviours which is acquired from society and not inherited from parents. This learning includes languages, knowledge, beliefs, morals, laws, customs, kinship systems, values, art, and folklore.

As we know anthropology is the holistic study of man. That is, it pays attention to a society as a functioning whole. Humanity is a very diverse and adaptable species, and no matter what one's special interest, anthropologists try to relate the process or subject of their study to a broader framework of what it means to be human.

As an individual, we perceive the world around us, and we learn language from other people. We also learn "why, how, and when." We learn correlations between trials and states. Thus, anthropology is the comparative study of humans as physical/biological and social/cultural beings. It is holistic, and its aim is to understand the human being and its place in kingdom.

Biological anthropologist brings the full conceptual framework of biology to the study of humanity. Physical anthropologists use scientific methods in their studies. Many of us think that science is body of knowledge gained through observation, experimentation and come to the inference. But science is not a body of knowledge, although knowledge is important to science. Science is a creative movement whereby we try to understand the natural processes that shape our universe.

Nutritional anthropology emerged in the 1970s that tended to reproduce the ‘two cultures’ of an anthropology divided methodologically into social and biological sciences. The former had been concerned with the social role of food stuffs, the determinants of their production and distribution, and the management of shortages. Freedman (1976) has defined nutritional anthropology as ‘the study of the interrelationship between diet and culture and their mutual influence upon one another’. By distinction, biological anthropologists and nutritionists have treated food mainly as a vehicle of energy and nutrients. Nutritionists have focused on determinants of variation in nutritional status and its measurement, the nature of energy and nutrient requirements, ethnic differences in nutrient utilization, and the possibility of nutritional adaptation by biological and social means (Blaxter and Waterlow, 1985; Ulijaszek and Strickland, 1993). Biological anthropologists have tended to see nutrition as a dimension of the complex human-environment relationship. Thus, Haas and Harrison (1977) postulated several ways of approaching nutrition in human population biology: as a constraint or stressor; as a modifier of other environmental stress; and as contributing to limits to human biological adaptation.

Study of nutrition and health of an individual and population in community level requires nutritional assessment of them. “Nutritional assessment” the original term was used by a sub-committee of the League of Nations (1932) referring to a set of medical tasks to determine the nutritional status of a population (Cited in Gibson,2005). After

(Bistrian & Blackburn et al., 1976), it became a standardized, hospital-based set of tools to predict nutrition and health outcomes in individual patients with post-operation complications, trauma or malnutrition. According to Gibson (1990): “Nutritional assessment is the interpretation of information obtained from dietary, biochemical, anthropometric and clinical studies in determining the health status of an individual or population as influenced by their intake and utilization of nutrients”.

Health: The word ‘health’ was derived from the old English word ‘health’, which meant a state of being sound, and was generally used to infer a soundness of the body (Dolfman, 1973). According to WHO (1948) “Health is a state of complete physical, mental and social wellbeing and not merely an absence of disease or infirmity”. Health is a prerequisite for human development and is an essential component for the wellbeing of the mankind. The health problems of any community are influenced by interplay of various factors including biological, social, economic and political ones. The common beliefs, customs, practices related to health and disease in turn influence the health seeking behaviour of the community (Gopalan, 2008).

Nutrition may be defined as the science of food and its relationship to health. It is concerned primarily with the part played by nutrients in growth, development and maintenance of the body. And nutrients are the organic and inorganic compounds required for the proper growth, development and maintenance of the body. Nutrition also improves their ability to learn, communicate, think analytically, socialize effectively and adapt to new environments and people. Growth and development are continuous processes which begin at conception and end at maturity. Humans are the only bio-cultural creature in this world who can adjust themselves accordingly with the help of culture. In the area of nourishment they also rely upon their bio-cultural prospective to take advantage of the natural as well as manmade part of dietary resources. Anthropology is a unique discipline with its varied methodology of approaching and analyzing human variation. There are some other disciplines, including nutritional epidemiology, public health nutrition, community nutrition, and nutritional anthropology, focus on the spectrum from biological and social facets of food and nutrition.

Balanced diet is required for better growth, development, survival and reproduction. It is a diet which contains adequate amount of all nutrients. However, there is great variety in human dietary patterns. The knowledge of nutrition has developed from chemistry and physiology and remains a basically biological discipline. Socio-economic factors play an important role in influencing access to nutritional resources, but have been likely to be seen as secondary to the discipline.

1.2: NUTRITIONAL STATUS:

Nutritional status is the present body status, of a person or a population, related to their state of nourishment (the consumption and utilization of nutrients). The nutritional status is determined by a complex interaction between internal factors and external factors: Internal factors like: age, sex, nutrition, behaviour, physical activity and diseases. External environmental factors like: food safety, cultural, social and economic circumstances. According to WHO (1978), nutritional status is the condition of the body as a result of the intake, absorption and use of nutrition and the influence of disease-related factors. The nutritional status is a major, modifiable and powerful element in promoting health, preventing and treating diseases and improving the quality of life.

The nutritional status of a community is the sum of the nutritional status of the individual who form that community. The main objective of a "comprehensive" nutritional survey is to obtain precise information on the prevalence and geographic distribution of nutritional problem of a given community, and identification of individuals or population groups "at risk" or in greatest need of assistance.

The term **malnutrition** in its broader sense reflects both undernutrition and overnutrition. Malnutrition is typically caused by a combination of inadequate food intake and infection which impairs the body's ability to absorb or assimilate food. Undernutrition may lead to increased infections and decreases in physical and mental development. Undernutrition remains a widespread problem in developing countries, in particular among the poorest and most vulnerable segments of the population. Undernutrition is a consequence of consuming too few essential nutrients or using or excreting them more rapidly than they can be replaced. Methods of Nutritional Assessment are assessed by two methods; 1.Direct, and 2.Indirect.

The **direct methods** deal with the individual and measure objective criteria, while indirect methods use community indices that reflect the community nutritional status.

Direct Methods of Nutritional Assessment are summarized as ABCD;

• Anthropometric methods: Is the systematic and scientific measurement of human nutrition and body composition.

• Biochemical, laboratory methods: Is the study of concentration and metabolism of nutrients in body.

• Clinical methods: It is ascertains the clinical consequences of imbalanced nutrient intakes.

• Dietary evaluation methods: It is estimates food and /or nutrient intake, food frequency questioner, food weighed record etc.

Among all these methods, anthropometrical techniques are easy to collect and accurate. It is also inexpensive and non-invasive, and thus easy to be used in field situation. In spite of the introduction of the sophisticated and modern techniques for the measurement of nutritional status and body composition of individuals, the techniques of anthropometry is still being considered to be the most useful in the population surveys, especially in developing countries. This is because of the fact that it is quick, easy, and inexpensive method, and at the same time it is internationally accepted (Ulijaszek and Strickland 1993, Seidell et al 1997). It is suggested that the common use of anthropometry to assess nutritional status should continue as a useful tool (Chumelia and Roche 1988).

INDIRECT METHODS OF NUTRITIONAL ASSESSMENT ARE:

•**Economic Status and Educational Status**:

Such as, household income, per capita income, population density, food availability and prices, cultural and social habits, vital health statistics: morbidity, mortality and other health indicators and sanitary conditions.

Anthropometric measurements play a very important role in the assessment of nutrition in human populations. Anthropometric measurements are well established and widely used as indicator of nutritional and health status of children and adults (WHO, 1995). Among all methods of nutritional assessment, anthropometric measurements are accurate, less expensive and non-invasive, and thus widely used in large-scale surveys. In spite of the introduction of sophisticated and modern techniques for the evaluation of nutritional status and body composition of individuals, the techniques of anthropometry are still being considered to be the most useful in the population surveys, especially in developing countries and at the same time it is internationally accepted (Ulijaszek and Strickland, 1993; Seidell and Bouchard, 1997).

1.3: ANTHROPOMETRY:

The term ‘anthropometry’ derived from two Greek words ‘anthropos’ means ‘man’ and ‘metron’ means ‘measurement’. Therefore, it is the systematic and scientific measurement of human body.

The word ‘anthropometry’ was first used in the seventeenth century by a German physician, J. Sigismund Elsholtz (1623-1688) in his graduation thesis entitled “Anthropometrica”. Anthropometry, as a scientific discipline, however, began with Johann Friedrich Blumenbach (1752-1840) (Singh and Bhasin 2004). Anthropometric measurements, such as weight, skin fold thickness; arm and hip circumferences are commonly used to assess the nutritional status of both children and adults. For adults, as for example, **Body Mass Index** (BMI) expressed as body weight (in kilogram) divided by stature (in meter^2) is widely used as a measure of fatness, or the nutritional status of a population in both developed and developing countries. World Health Organization (1995) has recommended that anthropometry could be used to assess the nutritional and health status of the adults.

Anthropometry is the single most portable, universally acceptable, inexpensive, and non-invasive method available to assess the size, proportions, and composition of the human body (WHO 1995). It is the means of quantifying variations in body size, shape and composition. It has been recognized as one of the most fundamental practical techniques of human biological studies, since almost every biological function in some way or other related to one or other aspects of the physical dimensions of the body (Weiner and Lourie 1981).

1.4: BODY MASS INDEX (BMI):

Body mass index is also widespread as Quetelet's index, which is body weight (in kg) divided by stature (in m 2) (Keys et al., 1972). Better known as body mass index (BMI), this measure was an attempt by the 19th century mathematician Lambert Adolphe Jacques Quetelet to describe the relation between body weight and stature in humans (Quetelet, 1842). It is widely used as a measure of overall adiposity and the nutritional status of a population in both developed and developing countries. It has been recognized as one of the most fundamental practical techniques of human biological studies, since almost every biological function in some way or other related to one or other aspects of the physical dimensions of the body (Weiner and Lourie,1981). Although there are several methods available to assess nutritional status, only a few of them are suitable in large-scale epidemiological surveys. BMI is also established as a good indicator of living standards (Nube et al., 1998) and has been correlated with socio economic status (SES) in both developed and developing countries (Bharati, 1989, Osmani, 1992, Naidu and Rao, 1994, Cornu et al ., 1995;Reddy, 1998; Martikainen and Marmot, 1999).

1.5: CHRONIC ENERGY DEFICIENCY:

In 1988, the International Dietary Energy Consultative Group proposed a definition of chronic adult undernutrition calling it' chronic energy deficiency' (CED), it was defined as: "A steady state at which a person is in an energy balance although at a cost either in terms of increased risk to health or as an impairment of functions and health" (James et al., 1988). Chronic Energy Deficiency (CED) has been defined as a state of ‘steady’ or body energy stores. A BMI < 18.5 kg/m2 is widely used as a practical measure underweight in which an individual is in energy balance irrespective of a loss in body weight (Khongsdier 2005). CED is caused by inadequate intake of energy and accompanied by high level of physical activities and infections (Shetty and James 1994, Shetty et al 1994). It is also associated with reduced work capacity (Pryer 1993, Durnin 1994), performance and productivity (Garcia and Kennedy 1994, Shetty and James 1994, Strickland and Ulijaszek 1994) and also behavioural changes (Kusin et al 1994).

1.6: OVERWEIGHT AND OBESITY:

Overweight and obesity generally refer to the presence of body fat in excess according to some scientifically established standard. Obesity has been defined as a condition in which there is accumulation of excess body fat to a degree which has adverse effect on health and well being (WHO 2000, Ulijaszek 2006). Obesity is a global epidemic. By now it has been established as a highly potential and independent risk factor for a number of chronic and non-communicable diseases like type-II diabetes, cardio-vascular diseases (CVD), hypertension, gallstones and also certain types of cancers (WHO 2000). Obesity is now recognised as one of the major health problems not only in developed but also in developing countries including the poorer ones (Popkin and Doak 1998). Although obesity has a genetic etiology, the major contributing factors are attributed to the alteration in diet and activity patterns and an exposure to obesogenic environment (Ulijaszek 2006, French et al 2001, Hill et al 2003, Ramachandran 2004) In India also, it is emerging as a serious health hazard, paradoxically co-existing with high proportion of under nutrition present in different sections of populations (Shukla et al 2002, Kapoor and Anand 2002). Body mass index (BMI) is the most commonly used measure of nutritional status including obesity, especially in adults (Bose and Mascie-Taylor 1998). It is a measure of overall adiposity (Kopelman 2000, Lohman et al 1988) and most commonly used because its use is inexpensive, non-invasive and suitable for large-scale surveys (Norgan and Ferro-Luzzi 1982, James et al 1992). The BMI is widely used as a surrogate measure of body fat content because of its simplicity and high correlation with PBF (Norgan 1990, Taylor et al 2000, Bose 2001).

WHO defines adult overweight and obesity as having a BMI of 25.0-29.9 kg/m^2 and BMI of $\geq$ 30.0 kg/m^2, respectively (WHO 1995). However, a lower level of BMI as the first action point, with, to identify overweight, and a cut off point of $\geq$ 25 kg/m^2, with respect to the associated risk factors or co-morbidities in Asian populations, has been recently recommended by WHO (WHO 2000).

1.7: CENTRAL ADIPOSITY:

Central adiposity has been linked to increased risk of cardiovascular disease, hypertension and diabetes (Wang et al 2005, Rosenthal et al 2004, Pau and Ong

2005, Fernandez et al 2006). Waist circumference (WC), waist-to-hip ratio (WHR), and conicity index (CI) are reliable proxy measures of abdominal fat in contrast to BMI, which is a measure of overall adiposity (Kopelman 2000, Lee and Nieman 2003). Studies have indicated that BMI, WC and WHR have independent roles in identification of overweight and obesity. These indices of adiposity have been widely recommended for epidemiological surveys because of their independent association with major cardiovascular and metabolic risk factors and WC often provides with the best assessment of intra-abdominal fat in contrast to subcutaneous fat (Bjorntorp 1987, Seidell JC et al 1990). It is also desirable to have simple and inexpensive measures for use in field situations and for clinical diagnosis. Among the measures mentioned above, WC seems to have the highest potential in this regard, as it has been recommended to predict most closely total body fat (Lean et al 1996). Although Asian Indians, in general, have lower BMI than Europeans, they are reported to have higher per cent body fat, waist-to-hip ratio and abdominal fat (Ramachandran et al 1997, Dudeja et al 2001, Snehalatha et al 2003). However, there is no consensus as to which of these measures is preferable in studies dealing with abdominal adiposity and their relationship (Dalton et al 2003, Neovious et al 2005, Bose 2006). The interrelationship of WC with WHR and BMI should be understood to identify not only those who have high BMI, but also those who have low BMI but high WHR by using the simple measure of WC (Dasgupta and Hazra 1999). Higher BMI is associated with central adiposity and higher WHR, along with the non-communicable diseases that appear at lower BMI ranges in Indian populations (Yajnik 2001).

1.8: BODY COMPOSITION:

Body composition is the “makeup of the body in terms of the absolute and relative amounts of adipose tissue, muscle mass, skeletal mass internal organs and other tissues” (Bogin, 1999). Overall body fat is an important indicator of weight-related disease such as diabetes and the location of this tissue is equally, if not more, significant. Some fat is necessary for overall health; it helps protect internal organs, provides energy and regulates hormones that perform various functions in body regulation. Fat in the marrow of bones, in the heart, lungs, liver, spleen, kidneys, intestines, muscles, and lipid-rich tissues throughout the central nervous system is called essential fat, whereas fat that accumulates in adipose tissue is called storage fat. Essential fat is necessary for normal bodily functioning. The measurement of body composition is essential for understanding variation in human body dimension and adaptation, growth and nutritional status, fitness, work capacity, disease and its treatment (Norgan, 1995).The search for valid methods of measuring body composition that are practical and inexpensive is an ongoing process for exercise scientists and nutritionists. Some practical methods of measuring body composition include skinfolds, circumference (girth) measures, hydrostatic weighing, bioelectrical impedance, and near-in frared inter actance (Kravitz & Heyward, 1992). Most practical methods have a 3% to 4%error factor in their prediction of body fat (Brodie, 1988). The skinfold method of measuring body fat is a practical, economical, and administratively feasible field technique for body composition analysis. It involves measuring the skinfold (subcutaneous fat) thickness at specific sites of the body (Kravitz & Heyward, 1992).

There is considerable biological variation in the distribution of subcutaneous, inter muscular, intramuscular, and internal organ fat due to age, gender, and degree of fatness (Heyward, 1991). Scientists suggest the use of the skinfold method, the measurement of subcutaneous fat, in field setting as an alternative to laboratory methods. Since the instruments used are portable, inexpensive and non-invasive, skinfold method can be readily applied in clinics, laboratories and schools. It also has high correlation with percent body fat (Billisari & Roche, 2005).

1.9: PERCENT BODY FAT:

The obesity epidemic, at one time confined to adults, has now penetrated the paediatric age range and shows every sign of a rapid escalation. This has led to calls for better assessment tools both for longitudinal and cross-sectional surveillance of populations, and for clinical management of individuals (Lobstein et al., 2004; Pietrobelli et al., 2003). There were diverse ways of measuring body composition. Laboratory measurements are precise, involve complicated equipments and intricate measures and trained technicians. Anthropometric methods, though less accurate compared with laboratory methods, are much simpler and inexpensive, and can be carried out for different ethnic groups with ease.

These anthropometric based methods are easier, inexpensive and relatively quick to perform but are not direct measures of body fat percentage (BF, %). BMI is a measure of overall adiposity based on weight relative to height and therefore does not give any information on body composition. Skinfold data require equations to calculate BF (%) from thickness measurements respectively.

1.10: BACKGROUND OF THE PRESENT STUDY:

Urban populations and the slums: international and national context

A report by the United Nations Population Division mentioned that half of the world's population now lives in cities and within next 30 years, nearly two-third of the world's population will live in urban areas (UN Population Division, 2004). More interestingly, most of this population growth is expected in urban areas in less wealthy regions of the world (estimated growth from 1.9 billion in 2000 to 3.9 billion in 2030), with the most rapid growth expected to occur in Asia and Africa (McCord and Freeman 1990, Brockerhoff 2000). The number of urban dwellers in Asia is already greater than the urban population of North America and Europe combined (1.2 billion) in 2000 (Vlahov et al 2007).

According to the UN-HABITAT's Global Report on Human Settlements, some 923,986,000 people, which are 31.6% of the world urban population, are slum dwellers and about 43% of the urban populations of all developing regions combined live in slums. In the least developed countries, some 78.2% of the urban populations live in slums. The total number of slum dwellers in the world increased by about 36% during the 1990s, and in the next 30 years the number will increase to about 2 billion and in 50 years to 3 billion (UN-HABITAT 2003). This growth of slum is supposed to exert a monumental pressure on urban health in specific and global health as a whole. This expansion of slums is also considered to be one of the major urban challenges as these will become shelters of a huge proportion of the world's poor, with profound implications of population health (Vlahov et al 2007).

In India, 31.16% of the population lives in urban areas, out of which around 43% are living in metropolitan cities. About 27.5% of the metropolitan population lives in slum clusters and resettlement colonies. According to government figures, the percentage of urban households living in recognized slums is highest in Andhra Pradesh (35.7%), followed by Chhttisgarh (31.9%) Madhya Pradesh (28.3%) Odisha

(23.1%) and West Bengal (21.9 %). In India total slum population was 1210569573 (male 623121843, female 587447730). The total slum population of West Bengal was 91276115 (male: 46809027, female: 44467088) and the total slum population of Paschim Medinipur was 5913457 (male: 3007885, female: 2905572) (Govt. of India, Census 2011).

The difference between urban and rural in almost every sphere of life is well recognized and documented. This difference is also evident in nutritional profile. But there may be huge intra-urban differences, too. Pooled data on poverty and malnutrition in cities of developing countries underestimates large intra-urban differences (Ruel et al 1998) and once these data are disaggregated and analyzed separately, the urban slum dwellers are found to suffer worse conditions than even their rural counterparts (Pryer and Crook 1988). Accurate health statistics in slums are difficult to obtain, especially a developing country like India, and whenever available, rarely found to deal with intra-urban differences. These results are gross generalization about the health scenario of the city and suppress the disparities even within a close proximity. Since, most available disease and mortality data from slums are based on clinic, hospital or national mortality registry information, the underlying medical conditions such as risk factor profiles for chronic diseases are underestimated (Riley et al 2007). Slum-specific information may reveal that health priorities in slums may be different than national or even local urban ones. With the specific health information, the related social and living conditions are also needed to be understood for effective interventions (Unger and Riley 2007).

In many countries, nutritional status has been evaluated among populations residing in urban low-socio-economic conditions such as in slums (Pryer et al. 2002 2003, Pryer and Rogers 2006, Bose et al 2007b, 2007c). However, the connections between poverty and undernutrition have not been fully understood (Pryer 2003). Several recent investigations have studied the relationships of socioeconomic status (SES) with nutritional status (Pryer et al. 2002, 2003, Pryer and Rogers 2006, Bose et al. 2007b, 2007c, Nube et al. 1998 Ulijaszek 2003, Godoy et al. 2005, Kabir et al. 2006, Hong and Hong 2007), body mass index (BMI) and chronic energy deficiency (CED) among different populations (Ulijaszek 2003, Khongsdier 2002, Delpeuch et al. 1994, Mahmud et al. 2006, Fernald 2007). Some of them have shown a strong relationship between nutritional status and several measures of income (Pryer et al. 2002, 2003, Pryer and Rogers 2006, Bose et al. 2007b, 2007c; Nube et al. 1998, Ulijaszek 2003, Godoy et al 2005, Hong and Hong 2007). Housing condition and health has also been investigated in some recent studies (Fernald 2007, Kari-Koskinen and Karvonen 1976, Frisitzer and Mose 1981, Kroeger 1980, Saito et al. 1993). Moreover, some studies have been undertaken to investigate the relationship between housing qualities, in particular, with BMI and CED (Fernald 2007, Saito et al. 1993, Hodge et al. 1995). But the information is still scanty for the numerous populations living in urban, sub-urban and rural slums, squatter settlements of the developing countries, more particularly in India.

Therefore, it is important from the public health perspective to evaluate the relationship of different measures of SES with nutritional status in different populations, especially in the developing countries. This would assist in the identification of high-risk individuals to target for appropriate nutritional and socio-economic intervention programmes in these underprivileged parts of the world. However, such information from India (Barker et al. 2007, Ghosh and Bandyopadhyay 2006, Bharati et al 2008, Devgun et al 2014,Gouda et al 2014), some information in west Bengal (Ghosh 2015) and more specifically, in slums of West Bengal (Bose et al. 2007b, 2007c), is literally handful.

Moreover, there is no study, in particular, among the people of low socio-economic status, e.g., slum dwellers of India to find out the relationships between the different anthropometric measures important for determining nutritional status (e.g., between BMI and MUAC, or between WC and BMI), or between nutritional status and body composition (e.g., between BMI and PBF, or between WC and PBF).

There are some studies, however, which have examined BMI values to identify risk profile for cardio-vascular and metabolic disorders in Indian populations (Snehalatha et al 2003, Misra et al 2003, Vikram et al 2003, Singh et al 2004) but not for obesity in terms of total body fat (PBF) as such. One study (Dudeja et al 2001) from northern India has reported BMI cut off point for overweight, and only one recent study among Bengalee population in non-slum settings (Ghosh and Bandyopadhyay 2007c) has attempted to establish appropriate BMI cut off to identify obesity.

A recent report by the United Nations Population Division mentioned that half of the world's population now lives in cities and within next 30 years, nearly two-third of the world's population will live in urban areas (UN Population Division, 2004). The number of urban dwellers in Asia is already greater than the urban population of North America and Europe combined (1.2 billion) in 2000 (Vlahov et al 2007).

Moreover, some studies have been undertaken to investigate the relationship between housing qualities, in particular, with BMI and CED (Fernald 2007, Saito et al. 1993, Hodge et al. 1995). Quality of housing has been used as a proxy measure for socio-economic status (Fernald 2007, Hodge et al. 1995). But the information is still scanty for the numerous populations living in urban, sub-urban and rural slums, squatter settlements of the developing countries, more particularly in India.

Therefore, it is important from the public health perspective to evaluate the relationship of different measures of SES with nutritional status in different populations, especially in the developing countries.

Moreover, there is no study, in particular, among the people of low socio-economic status, e.g., slum dwellers of India to find out the relationships between the different anthropometric measures important for determining nutritional status (e.g., between BMI and MUAC, or between WC and BMI), or between nutritional status and body composition (e.g., between BMI and PBF, or between WC and PBF).

1.11: THE PRESENT STUDY:

In view of this, the present investigation was undertaken to document the anthropometric profile of the urban Bengalee adult slum dwellers in Midnapore Town of Paschim Medinipur, west Bengal. The anthropometric characteristics and nutritional assessment of the studied sample was also undertaken. The well-established anthropometric measures of nutritional status (viz. BMI and MUAC) and their established cut off values were also evaluated.

The relationships of monthly family income (MFI), monthly per capita income (MPCI), education, Occupation and house type with anthropometry and nutritional status were also studied. It has also been attempted by this study to test whether an easily visible aspect of the quality of house-structure could be a good indicator of socio-economic differentials in this marginalized urban group to facilitate an easy way to identify the nutritionally vulnerable individuals.

In this study, BMI and MUAC were considered to be key anthropometric measures (outcome variables) to be studied in relation with the others. BMI was also evaluated as a risk factor being a measure of overall adiposity. Since central adiposity is also a risk factor, and it has been well documented that the South Asian populations had more abdominal fat at a BMI level lower than in Europeans. For these reasons, measures of central obesities, with a special emphasis to WC, were also evaluated in relation to BMI (as a measure of nutritional status), PBF, and also to the measures of SES.

To have a broader background regarding the lifestyle related to nutritional status of the subjects, the general food habit and physical activity patterns were also recorded and used in interpretations of the findings, wherever were necessary. Since diet and physical activity patterns were not among the principal focuses of this study, the methodologies for collection of information on those aspects were somewhat arbitrary, and the analyses of those aspects in relation to others were also not so rigorous. Information on food patterns and habitual physical activities (HPA) were provided to have a somewhat holistic understanding of the anthropometric profile and the nutritional status of those adult slum dwellers.

1.12: THE OBJECTIVES OF THE STUDY:

1. To investigate the interrelations of socio-demographic variables with anthropometric and body composition characteristics and nutritional status among the slum dwellers of the study area.

2. To evaluate age and sex variations in nutritional status of the subjects of the study area.

CHAPTER – II

LITERATURE REVIEW

II

Literature review

There is a wide range of publications regarding nutrition, its assessment, nutritional status, over-weight and obesity, adiposity and relative fat patterning, undernutrition and Chronic energy deficiency (CED) etc. Prevalence rates of underweight in children, low BMI in adults, and low birth weight in new-born are considerably higher in South Asia. In spite of these nutritional studies on adult men are lacking. Here, looking at the objectives and scopes of the present research proposal, some of those works, seemingly relevant, are being mentioned.

The relationship between BMI and SES has been studied in both developed and developing countries, including the Latin America. A positive relationship between BMI and SES has been established in other Latin American Countries except in Mexico (Martorell et al 1998, Godoy et al 2005). It was also indicated that although the associations between BMI and different SES variables were established at the national level in many countries, smaller populations within those countries might differ from the national trend.

All of these above-mentioned studies have addressed the issues of relationship between risks of NIDDM, CVD, HT and adiposity, obesity, central obesity, effect of age over these relationships and also the prevalence of the risk factors in various populations of India. These studies have shown either the age trends in adiposity and relative fat distribution, with special emphasis on central fat distribution (WC, WHR, CI), or the association of hypertension with patterns of obesity.

There is only one study (Ghosh and Bandyopadhyay 2007), till date, to find out the appropriate cut off point of BMI to determine obesity based on PBF in Bengalese population, and no study to find out cut off of central adiposity by waist circumference to define obesity base on either BMI or PBF. The present thesis has attempted these works under respective broad objectives.

On the basis of these recommendations given in the above mentioned literature, a number of studies have been carried out in different parts of the world to demonstrate the adult nutritional status in terms of BMI based classification. Some of the relevant works are discussed below.

There are some studies on various tribal populations of India where the main emphasis were given on BMI and chronic energy deficiency. Although the present PhD work was done on a non-tribal population, but these various tribal groups and the present slum populations together belonged to the low SES section of the population.

2.1 INTERNATIONAL CONTEXT:

2.1.1 Anthropometry and Body Composition:

In a study at a city of north of Iran, involving 1800 men and 1800 women aged 20-70 years, the prevalence of different nutritional states as well as central obesity across the age groups were estimated in the background of socio-economic status. The relative risks of obesity were also evaluated at different grades of different SES parameters (Hajian-Tilaki and Heidari 2006).

The prevalence of overweight / obesity and high preference for larger body size among adults (4934 no) in the two slum (Korogocho Viwandani slum) of Nairobi Kenya. Overall, 43.4% of the females in the study population were overweight / obese compared with 17.3% of males. More than half (53%) of the individuals who were overweight/obese underestimated their weight, with females (34.6%) doing so more often than males (16.9%). In all BMI categories, over a third of females and males preferred body sizes classified as overweight/obese (Mondal et al 2016).

2.1.2 BMI and Socio-Economic Status (SES):

Ahmed et al (1998) studied the relationship of a number of socio-economic factors thought to explain the prevalence of undernutrition among rural women of Bangladesh. The women aged >35 years were more prone to be undernourished. Both years of schooling and SES were important and significant predictors of BMI. Better-off women were less likely to have CED than the women from poor households. Body weight, MUAC and BMI, all had higher mean values in the better-off women than the poor group.

The studied included data from 49,532 patients enrolled in the Diarrheal disease surveillance system (DDSS) at Dhaka hospital from 1993-2011. Individuals 5-19 years, those with higher socioeconomic status and use of sanitary toilet were at higher risk of being overweight and obese. Among those >19 years, additionally males were less likely to be overweight and obese .Over the last two decades the prevalence of overweight and obesity in Dhaka city has increased at least five folds and it was much higher among those with better socioeconomic status (Das et al 2013) .

2.1.3 Undernutrition and Morbidity:

There are a very few prospective studies which have found evidence of the relationship of low BMI and mortality (Naidu and Rao 1994). But these findings remained doubtful due to lack of methodological precision (WHO, 1995).

Khongsdier (2002) demonstrated the relationship between self-reported morbidity and BMI (especially low BMI) after a study on 575 adult males of the rural War Khasi population of the Northeastern part of India. The study concluded that BMI might be a better indicator of standards of living than the predictor of illness as the later might also predispose individuals to the former. Morbidity and low BMI were perceived as parts of ill health. But the study also demonstrated that the prevalence of illness were higher at both the lower and upper end of the BMI values.

There are a very few studies among urban low SES people or more particularly in urban slums to see relationship between self-reported morbidity and BMI (especially low BMI). In a study among 199 adult males of an urban slum in Bangladesh, Pryer (1993) investigated the association between BMI and work-disabling morbidity. There was a significant inverse association between BMI and work-disabling morbidity. Below a BMI of 16.0, 55% men had lost at least one working day, and the proportion decreased to 35% among those having a BMI between 16.0 and 17.0. Above a BMI of 17.0, the prevalence of work disability due to illness almost stabilized.

In a cross sectional study (Sultana et al 2015) on 650 adult (260 male, 390 female) attendance of the patients of Dhaka Hospital, Dhaka, Bangladesh. MUAC correlates closely with BMI. For the simplicity and easy to remember MUAC <25 cm for male and <24 cm for female may be considered as a simpler alternative to BMI cut-off <18.5 to detect adult undernutrition. Our results show a strong correlation between BMI and MUAC. This finding lays the ground for the suitability of MUAC as an indicator of nutritional status in adult.ROC analyses also echo this finding. Although both BMI and MUAC could be used to evaluate nutritional status, MUAC may be Preferred for its simplicity.

This Studied (Madden et al 2014) assessment of nutritional status using anthropometry can be undertaken using a range of methods which vary in their practically, validity and ability to identify undernutrition and obesity. Evaluation of body composition is an important part of assessing nutritional status and provides prognostically useful data and an opportunity to monitor the effects of nutrition related disease progression and nutritional intervention.

2.2 NATIONAL CONTEXT:

2.2.1 Anthropometry and Body Composition:

In India also, there are many recent studies addressing adult nutritional status in terms of BMI.

The investigation of the nutritional status (BMI-based) of adult women in India (aged 15-49 years) with special emphasis on the prevalence of CED and obesity (Bharati et al 2007).The study also attempted to understand the influence of the SES on these prevalence rates. It had utilized the database on 81712 women from the Indian National Family Health Survey, 1998-99. The women represented 26 states of India. All the socio-economic variables, especially, the educational status and standard of living, had significant positive effects on the nutritional status of women.

Bose et al (2006d) also published results of their study on the anthropometric characteristics and their nutritional status based on body-mass index (BMI) and mid-upper-arm circumference (MUAC) of the adult (aged > 18 years) male Santals, a tribal population of Keonjhar District, Orissa, India. A total of 332 Santals from five villages were included in the study. The prevalence of (CED) was 26.2%. According to MUAC cutoff points, the prevalence of undernutrition was 33.7%.

In a cross sectional study (Bose et al 2007a) on 283 adult females belonging to Bathudi tribal group of Keonjhar district of Orrissa, the age variations of anthropometric and body composition variables and nutritional status were investigated. Significant age variation in anthropometric and body composition measures was reported. Age had significant negative impact on most of these variables including weight and BMI and MUAC. With increasing age there was also a significant increase in the prevalence of CED.

Variation of adult body dimension and prevalence of chronic energy deficiency (CED) with its determinants (socio-economic, nutrient and morbidity) among the shabar tribe living in urban, rural and forest areas of Orissa, India. The study carried out 444 males and 489 females aged20-60 years from the Khurda and cuttack districts. The highest prevalence of undernutrition is observed among forest dwelling males and rural females. Gender differences are high in rural area. Higher prevalence of CED is observed among illiterates, within larger families, economically poorer groups, those with inadequate nutrient consumption, and those who had experienced morbid conditions. Sex and habitation-wise, the risk factors associated with CED were different. Notably, economic disparity and morbidity condition were a significant risk factor of CED among rural females (Chakrabarti et al 2010).

The Present study (210 adult females) is conducted to assess the prevalence of chronic energy deficiency and its socio-demographic correlates among women in various slum areas of Amritsar city, Punjab, India. Nutritional status of women is assessed by using body mass index and it is observed that 21.3% of women were suffering from chronic energy deficiency. Out of these 13.8% had grade I chronic energy deficiency 4.7 % and 2.8% were suffering from grade II and grade III CED deficiency respectively. On bivariate analysis nativity, socio-economic status, literacy, and contact with health worker were the statistically significant factors affecting CED amon women. But multivariate regression analysis identified only literacy of women as significant factor affecting the nutritional status of women. Literacy of women is the only statistically significant factor determining the prevalence of CED (Devgun P 2014).

The study (Goswami .M 2014) is compared with the 204 Lodha and 157 Kharia adult men of Mayurbhanj District, Odisha, India. Lodha males had significantly higher mean height (P<0.001), weight (P<0.001) and BMI (P<0.1) compared with the Kharias. Both the Lodha (48.5%) as well as the Kharia(50.3%) males and similar high rates of chronic energy deficiency (CED). The prevalence of CED is very high (>=40%) in both these groups, indicating a critical situation.

Obesity and overweight have become a global epidemic now. The third round of the National Family Health Survey (NFHS) 2005-2006 data were used. The study (Goada et al 2014) shows that the prevalence of overweight and obesity is very high in urban areas, more noticeably among non-poor households. Overweight and obesity increase with age, education and parity of women. This study used a separate wealth index for urban India constructed using principal components analysis. Marital status and media exposure are the other covariants associated positively with overweight and obesity

A cross sectional study (Mondal et al 2016) were undertaken among 1169 karbi adults (male 625, female 544) residing in Karbi Anglong district of Assam, Northeast, India. The results shows that the prevalence of obesity using BMI (>=25.00 kg/m2) are 15.52% and 15.26% among males and females respectively (P>=0.05). The prevalence of obesity using neck circumference (NC) is observed to be significantly higher among males (48.80%) than female (19.12%) (P<0.01). The binary logistic regression analysis showed that NC predicted obesity over the conventional anthropometric variable with reasonable accuracy ($P<0.01$). The ROC-AUC analysis showed a relatively greater significant association between BMI, WC, HC and NC for obesity ($P<0.01$).

A community based cross sectional study of 100 rural overweight women in rural areas of Nellore town aged 20-50 years. There is a significant association observed between age group and body mass index. It is observed that no significant association observed between age-waist-to-hip ratio, age-waist circumference, age-body fat and age body type. Hence, it is evident that body fat had a positive and significant relationship with triceps, biceps, chest, suprailiac, waist circumference, hip circumference, mid upper arm circumference and BMR (Vijayalakshmi et al. 2014).

2.2.2 BMI and Socio-Economic Status (SES):

In India, there are a number of studies to see the relationship of SES and anthropometric characteristics, especially BMI and CED.

In their study (Shukla et al 2002) referred above, found that low BMI was associated with lower educational attainment in both the sexes. The lowest educational grade (illiterate) was 4.83 times likely to be CED than the highest (college) grade. Again, the highest grade had 2.25 times higher a chance to be overweight than the illiterates.

A study in six villages in the Pune district of Maharashtra, India (Barker et al 2006) showed that living in poorer quality of houses was associated with lower BMI in both sexes. Higher educational status on part of women was associated with higher BMI in men but not the women themselves.

The study (Gautam 2008) of the central Indian caste populations, had pointed out the differences in the prevalence of CED according to the occupational categories. The prevalence of CED was found to be the highest (72%) among the castes earning their living as daily wage labourers.

The studies carried out 865 individuals of both sexes and all ages selected from urban slum, villages, and indoor and outdoor patients of a private medical college, Bhosari, Pune. A cross sectional study on socioeconomic factors and longevity found higher income households had longer life expectancy as compared to deprive persons (Banerjee et al 2012).

The recently Studied (Das S. and Bose K. 2015) the nutritional status and socio-demographic profile of adults tribal people (aprox 600). The prevalence of chronic energy deficiency (CED) using Body mass index (BMI) and various demographic profile of Indian tribes based on studies published hitherto. In total 76 studies were reviewed for mean BMI based on the World Health Organization (WHO) classification of the public health problem of low BMI, based on adult populations worldwide. The overall sex specific prevalence of CED showed that both the tribal females (52.0%) and males (49.3%) were passing through the critical situation with respect to nutritional status with female being more underprivileged.

2.2.3 Undernutrition and Morbidity:

In a very recent study (Sauvaget et al 2008), based on a follow-up data (1995-2004) comprised of 75868 adult persons (aged 35 years and above) from Kerala state of South India, was conducted. The study concluded that among that rural Indian population, mild to severe leanness (BMI < 16.0 kg/m^2) and weight loss were important determinants of mortality, especially from chronic respiratory diseases, while overweight and above (BMI > 23.0 kg/m^2) did not show any detrimental effect. The authors also emphasized that underweight and weight loss had major public health implications in India, predominantly in rural areas, where the leanest people were found frequently. Therefore, it put an unasked question about the urban sections of the poorer people with a high prevalence of CED.

Thus, the number of studies in India dealing with undernutrion and morbidity is limited. Among those, most of them used BMI as the measure of undernutrition. Only one study from India assessed the relationship of self-repoted morbidity with anthropometrically assessed body composition in one tribal population in Meghalaya state (Khongsdier 2005). Therefore, it was of interest to the present researcher to investigate the relationship of reported morbidity with the overall anthropometric profile and body composition, which, none of the workers had reported.

In some studies, which used self reported morbidity (Khongsdier 2002) and reported work-disabling morbidity (Pryer 1993), also shown some indications that the conventional cut off value of 18.5 kg/m^2 of BMI for defining CED might not be appropriate for Indian subcontinent. But there is a dearth of studies in these directions in India as well as abroad. There is also lack of studies involving self reported morbidity as a proxy measure of morbidity history in communities.

The Study (Das et al 2012) is a review work, done to understand the prevalence of undernutrition among the adult tribal people of different states of India. It has been observed that various tribal populations have high to very high rates of chronic energy deficiency (CED) based on their body mass index (BMI) value. These populations are experiencing extreme nutritional stress, implications with respect to morbidity and mortality.

Mukherjee at el (2015) carried out a cross sectional study was conducted to evaluate the nutritional status based on BMI of 176 adults Tharu a tribal population of Uttarakhand, India. The extent of undernutrition (BMI<18.5) was found to be moderately high (22.2%) especially among old aged individuals. Moreover, there was a significant differences in the prevalence of under nutrition between males (26.2%) and females (18.9%).

2.3 REGIONAL CONTEXT:

2.3.1 Anthropometry and Body Composition:

A cross-sectional study (Bose et al 2006a) was undertaken to determine anthropometric profile and the prevalence of chronic energy deficiency (CED), based on body mass index (BMI) of adult Santals, a tribal population of Jhargram, West Medinipur District, West Bengal, India. A total of 410 adult (aged > 18 years) Santals near Jhargram town of West Medinipur District, West Bengal, India, were studied. The overall extent of CED (BMI < 18.5) was found to be very high (36.8%). The prevalence of CED was higher in women (41.8%) compared to men (31.5%), although this difference was statistically not significant.

The investigation of sexual dimorphism in age variations in anthropometry, body composition and undernutrition among Kora Mudis, a tribal population of

Bankura District, West Bengal, India. A total of 500 adult (18.0 < age ≤65.0 years) subjects (250 men and 250 women) were included in the study. Age was significantly negatively related with adiposity measures and CED was a serious problem among this group, especially among the older individuals (Bisai et al 2008).

The studied carried out among 513 (196 males and 317 females) adults Santal tribals of Purulia District, West Bengal, India. Based on BMI and Chronic energy deficiency females were found to be more undernourished than their male counterparts (30.6%) & 63.4%). The sex differences were statistically highly significant. This study demonstrated that sandals of Purulia, both males as well as females, were under nutritional stress (Das et al 2010).

A cross sectional study conducted in randomly selected 100 female students of different colleges of Kolkata with the age of 18-22 years studied Sengupta et al. (2013). The results showed majority of the students have normal range of BMI (67.95%), but, 21.95% of students found to be overweight and 3.84% are obese. They also showed higher fat mass but lower waist-to-hip ratio and conicity index. They were found to have poor to moderate physical fitness and higher energy expenditure.

A total of 236 individuals including 133 males and 103 females aged 17-30 years were studied Biswas et al. (2016) and were divided into three groups, Eastern India as represented by bengalee young adults, North east Indians of Mongolian origin as represented by Nepalese & Bhutia young adults and Proto Australoid ethnic groups as represented by young adult of Santal tribe. It was observed that there existed significant ethnic group differences for $SF_{4,}$ TER, PBF and FM. It was also observed in the study that there existed no significant differences for central obesity status by ethnic groups and sex.

2.3.2 BMI and Socio-Economic Status (SES):

A cross-sectional study by Bose et al (2007c) among the adult male slum dwellers of the Midnapore town, to study the inter-relationships of chronic energy deficiency (CED) and monthly family income (MFI). Subjects belonging to the lowest family income group (FIG I) had the lowest mean BMI (19·1 kg/m2) and the highest rate of CED (46·3%) and morbidity (36·6%). Those in the highest family income group (FIG III) had the largest mean BMI (20·8 kg/m2) and lowest rate of CED (30·2%) and morbidity (30·2%). The highest rate (18·9%) of hospitalization was found in this group.

Another cross-sectional study (Bose et al 2007b) on 333 adult females belonging to the same slum in Midnapore town in West Bengal was carried out to study the relationships of monthly per capita income (MPCI) with two anthropometric measures, namely body mass index (BMI) and mid-upper arm circumference (MUAC). It also investigated the association of MPCI with chronic energy deficiency (CED). Results revealed that the mean height, weight, MUAC and BMI of the subjects were 148.2 cm, 43.2 kg, 22.7 cm and 19.6 kg/m2, respectively. The overall frequency of CED based on BMI (BMI < 18.5 kg/m2) and MUAC (MUAC < 22.0 cm) was 46.8 % and 43.5%, respectively. In conclusion, this study provided evidence that PCI was significantly associated with BMI, MUAC and the presence of CED. The relationships of PCI with BMI and MUAC were similar. The rate of CED was very high indicating a critical situation. These findings might have severe public health implications. It was recommended that immediate appropriate nutritional intervention programme be initiated among this population along with serious efforts to increase their PCI. In this population, either BMI or MUAC was proposed to be effectively used to study the effect of PCI on nutritional status.

A cross sectional study (Bhattacherjee et al 2010) survey is conducted among 309 adults of age group 20-70 years in three villages of Coochbehar district, North Bengal, India. The subjects were moderately thin in all age groups. The prevalence of thinness among males and females is 51.4% and 45.6% respectively.15.2% of men and 17.5% of women were found to be severely thin. The mean BMI of the respondent of lowest (20-29 years) and highest (>50 years) age group is comparatively lower than other age groups. This implies that the survey area in critical situation with very prevalence of undernutrition. Significant association of hemoglobin level is found with body mass index and smoothing in the present study. The study demonstrates that low BMI and anemia are present at considerable levels in both adult males and females.

A cross sectional study (Ghosh S. 2015) of 1262 adults sandals (692 males and 570 females)were collected from Bankura District of west Bengal.The effect of various socio-economic factors on nutritional status which is estimated from BMI. The result shows that undernutrition is an increasing problem in West Bengal, especially in tribal communities.

The study was conducted among urban adult Bengalee Hindu males residing at Hridaypur within the Barasat Municipality, in the District of North 24 parganas, west Bengal, India.The study population of present investigation consisted of 300 males aged 20 to 50 years. The main finding of the present study according to BMI, there is a moderate rate of obesity in the studied smple (3.33%). The frequency of overweight is alarming (29.33%) in the studied population (Roy et al 2016).

In this study conducted by Sinha et al. (2015) haemoglobin level of 353 women belonging to the reproductive age group (15 to 45 years) residing in Paschim Medinipur district, West Bengal India.The socio-economic status of the women in this study was assessed by revised Kuppuswami's socio-economic scale. The data revealed a significant correlation between haemoglobin level in this group of women with their corresponding anthropometric parameters like weight, height, waist circumference, waist-hip-ratio while the basal metabolic rate was found to be strongly correlated with haemoglobin level.

2.3.3 Undernutrition and Morbidity:

There is only one study from West Bengal, typically addressing the relationship of self reported morbidity, days of hospitalization and BMI and CED among slum population. Bose et al (2007c) undertook a cross-sectional study on 212 adult (>18 years) male slum dwellers of the same Midnapore town described in Bose et al (2007c), to study the inter-relationships of chronic energy deficiency (CED), monthly family income (MFI), self-reported morbidity and hospitalization due to severe illness. In conclusion, this study provided evidence that there were strong inter-relationships between BMI, CED, MFI and morbidity.

A cross sectional study (Roy et al. 2013) of 357 adults Oraon labourers engaged in two different occupations, namely, agriculture and brickfield in Jalpaiguri district, West Bengal, of which are 62 male and 43 female agricultural labourers and 136 male and 116 female brickfield labourers. Mean values of both the occupational groups show similar trends in case of selected anthropometric and health traits. Individuals are ecto-mesomorphic irrespective of sex and occupation. Majority of individuals of either sex of both the occupational groups are underweight but hypertensive. The trend of mean values is important than mere statistical significance. Data indices that both the occupational groups have similar health conditions may be due to their heavy manual activity.

A cross sectional study (Das et al. 2013) was conducted among two male tribal groups Munda (n=106) and Oraon (n=104) aged 18-73 years of Paschim Medinipur, west Bengal. The prevalence of undernutrition was very high (critical situation), both among Munda and Oraons males. On the other hand using PBF it showed that (29.3%) Mundas and (35.4%) Oraons had low body fat percentage. Significantly negative correlations were observed between age and BMI and positive correlation between age, waist-hip ratio (WHR), and conicity index (CI) among Mundas and Oraons.

CHAPTER – III

MATERIALS AND METHODS

III

Materials and methods

3.1 THE AREA AND THE POPULATION:

Pashcim Medinipur lies to the south west of the state of West Bengal. It is surrounded by Bankura to the north, state of Jharkhand to the west, Hugli to the north east and Orissa to the west. Purba Medinipur lies to the east of Paschim Medinipur. The district lies between 21 degree 47 minutes and 23 degrees north latitude and between 86 degrees 40 minutes and 87 degrees 52 minutes east longitude. The head quarters are located in Medinipur city.

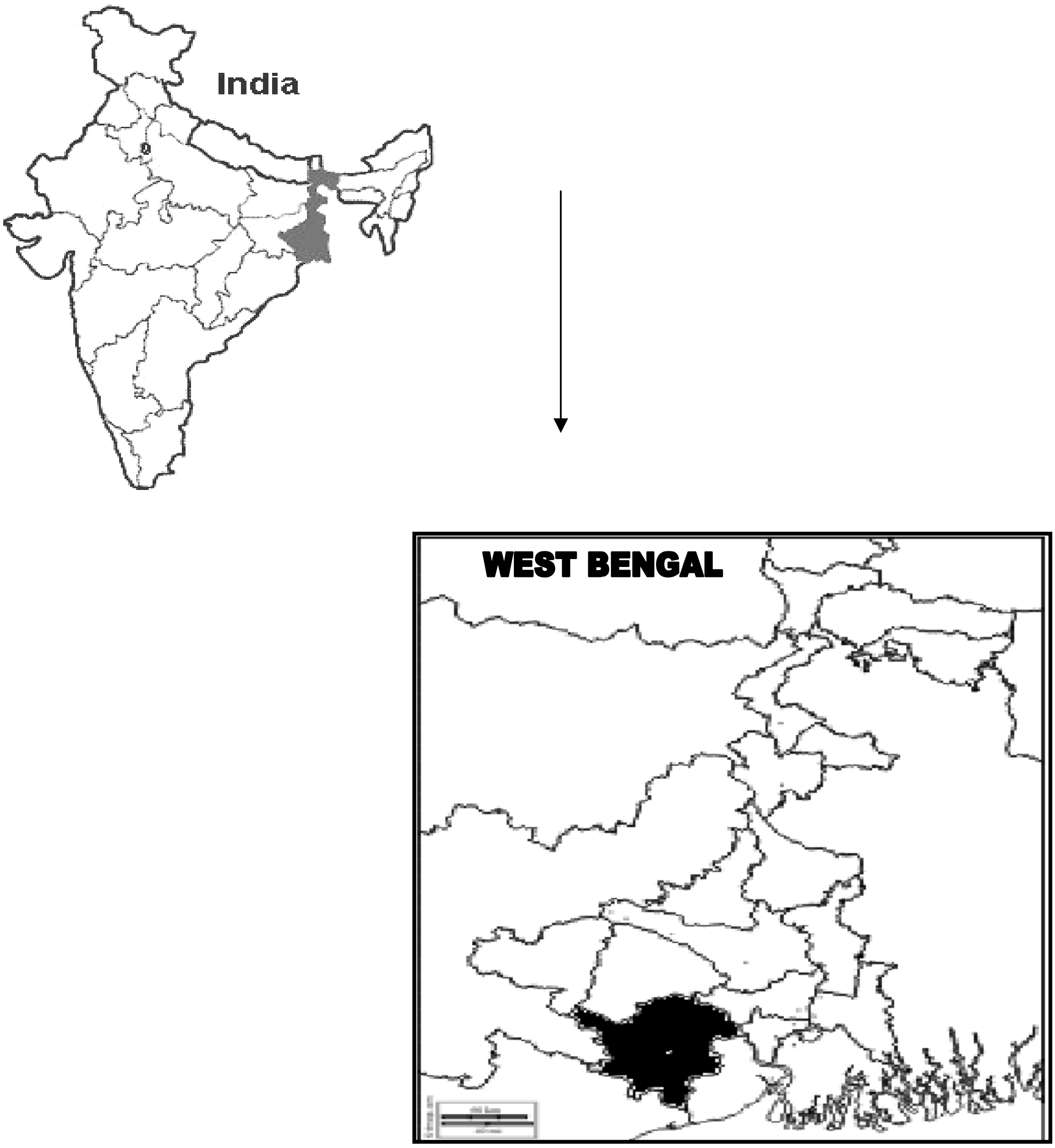
3.1.1 THE BOUNDARY OF THE STUDY AREA:

The study was conducted in an urban slums situated in several wards of Midnapore town. Midnapore is approximately 130 kms from Kolkata, the provincial capital of west Bengal. The period of the study was 2011-2016.

Presently, the slum dwellers of Midnapore are predominantly populated by the Hindu–Bengalee ‘lower–caste’ groups, mainly the ‘Harijon’, with the exception of a few Muslim and few ‘higher caste’ families. Most of the people are engaged in so-called jobs of low socio-economic status, such as Municipality sweeper, rikshow –puller, day-labourers, made servents etc. The general hygienic condition clearly seems to be poor. The sanitation, sewerage systems and household structures are the silent but definite indications of their poverty and poor quality of life.

Finally, they were requested by the present worker to campaign for the work in their respective parts of the area. The municipal authorities and local community leaders were also informed formally before commencement of the study.

Figure 3.1: Outline Map of the Field Area at the National, State and District Level



District Paschim Medinipur Field Site (Midnapore Town)

Figure 3.2: Outline Map of Paschim Medinipur District of West Bengal

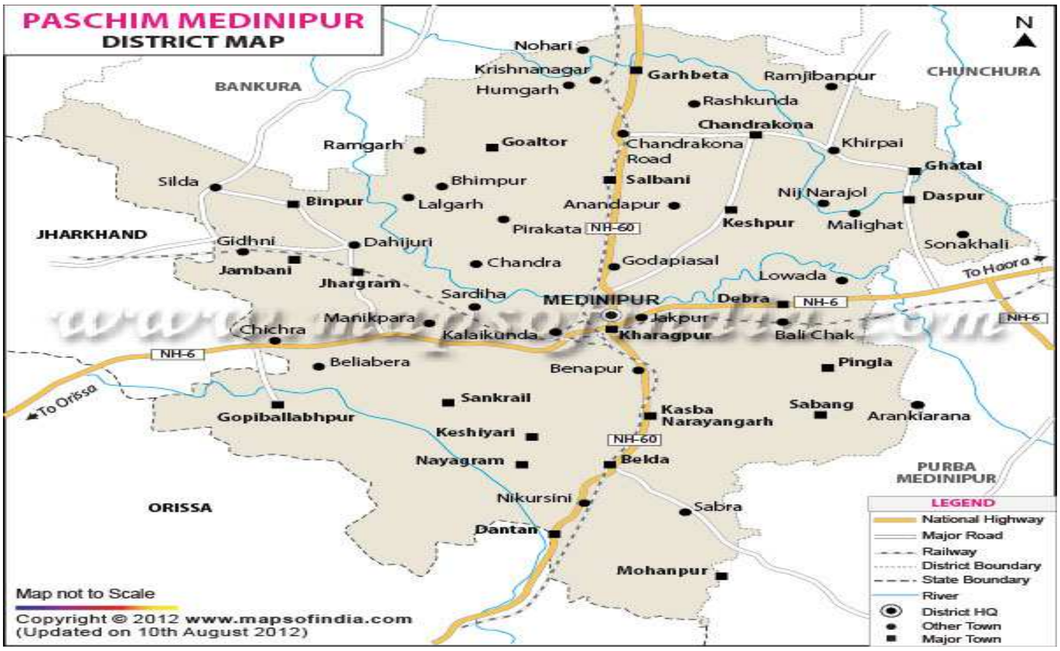


Figure 3.3: Outline Map of Midnapore Town

3.2 THE SUBJECTS AND THE SAMPLING:

On principle, all households were initially considered eligible for inclusion in the study. No strict statistical sampling of individuals could be applied to collect data due to operational difficulties in the field as was also mentioned by other researchers (Khongsdier 2002). On first approach, the adult members of the household were informed and convinced about the objective of the research. An attempt was made to include in the sample all those adult males and females aged 18 years and above, who were willing to co-operate after getting proper information. On agreement, reportedly and apparently healthy (devoid of apparent acute disease and being in their normal working condition) males and females aged 18 years and above, were included to carry out the work. The municipal authorities and local community leaders were informed before commencement of the study. The houses were situated in a linear fashion one after another from one end to the other of the slum. Each household was approached during field visits from one direction to another of the slum and the available adult slum dwellers member(s) were selected for the study. They were measured on the same day of the verbal introduction or on any other day as per their convenience by fixing prior appointments. In the same manner the previously selected parts of the slum was covered totally from one direction to the other. Almost each subject was interviewed and measured at their respective household. In some cases, due to logistical problems, they were taken to a common place where a number of them were examined. However, the fact that all the participants essentially resided inside the various wards in Midnapore town was taken care of. Overall response rate was found to be around 80%. Informed consent was also obtained from each participant. Apparently healthy men, who were reportedly not suffering from any acute illness, and were self-satisfactorily under their normal day-to-day work-schedule at the time of measurements, were enrolled to participate in the study. The apparently and self-reportedly healthy slum dwellers of each family unit were thus, sampled randomly.

3.2.1 THE FINAL SAMPLE SIZE:

In the above mentioned procedure, data were collected on 496 male and 508 female belonging to the Bengalee Hindu, Muslim and Other castes aged 18 and above in the Midnapore town under the jurisdictions of the municipal wards respectively.

Among them four was excluded for some missing anthropometric data. Therefore, the final sample size of the study was 494 male and 506 female comprising adult male and female aged between 18 and 84 years.

3.3 AGE GROUPS:

Subjects were classified into five age groups, each with a width of 10 years. The groups were 18-29, 30-39, 40-49, 50-59, and >60 years ***(Table 3.1).***

Table 3.1: Studied Sample: An Overview

Field Setup		5 Slums of Midnapore town
Age Range		18.0 – 81.0 Years
Mean Age	Males	34.75 (SD $\pm$ 2.20) Years
	Females	37.05 (SD $\pm$ 2.13) Years
Total Sample	1000	494 Males , 506 Females
Age-wise Sample Distribution :	Males	Females
18.0 - 29.9	238	186
30.0 - 39.9	105	119
40.0 - 49.9	61	98
50.0 - 59.9	46	55
60 and above	44	48

3.4 ANTHROPOMETRY:

The technique of Anthropometry was used in this study as the most important primary tool of investigation of the individual nutritional status, body fat distribution and other necessary body dimensions.

3.4.1 THE ANTHROPOMETRIC MEASUREMENTS USED:

Unit of measurements: Units of measurements were according to International system of measurement units (System Internationale – SI), as it is now being followed internationally. All British Commonwealth countries, including the United Kingdom and Great Britain and Northern Ireland, have now accepted SI. Therefore, instead of using the conventional unit of centimeter in case of height and circumferencial anthropoetric measures, millimeter unit was used. In the result section of this thesis it was followed strictly.

General measurements: Stature or Height (cm), Sitting Height (cm), Height Acromion (cm) and Body Weight (kg),

Circumferences (cm): Mid Upper Arm Circumference (MUAC), Chest Circumference (CC), Minimum Waist Circumference (WC), Maximum Hip Circumference (HC).

Skinfolds(mm): Biceps Skinfold (BSF), Triceps Skinfold (TSF), Sub scapula Skinfold (SSF), Suprailliac Skinfold (SISF), Medial Calf Skinfold (MCSF), Anterior Thigh Skinfold (ATSF), .

All bilaterally represented measurements were taken on the left side of each subject. Standard anthropometric techniques (Lohman et al.1988) were followed to take all anthropometric measurements.

Derived Variables: Body Mass Index (BMI, kg/m^2), Waist-Hip Ratio (WHR), Waist Height Ratio (WHTR), and Conicity Index (CI) (Valdez, Seidell, Ahn et al 1993) were computed using standard equations as follow:

BMI (kg/m^2) = weight (kg) / height (m^2).

WHR = WC (cm)/HC (cm).

CI = WC (cm) / (0.109) x √ [weight (kg)/height (m).

3.4.2 ANTHROPOMETRIC MEASUREMENTS:

There were various methods of nutritional assessment in a population viz. 24hour's recall, estimated food record, weighed food record, food frequency questionnaire, biochemical examination, immunological examination, clinical examination etc. Of all these methods, anthropometry provides the single most portable, universally applicable, inexpensive and non-invasive method for assessing the size, proportion and composition of the body of children and adults.

Internationally accepted standard protocol (Lohman et. al., 1988) for anthropometric measurements was adopted. Anthropometric variables included height, weight, sitting height ,height acromion and circumferences like mid-upper arm, chest, waist and hip; along with, skinfold thickness of biceps, triceps, sub-scapular, and suprailiac measurements. Instruments were standardized before the commencement of data collection.

Fourteen anthropometric measurements were recorded from all adults males and females slum dwellers aged 18 years to onwards. The measurements were–

MEASUREMENTS INSTRUMENT USED NAME

General Anthropometric Rod (cm), Weighing Machine (kg), Measuring Tape (non-stretchable) (cm), Holtain skinfold Caliper(mm).

3.4.3: ANTHROPOMETRIC MEASUREMENTS:

Height (HT):

It was the measure of the vertical distance from floor to the top most point (vertex) of the head. The barefooted subject's head was straight (FH Plane) at the time of measurement. Height was recorded to the nearest 0.1cm.

Instrument used: Standard anthropometric rod.

Sitting Height (SHT):

The measurement of sitting height requires a table an anthropometer, and a base for the anthropometer. The table should be sufficiently high so that the subject's legs hang freely. The subject sit on the table with the legs hanging unsupported over the edge of the table and with the hands resting on the thighs in a cross handed position.The measurements is recoded to the nearest 0.1 cm.

Instrument used: Standard anthropometric rod.

Height Acromion (HTAC):

Height Acromion is the vertical distance taken from a standing surface to the right Acromial landmark.An anthropometer to measure the vertical distance between the standing surface and the drawn Acromion landmark on the tip of the right shoulder. The subject stand erect with his heels together and weight evenly distributed between his feet. Measure the vertical distance from the Acromion to the floor using an anthropometer.

Instrument used: Standard anthropometric rod.

Weight (WT):

It was defined as the composite measure of the total body size. Weight of lightly- clothed subjects were recorded to the nearest 0.5 kg.

Instrument used: Weighing machine (Libra, New Delhi).

CIRCUMFERENCE MEASUREMENT:

Mid upper arm circumference (MUAC):

MUAC was measured in the middle of upper arm, a point midway between the lateral projection of the acromion process of the scapula and the inferior margin of the olecranon process of the ulna. The level of measurement is determined by measuring a distance between the two points, using a tape, with the elbow flexed to 90° with the palm facing superiorly. It was recorded to the nearest 0.1cm.

Instrument used: Non stretchable measuring tape.

Chest Circumference (CC):

The measurements of chest circumference requires a highly flexible inelastic tape measure that is no more than 0.7 cm wide .During the measurement of the subject stand erect ,in natural manner,with the feet at shoulder width.The arms are abducted slightly to permit passage of the tape around the chest.When the tape is snugly in a place, the arms are lowered to their natural position at the sides of the trunk.

Instrument used: Non stretchable measuring tape.

Waist circumference (WC):

WC was taken at the level of a natural waist, which is the narrowest part of the torso. In this case the tape must be in a horizontal plane. The subject wears little clothing so that the tape may be correctly positioned. It was recorded to the nearest 0.1cm.

Instrument used: Non stretchable measuring tape.

Hip circumference (HC):

The measurer squat at the side of subject so that level of maximum extension of buttocks can be seen. Tape was placed around the buttocks in a horizontal plane at this level without compressing the skin. It was recorded to the nearest 0.1cm.

Instrument used: Non stretchable measuring tape.

SKIN FOLD MEASUREMENT:

Triceps skinfold (TSF):

TSF was measured in the mid-line of the posterior aspect of the arm, over the triceps muscle, at a point midway between lateral projection of acromion process of scapula and inferior margin of olecranon process of ulna. The level of measurement was determined by measuring a distance between the two points, using a tape, with the elbow flexed to 90°. It was recorded to the nearest 0.2 mm.

Instrument used: Holtain skinfold caliper.

Biceps skinfold (BSF):

It was measured as the thickness of a vertical fold raised on anterior aspect of arm, over belly of biceps muscle. The skinfold was raised 1.0 cm superior to the line marked for measurement of triceps skin fold thickness, on a vertical line joining the anterior border of the acromion and the center of the antecubital fossa. It was recorded to the nearest 0.2 mm.

Instrument used: Holtain skinfold caliper.

Subscapular skinfold (SUBSF):

SSSF was picked up on a diagonal, inclined infero-laterally approximately 45° to the horizontal plane in the natural cleavage lines of the skin. This site is just inferior to the inferior angle of the scapula .The subject stands comfortably erect, with the upper extremities relaxed at the sites of the body. To measure palpates the scapula, running the fingers inferiorly and laterally along its vertebral border until the inferior angle is identified. For some subjects especially the obese, general placement of the subject's arm behind the back aids in identifying the site. It was recorded to the nearest 0.2 mm.

Instrument used: Holtain skinfold caliper.

Suprailiac skinfold (SUPSF):

SUPSF was picked up on a diagonal, inclined superio-laterally approximately 45° to the horizontal plane in the natural cleavage lines of the skin. This site is just superior to the iliac process .The subject stands comfortably erect, with the upper extremities relaxed at the sites of the body. To measure the suprailiac position, running the fingers superiorly and laterally along its horizontal border just above the suprailiac angle. It was recorded to the nearest 0.2 mm.

Instrument used: Holtain skinfold caliper.

Medial-Calf skinfold (MCSF):

This measurement, the leg of the subject is positioned just as in the case of calf circumference. The measurement is taken at the level of the circumference. The skin fold is raised parallel to the long axis of the calf on its medial aspect.

Instrument used : Holtain skinfold caliper.

Anterior Thigh Skinfold (ATSF):

The thigh skin fold site is located in the mid-line of the anterior aspect of the thigh, midway between the inguinal crease and the proximal border of the patella.

Instrument used: Holtain skinfold caliper.

3.4.4: DERIVED MEASUREMENTS:

Body mass index (BMI, kg/m 2):

Body mass index (BMI, kg/m 2) = Weight (kg) / height (m 2) Body mass index is one of the measures of overall adiposity. It is calculated by dividing weight (kg) by height (m 2). The BMI was used to evaluate the nutritional status of the subjects (WHO, 1995). BMI cut-off points were followed to define thinness.

Waist hip ratio (WHR)

It is a ratio, which indicates the central obesity. The amount of fat accumulated in the central or abdominal region of the body. WHR is measured as Waist circumference (cm)/ Hip circumference (cm).

WHR: Waist circumference (cm)/Hip circumference (cm)

Waist height ratio (WHTR):

It is a ratio, which indicates the central obesity. The amount of fat accumulated in the central or abdominal region of the body. WHTR is measured as Waist circumference (cm)/ Height circumference (cm).

WHTR = Waist circumference (cm) / Height circumference (cm)

Conicity Index (CI):

CI= (waist/100)/ (0.109*SQRT(weight/height/100)))

3.5 ADIPOSITY AND BODY COMPOSITION

3.5.1 MEASUREMENTS OF ADIPOSITY AND BODY COMPOSITION

Measures of Subcutaneous Fat Content

There are 5 (five) following measurements are used to compute the adiposity of the subjects.

01. Sum of all Skinfolds (SumALSF) (mm) = {Biceps + Triceps + Subscapular + Suprailiac + Medial Calf + Anterior Thigh} mm

02. Sum of Truncal Skinfolds (SumSFT) (mm) = {Subscapular + Suprailiac} (mm)

03. Sum of Extremity Skinfolds (SumSFEx) (mm) = {Biceps + Triceps + Medial Calf + Anterior Thigh} (mm)

04. Sum of Lower Extremity Skinfolds (SumLSFEx) (mm) = {Medial Calf + Anterior Thigh} (mm)

05. Sum of Upper Extremity Skinfolds (SumUSFEx) (mm) = {Biceps + Triceps} (mm)

Measures of body composition:

Percent Body Fat (PBF) was calculated using six skin folds with the following standard equations [Durnin and Womersley, 1974]:
PBF = (4.95 / density-4.5) x 100

Where,Density=1.1356-0.07x$\log_{10}$ (BSF+TSF+SUBSF+SUPSF+MCSF+ATSF).

Fat mass (FM), fat free mass (FFM), fat mass index (FMI) and fat free mass index (FFMI) were computed using following standard equations (Van Itallie et al 1990; Bose and Chaudhuri 2003).

FM (kg) = (PBF/100) x Weight (kg)

FFM (kg) = Weight (kg) – FM (kg)

FMI (kg/m^2) = FM (kg) / Height (m^2)

FFMI (kg/m^2) = FFM (kg) / Height (m^2)

3.6 ASSESSMENT OF NUTRITIONAL STATUS:

Nutritional status was determined following World Health Organisation (WHO) guidelines (WHO, 1995) to facilitate international comparison. The following BMI (kg/m^2) cut-off points were used:

CED grade III:	BMI < 16.0
CED grade II:	BMI = 16.0 – 16.9
CED grade I:	BMI = 17.0 – 18.4
Normal:	BMI = 18.5 – 24.9
Overweight:	BMI ≥ 25.0
Obese:	BMI ≥ 30.0

Therefore CED (Chronic Energy Deficiency), in general was defined as BMI < 18.5 kg/m^2. The WHO classification (WHO, 1995) of the public health problem of low BMI, based on adult populations worldwide, was followed. This classification categorizes prevalence according to percentage of a population with BMI < 18.5.

1) Low (5-9%)	Warning sign, monitoring required
2) Medium (10-19%)	Poor situation
3) High (20-39%)	Serious situation
4) Very high (≥ 40%)	Critical situation

Nutritional status was also determined using Mid-upper arm circumference (MUAC) values. The following internationally accepted cuts off values were used (James et al., 1994):

Under nutrition	MUAC < 23 cm
Normal	MUAC ≥ 23 cm

3.7 SOCIO-ECONOMIC VARIABLES:

3.7.1 INCOME:

Total monthly family income (MFI) was recorded in terms of the Indian currency of Rupees (Rs.). During the survey the rate of currency exchange was around Rs. 45 per US$ 1 (approximately). The subjects were asked about the approximate values of their total monthly income for the family unit they belonged to. The reported values were cross checked with the other adult members, mostly with the spouses, where applicable, or with other adult members.

Subjects monthly family income groups (MFIG) and the monthly per capita income groups (MPCIG) were computed.

The categories were as follows:

a) Monthly family income groups:

FIG I: MFI ≤ Rs. 3000; FIG II: MFI = Rs. 3000 – 5000

FIG III: MFI = Rs. 5001-7500; FIG IV: MFI = Rs. 7501-10000

FIG V: MFI >Rs. 10000

b) Monthly per capita income groups:

PCIG I: MPCI ≤ Rs. 850

PCIG II: MPCI = Rs. 851-1500

PCIG III: MPCI = Rs. 1501-3000

PCIG IV: MPCI > Rs. 3000

3.7.2 HOUSE TYPES:

House types were categorized according to the material by which walls were constructed. Three types of materials were found, namely mud, brick and bamboo fencing. Accordingly, they were classified here as brick-walled (*pucca*), mud-walled and bamboo-fenced (*kuchha*), respectively. The roofs of all the houses covered with four types of material were found, namely tile, asbestos/tin, pucca and straw. For the categorization, the method of direct observation and interview were used according to situation. Another parameter for housing was based on whether the house was owned or rented.

3.7.3 EDUCATIONAL STATUS:

Educational status was recorded as the standard of class for which the subject, at least, appeared the examination. The ones, who were found to be able to sign their name, were recorded as ‘can sign only’. The ones, who could not even sign, were recorded as illiterates.The ones, who read in class III to class VII, was recorded as ‘Primary’. The ones, who read in class VIII to class XI, was recorded as ‘Secondary’. The ones, who read in class XII to unsuccessful graduation, was recorded as ‘Higher Secondary’. One, who could clear the final year under-graduate examination and who passed the masters examination were recorded as ‘graduates and above ’.

The following educational categories were recorded: Illiterate, can sign only (including below the third standard), primary (from the third standard up to the seventh standard), secondary (from eighth to the eleventh standard), higher secondary (from 12^{th} up the appearance and being unsuccessful in graduation), graduate and above.

3.7.4 OCCUPATION:

The exact reported occupations of each individual were recorded in the questionnare. About fifteen types of different occupations were found. For analyses, the different occupations were divided in to two groupd, viz., manual and non-manual. The criteria for classification were arbitrary and based on the perception of the present worker. The perception was, however, based on the reported activity patterns and their intensity for the jobs. The manual category included rickshaw pullers, workers in different factories, day-labourers, carpenters, Masons, maid servent hokar/sales man of different items, drivers of heavy vehicles, salesmen who used to walk or cycle extensively or carried heavy items with them on job. The non-manuals were: holders of sedentary sevices, students, grocers, retired men, unemployed, drivers of light vehicles, artists and painters, tailors, barber, electrical and electronics mechanics, goldsmiths, etc.

3.7.5 SELF REPORTED MORBIDITY:

This method, based on self-reporting, has been considered preferable in consideration of the greater amount of time involved in clinical diagnosis, cost and availability of technical expertise, which is not always possible in conducting community based studies in a developing country like India (Khongsdier 2002). Therefore, it has been a good proxy measure for assessment of general morbidity at the community level.

In this study, **self-reported morbidity status** was defined in terms of experiencing episodes of any kind of illness during the last four weeks and/or within the last one year (excluding the last four weeks) preceding the date of measurement. Each subject was asked whether or not he had been ill at any time in the **last four weeks** or the **last one-year excluding the last month**. Individuals were classified as '*ill*' or '*not ill'* on for each of the two parameters mentioned above. No attempt was made to define any specific disease or its frequency of occurrence.

3.8 PROCEDURE OF HABITUAL PHYSICAL ACTIVITY AND EXERCISE:

Information on regular physical exercise and habitual physical activity are collected using a interview schedule questionnaire. Each subject informed me that they do regular physical excise or not. I also take subjects doing habitual physical activities i.e walking and cycling. The activity levels were classified into two categories, namely, **moderate** and **heavy**. The subjects who are doing walking only, it is mentioned as moderate, who are doing walking and cycling both, it is mentioned as heavy.

3.9: NORMALITY TEST:

Mean with standard deviations of all anthropometric variables and derived variables were computed. Variation of CED between the groups has been assessed by Chi-square test. One-way Analysis of Variance (Mascie-Taylor, 1994a, 1994b) was used to test for age differences in mean measurements within the populations. Pearson correlation analysis was computed to evaluate the association between variables. Pearson correlation coefficients (r) and linear regression analyses were used to study the interrelationship between age and anthropometric and body composition characteristics. In linear regression analyses, age was used as the independent variable. Ethical clearance Ethical approval was obtained from the Vidyasagar University Ethical Committee before the commencement of the study (details of the research are mentioned in the acknowledgement). Subjects were informed and had details about the purpose of the study explained and verbal consent of the community leaders, subjects, were obtained before the commencement of the survey. Identities of subjects were kept with confidentiality and were marked with folio numbers in the database. All analyses were done using the statistical package of SPSS (version 16.00). Microsoft® Excel was also used for some basic mathematical analyses and construction of some figures.

3.10: RELIABILITY OF ANTHROPOMETRIC MEASUREMENTS:

At the preliminary stage of the present interpretation, intra-observer technical errors of measurements (TEM) were calculated based on replicate measurements on 30 random selected subjects. But the results were fell within acceptable ranges when compared with other research (Cameron 1984, Mueller and Martorell 1988, Ulijaszek and Lourie 1994, Ulijaszek and Kerr 1999). Therefore, TEM was not incorporated in further statistical analyses.

3.11: DATA MANAGEMENT AND STATISTICAL ANALYSIS:

Data were collected on a pre-designed schedule and finally transferred from data sheets onto a computer software programme (SPSS). All the entries were double-checked for any probable keyboard mistake. All statistical analyses were computed using the SPSS Package (SPSS 16) on a computer. Descriptive statistics for continuous variables were computed by mean, standard deviation (SD), and 25, 50 and 75 percentile values. Necessary statistical test were performed, as per requirements, following standerd manner (Mascie-Taylor 1994a, 1994b; Madrigal 1998, Landau and Everitt 2004). Age variation was tested using ANOVA. The statistical tests were two-tailed; $p < 0.05$ was considered as statistically significant.

CHAPTER – IV

RESULTS - I

AGE AND SOCIO – ECONOMIC CHARACTERISTICS

(WITH 35 TABLES AND 29 FIGURES IN THE TEXT)

IV

Results - I

AGE AND SOCIO-ECONOMIC CHARACTERISTICS OF THE SAMPLE:

4.1 AGE:

Table 4.1.1 shows mean, SD and 25th, 50th and the 75th percentiles values of age of the studied sample. The mean (SD) of adult males and females age were 34.75 (14.72) and 37.05 (14.24) years respectively. The range was 81.00 years.

4.2 OCCUPATION:

The distribution of the subjects according to the occupational categories is presented in ***table 4.2***.1 ***(Fig 4.1)***. Present studied sample engaged in manual occupation of males were 55.06% and females were 37.94% respectively. The subjects were engaged in non-manual occupation of males and females were 44.94% and 62.06% respectively.

4.3 EDUCATION:

Table 4.3.1 (Fig 4.2) describes the educational status of the subjects. 22.87% of males and 48.02% of females were illiterate. Leaving them, the literacy rate of males and females were 77.13% and 51.98%. In the literate 2.23% of males and 0.79% of females were can sign only, 25.51% of males and 23.12% of females had primary education and 31.99% of males and 21.75% of females had completed secondary education, 9.51% of males and 4.15% of females had higher standards. Among them, only 7.89% of males and 2.17% of females were passed Graduation and above.

4.4 INCOME:

The income profile of the subjects is presented in ***table 4.4***.1 ***(Fig 4.3)***. The income was estimated through two parameters, viz., total monthly family income (MFI), and total monthly per capita income of a family (MPCI). The mean (SD) of males and females of studied samples monthly family income (MFI) were Indian Rs. 7827.73 (5336.35) and Rs. 6664.59 (4732.81) respectively. The mean (SD) of monthly per capita income were Rs. 1727.97 (1250.41) and Rs. 1480.13 (1092.29) respectively of adult males and females slum dwellers. The 25th, 50th and the 75th percentiles values are also presented for the two variables.

Table 4.4.2 (Fig 4.4) presents the distribution of the subjects across the five monthly family income groups (MFIG). 13.76% of the males and 18.58% of the females were belonged to lowest income category and 18.83% and12.65 % in the highest income category. ***Table 4.4.3 (Fig 4.5)*** depicts the distribution of the subjects according to the monthly per capita income groups (MPCIG). 18.62% and 10.32% of the males was in the lowest and the highest categories and the monthly per capita income groups (MPCIG) of the females was in the lowest and the highest categories were 25.30 % and 4.74 %.

4.5 HOUSING CHARACTERISTICS:

Table 4.5.1 (Fig 4.6) shows the housing characteristics of the subjects in terms of i) the material used for the construction of the walls and roofs ii) whether the individual owned the house or it was a rental one, and iii) the type of toilet. There were only three distinct types of walls: brick made, Mud made and bamboo-fenced and there are four types of roofs: Tile, Tin, pucca and straw were present in studied slum dwellers. The percentages of brick-walled, mud-walled and bamboo-fenced wall type of males slum dwellers were 83.81%, 14.17%, 2.02% and 82.61%, 16.80% and 0.59% of females slum dwellers respectively. The percentages of tile, tin, pucca and straw roof types of males slum dwellers were 27.33%, 43.52%, 26.32%, 2.83% and 24.51%, 52.77%, 17.39%, 5.33% of females slum dwellers respectively. 99.19% of males and 99.21% of females had their own house, whereas 0.81% of males and 0.79% of females were living on rental basis as tenants to the owners. 34.62% of males and 21.34% of females had separate toilet and 52.22% of males and 68.98%of females had common toilet. 13.16% of males and 9.68% of females had no toilet at all.

4.6 SELF-REPORTED MORBIDITY:

Table 4.6.1 (Fig 4.7) depicts the frequencies and prevalence of self-reported morbidity of the subjects. With regard to the reported illness during last four weeks to one year prior to the day of anthropometric measurements, 24.49% of the males and 23.91% of females reported some kind of illness, whereas 75.51% of the males and 76.09% of the females had not any illness.

4.7 HABITUAL PHYSICAL ACTIVITY AND EXERCISE:

Table 4.7.1 (Fig 4.8) presents the frequency and percent of the subjects practicing regular physical exercise. Result shows that only 7.09% of the males and 0.79% of the females practiced some sorts of regular physical exercise***. Table 4.7.2 (Fig 4.9)*** tabulates the frequency and percentage of the subjects doing habitual physical activities of walking and cycling separately. Nearly all the males (99.60%) and all the females used to walk little or more everyday to maintain their daily activities. 83.40% of the males and 14.43% of the females reported to use cycle as a means of their daily travel for one purpose or the other. ***Table 4.7.3 (Fig 4.10)*** shows the categorization of the subjects according to the HPA level on the basis of their practice of walking and cycling (explained in the materials and methods section). 99.60% of the males and all the females (100%) had moderate HPA level. 83.00 % of the males and 14.43% of the females had heavy HPA level.

4.8: RELATIONSHIP BETWEEN DIFFERENT SOCIO-ECONOMICCHARACTERISTICS:

4.8.1: Occupation and House Type:

Table 4.8.1.1 ***(Fig 4.11)*** presents the relationship between occupation and house type of males. The Present studied sample who were manual worker lived their own house (n=270) and rented house (n=2). The Present studied sample who were non-manual worker lived their own house (n=220) and rented house (n=2). There is no significant occupation difference ($\chi^2_{(df=1)}$ = 0.042, *p = 0.838) in house type among male slum dwellers of Midnapore town****. Table 4.8*****.1.2 (Fig 4.12)*** presents the relationship between occupation and house type of females. The Present studied sample who were manual worker lived their own house (n=191) and rented house (n=1). The Present studied sample who were non-manual worker lived their own house (n=311) and rented house (n=3). There is no significant occupation difference ($\chi^2_{(df=1)}$ = 0.287, *p = 0.592) in house type among female slum dwellers of Midnapore town****.***

Table 4.8**.1.3** ***(Fig 4.13)*** presents the relationship between occupation and wall type of males. The Present studied sample who were manual worker lived in mud walled house (n=55), bamboo walled house (n=6) and brick walled house (n=211). The Present studied sample who were non-manual worker lived in mud walled house (n=15), bamboo walled house (n=4) and brick walled house (n=203).There is significant occupation difference ($\chi^2_{(df=2)}$ = 18.54, *p = 0.000) in wall type among male slum dwellers of Midnapore town.* ***Table 4.8.*1.4 *(Fig 4.13)*** presents the relationship between occupation and wall type of females. The Present studied sample who were manual worker lived in mud walled house (n=47), bamboo walled house (n=1) and brick walled house (n=144). The Present studied sample who were non-manual worker lived in mud walled house (n=38), bamboo walled house (n=2) and brick walled house (n=274). There is significant occupation difference ($\chi^2_{(df=2)}$ = 13.06, *p = 0.000) in wall type among female slum dwellers of Midnapore town.*

Table 4.8.*1.5 *(Fig 4.14) presents the relationship between occupation and roof type of males. The Present studied sample who were manual worker lived in their tile house (n=82), tin house (n=128), pucca house (n=52) and straw house (n=10). The Present studied sample who were non-manual worker lived their tile house (n=53), tin house (n=87), pucca house (n=78) and straw house (n=4). There is significant occupation difference ($\chi^2_{(df=2)}$ = 16.93, *p = 0.001) in roof type among male slum dwellers of Midnapore town.* ***Table 4.8.*1.6 *(Fig 4.15)*** presents the relationship between occupation and roof type of females. The Present studied sample who were manual worker lived in their tile house (n=55), tin house (n=97), pucca house (n=25) and straw house (n=15). The Present studied sample who were non-manual worker lived their tile house (n=69), tin house (n=170), pucca house (n=63) and straw house (n=12). There is significant occupation difference ($\chi^2_{(df=2)}$ = 9.41, *p = 0.024) in roof type among female slum dwellers of Midnapore town.*

Table 4.8.*1.7 *(Fig 4.16) presents the relationship between occupation and sanitation type of males. The Present studied sample who were manual worker used open toilet (n=189), semi pucca toilet (n=3) and septic toilet (n=80). The Present studied sample who were non-manual worker used open toilet (n=104), semi pucca toilet (n=3) and septic toilet (n=115) .There is significant occupation difference ($\chi^2_{(df=2)}$ = 26.15, *p = 0.000) in sanitation type among male slum dwellers of Midnapore town.* ***Table 4.8.*1.8 *(Fig 4.17)*** presents the relationship between occupation and sanitation type of females. The Present studied sample who were manual worker used open toilet (n=154), semi pucca toilet (n=4) and septic toilet (n=34). The Present

studied sample who were non-manual worker used open toilet (n=156), semi pucca toilet (n=23) and septic toilet (n=135). There is significant occupation difference ($\chi^2_{(df=2)}$ = 47.07, *p = 0.000) in sanitation type among female slum dwellers of Midnapore town.*

4.8.2: Monthly Family Income Group and House Type:

***Table 4.8.2*.1** presents the relationship between monthly family income groups and house type of males. The Present studied sample who were belongs to MFIG I lived their own house (n=66) and rented house (n=2). The present studied sample who were belongs to MFIG II lived their own house (n=134) and rented house (n=2). The present studied sample who were belongs to MFIG III lived only their own house (n=104). The present studied sample who were belongs to MFIG IV lived only their own house (n=66). The present studied sample who were belongs to MFIG V lived only their own house (n=120). There is no significant monthly family income groups difference ($\chi^2_{(df=4)}$ = 6.95, *p = 0.138) in house type among male slum dwellers of Midnapore town.* ***Table 4.8*.2.2** presents the relationship between monthly family income groups and house type of females. The Present studied sample who were belongs to MFIG I lived their own house (n=92) and rented house (n=2). The present studied sample who were belongs to MFIG II lived their own house (n=160) and rented house (n=1). The present studied sample who were belongs to MFIG III lived only their own house (n=100). The present studied sample who were belongs to MFIG IV lived only their own house (n=56). The present studied sample who were belongs to MFIG V lived their own house (n=94) and rented house (n=1). There is no significant monthly family income groups difference ($\chi^2_{(df=4)}$ = 3.53, *p = 0.474) in house type among female slum dwellers of Midnapore town.*

Table 4.8*.2.3 *(Fig 4.18) presents the relationship between monthly family income groups and wall type of males. The Present studied sample who were belongs to MFIG I lived their mud walled house (n=22), bamboo walled house (n=5) and brick house (n=41). The present studied sample who were belongs to MFIG II lived their mud walled house (n=26), bamboo walled house (n=3) and brick house (n=107)). The Present studied sample who were belongs to MFIG III lived their mud walled house (n=12), bamboo walled house (n=1) and brick house (n=91). The Present studied sample who were belongs to MFIG IV lived their mud walled house (n=4), bamboo walled house (n=1) and brick house (n=61). The Present studied sample who were belongs to MFIG V lived their mud walled house (n=6) and brick house (n=114). There is significant monthly family income groups difference ($\chi^2_{(df=8)}$ = 49.023, *p = 0.000) in wall type among male slum dwellers of Midnapore town.* ***Table 4.8.2.4 (Fig 4.19)*** presents the relationship between monthly family income groups and wall type of females. The Present studied sample who were belongs to MFIG I lived their mud walled house (n=33), bamboo walled house (n=2) and brick house (n=59). The Present studied sample who were belongs to MFIG II lived their mud walled house (n=35) and brick house (n=126)). The Present studied sample who were belongs to MFIG III lived their mud walled house (n=6), bamboo walled house (n=1) and brick house (n=93). The Present studied sample who were belongs to MFIG IV lived their mud walled house (n=3) and brick house (n=53). The Present studied sample who were belongs to MFIG V lived their mud walled house (n=8) and brick house (n=87). There is significant monthly family income groups difference ($\chi^2_{(df=8)}$ = 50.297, *p = 0.000) in wall type among female slum dwellers of Midnapore town.*

Table 4.8.2.5 (Fig 4.20) presents the relationship between monthly family income groups and roof type of males. The Present studied sample who were belongs to MFIG I lived their tile house (n=25), tin house (n=35), pucca house (n=4) and straw house (n=4). The Present studied sample who were belongs to MFIG II lived their tile house (n=51), tin house (n=62), pucca house (n=19) and straw house (n=4). The Present studied sample who were belongs to MFIG III lived their tile house (n=25), tin house (n=54),pucca house (n=22) and straw house (n=3). MFIG IV lived their tile house (n=15), tin house (n=31), pucca house (n=19) and straw house (n=1). The Present studied sample who were belongs to MFIG V lived their tile house (n=19), tin house (n=33), pucca house (n=66) and straw house (n=2). There is significant monthly family income groups difference ($\chi^2_{(df=12)}$ = 84.764, *p = 0.000) in roof type among male slum dwellers of Midnapore town.* ***Table 4.8.2.6 (Fig 4.21)*** presents the relationship between monthly family income groups and roof type of males. The Present studied sample who were belongs to MFIG I lived their tile house (n=25), tin house (n=54), pucca house (n=6) and straw house (n=9). The Present studied sample who were belongs to MFIG II lived their tile house (n=45), tin house (n=91), pucca house (n=17) and straw house (n=8). The Present studied sample who were belongs to MFIG III lived their tile house (n=24), tin house (n=58), pucca house (n=17) and straw house (n=1). The Present studied sample who were belongs to MFIG IV lived their tile house (n=13), tin house (n=27), pucca house (n=13) and straw house (n=3). The Present studied sample who were belongs to MFIG V lived their tile house (n=17), tin house (n=37), pucca house (n=35) and straw house (n=6). There is significant monthly family income groups difference ($\chi^2_{(df=12)}$ = 47.23, *p = 0.000) in roof type among female slum dwellers of Midnapore town.*

Table 4.8.*2.7 *(Fig 4.22) presents the relationship between monthly family income groups and sanitation type of males. The Present studied sample who were belongs MFIG I used open toilet (n=47), semi pucca toilet (n=1), septic toilet (n=20). The Present studied sample who were belongs to MFIG II used open toilet (n=96), semi pucca toilet (n=3), septic toilet (n=37). The Present studied sample who were belongs to MFIG III used open toilet (n=55), semi pucca toilet (n=1), septic toilet (n=48). The Present studied sample who were belongs to MFIG IV used open toilet (n=41) and septic toilet (n=25). The Present studied sample who were belongs to MFIG V used open toilet (n=54), semi pucca toilet (n=1), septic toilet (n=65). There is significant monthly family income groups difference ($\chi^2_{(df=8)}$ = 25.822, *p = 0.001) in toilet type among male slum dwellers of Midnapore town.* ***Table 4.8.*2.8 *(Fig 4.23)*** presents the relationship between monthly family income groups and sanitation type of females. The Present studied sample who were belongs MFIG I used open toilet (n=69), semi pucca toilet (n=6), septic toilet (n=19). The Present studied sample who were belongs to MFIG II used open toilet (n=100), semi pucca toilet (n=11), septic toilet (n=50). MFIG III used open toilet (n=59), semi pucca toilet (n=6), septic toilet (n=35). The Present studied sample who were belongs to MFIG IV used open toilet (n=33), semi pucca (n=6) and septic toilet (n=21). The Present studied sample who were belongs to MFIG V used open toilet (n=49), semi pucca toilet (n=2), septic toilet (n=44). There is no significant monthly family income groups difference ($\chi^2_{(df=8)}$ = 17.267, *p = 0.27) in toilet type among female slum dwellers of Midnapore town.*

4.8.2: Monthly Per Capita Income Group and House Type:

***Table 4.8.*3.1** presents the relationship between monthly per capita income groups and house type of males. The Present studied sample who were belongs to MPCIG I lived their own house (n=92).The present sample who were belongs to MPCIG II lived their own house (n=199) and rented house (n=3). The present sample who were belongs to MPCIG III lived their own house (n=130) and rented house (n=1).

The present sample who were belongs to MPCIG IV lived only their own house (n=69). There is no significant monthly per capita income groups difference ($\chi^2_{(df=3)}$ = 2.47, *p = 0.48) in house type among male slum dwellers of Midnapore town.* **Table *4.8*.3.2** presents the relationship between monthly per capita income groups and house type of females. The Present studied sample who were belongs to MPCIG I lived their own house (n=126) and rented house (n=2). The sample who were belongs to MPCIG II lived their own house (n=214). The present sample who were belongs to MPCIG III lived their own house (n=124) and rented house (n=1). The present sample who were belongs to MPCIG IV lived their own house (n=38) and rented house (n=1). There is no significant monthly family income groups difference ($\chi^2_{(df=3)}$ = 4.24, *p = 0.236) in house type among female slum dwellers of Midnapore town.*

Table 4.8*.3.3 *(Fig 4.24) presents the relationship between monthly per capita income groups and wall type of males. The Present studied sample who were belongs to MPCIG I lived their mud walled house (n=26), bamboo walled house (n=4) and brick house (n=62). The present studied sample who were belongs to MPCIG II lived their mud walled house (n=35), bamboo walled house (n=5) and brick house (n=162)). The present studied sample who were belongs to MPCIG III lived their mud walled house (n=3), bamboo walled house (n=1) and brick house (n=127). The present studied sample who were belongs to MPCIG IV lived their mud walled house (n=6) and brick house (n=63). There is significant monthly per capita income groups difference ($\chi^2_{(df=6)}$ = 40.33, *p = 0.000) in wall type among male slum dwellers of Midnapore town.* ***Table 4.8*.3.4 *(Fig 4.25)*** presents the relationship between monthly per capita income groups and wall type of females. The Present studied sample who were belongs to MPCIG I lived their mud walled house (n=49), bamboo walled house (n=2) and brick house (n=77). The present studied sample who were belongs to MPCIG II lived their mud walled house (n=27), bamboo walled house (n=1) and brick house (n=186). The present studied sample who were belongs to MPCIG III lived their mud walled house (n=4) and brick house (n=121). The present studied sample who were belongs to MPCIG IV lived their mud walled house (n=5) and brick house (n=34). There is significant monthly family income groups difference ($\chi^2_{(df=6)}$ = 66.02, *p = 0.000) in wall type among female slum dwellers of Midnapore town.*

Table 4.8*.3.5 *(Fig 4.26) presents the relationship between monthly per capita income groups and roof type of males. The Present studied sample who were belongs to MPCIG I lived their tile house (n=28), tin house (n=48), pucca house (n=12) and straw house (n=4). The present studied sample who were belongs to MPCIG II lived their tile house (n=63), tin house (n=94), pucca house (n=36) and straw house (n=9). The present studied sample who were belongs to MPCIG III lived their tile house (n=31), tin house (n=55) and pucca house (n=45). The present studied sample who were belongs to MPCIG IV lived their tile house (n=13), tin house (n=18), pucca house (n=37) and straw house (n=1). There is significant monthly per capita income groups difference ($\chi^2_{(df=9)}$ = 52.04, *p = 0.000) in roof type among male slum dwellers of Midnapore town.* ***Table 4.8.*3.6 *(Fig 4.27)*** presents the relationship between monthly per capita income groups and roof type of females. The Present studied sample who were belongs to MPCIG I lived their tile house (n=32), tin house (n=77), pucca house (n=7) and straw house (n=12). The present studied sample who were belongs to MPCIG II lived their tile house (n=59), tin house (n=113), pucca house (n=33) and straw house (n=9). The present studied sample who were belongs to MPCIG III lived their tile house (n=27), tin house (n=65), pucca house (n=29) and straw house (n=4). The present studied sample who were belongs to MPCIG IV lived their tile house (n=6), tin house (n=12), pucca house (n=19) and straw house (n=2). There is significant monthly family income groups difference ($\chi^2_{(df=9)}$ = 48.37, *p = 0.000) in roof type among female slum dwellers of Midnapore town*

Table 4.8.*3.7 *(Fig 4.28) presents the relationship between monthly per capita income groups and sanitation type of males. The Present studied sample who were belongs to MPCIG I used open toilet (n=60), semi pucca toilet (n=2), septic toilet (n=30). The present studied sample who were belongs to MPCIG II used open toilet (n=128), semi pucca toilet (n=3), septic toilet (n=71). The present studied sample who were belongs to MPCIG III used open toilet (n=73) and septic toilet (n=58). The present studied sample who were belongs to MFIG IV used open toilet (n=32) and semi pucca toilet (n=1) and septic toilet (n=36). There is no significant monthly family income groups difference ($\chi^2_{(df=6)}$ = 11.41, *p = 0.076) in sanitation type among male slum dwellers of Midnapore town.* ***Table 4.8.*3.8 *(Fig 4.29)*** presents the relationship between monthly per capita income groups and sanitation type of females. The Present studied sample who were belongs to MPCIG I used open toilet (n=92), semi pucca toilet (n=13), septic toilet (n=23). The present studied sample who were belongs to MPCIG II used open toilet (n=122), semi pucca toilet (n=11), septic toilet (n=81). The studied sample who were belongs to MPCIG III used open toilet (n=74), semi

pucca toilet (n=3) and septic toilet (n=48). The present studied sample who were belongs to MFIG IV used open toilet (n=22), and septic toilet (n=17). There is significant monthly family income groups difference ($\chi^2_{(df=6)}$ = 25.45, *p = 0.000) in sanitation type among female slum dwellers of Midnapore town.*

Table 4.1.1: Age Characteristics of the Sample

Variables	**Mean (SD)**		**Percentiles**					
	Male	**Female**	**25**		**50**		**75**	
			Male	**Female**	**Male**	**Female**	**Male**	**Female**
AGE (years)	34.75 (14.72)	37.05 (14.24)	23.00	25.00	30.00	35.00	43.25	45.00

Table 4.2.1: Frequencies of Manual and Non-Manual Occupation of the Studied Sample

Occupation	**Frequency(n)**		**Percentage (%)**	
	Male	Female	Male	Female
Manual	272	192	55.06	37.94
Non-manual	222	314	44.94	62.06
Total	494	506	100	100

Table 4.3.1: Educational Status of the Subjects

Education	Frequency (n)		Percentage (%)	
	Male	Female	Male	Female
Illiterate	113	243	22.87	48.02
Can sign only	11	4	2.23	0.79
Primary	126	117	25.51	23.12
Secondary	158	110	31.99	21.75
Higher secondary	47	21	9.51	4.15
Graduate and above	39	11	7.89	2.17
Total	494	506	100	100

Table 4.4.1: Mean and SD Values of the Income Variables of Males and Females

Variables INCOME (RS)	Mean		Percentiles					
	Male	Female	25		50		75	
			Male	Female	Male	Female	Male	Female
MFI	7827.73 (5336.35)	6664.59 (4732.81)	4000.00	4000.00	6000.00	5000.00	9000.00	8000.00
MPCI	1727.97 (1250.41)	1480.13 (1092.29)	1000.00	833.33	1333.33	1250.00	2000.00	1750.00

Table 4.4.2: Distribution of the Subjects According to the Monthly Family Income Groups (MFIG)

MFIG	Frequency(n)		Percent (%)	
	Male	Female	Male	Female
MFIG I (≤3000 Rs)	68	94	13.76	18.58
MFIG I (3001-5000Rs)	136	161	27.53	31.82
MFIG III (5001-7500 Rs)	104	100	21.05	19.76
MFIG IV (7501-9999 Rs)	93	87	18.83	17.19
MFIG V (≥10000 Rs)	93	64	18.83	12.65
Total	494	506	100	100

Table 4.4.3: Distribution of the Subjects According to the Monthly Per Capita Income Groups (MPCIG)

MPCIG	Frequency(n)		Percent (%)	
	Male	Female	Male	Female
MPCIG I (≤850 Rs)	92	128	18.62	25.30
MPCIG I (851-1500Rs)	202	214	40.89	42.29
MPCIG III (1501-3000 Rs)	149	140	30.16	27.67
MPCIG IV (≥3000 Rs)	51	24	10.32	4.74
Total	494	506	100	100

Table 4.5.1: Frequency and Percentage of the Subjects According to the Housing Characteristics

Criteria	Characters	Frequency(n)		Percent (%)	
		Male	Female	Male	Female
Wall Type	Brick-walled	414	418	83.81	82.61
	Mud-Walled	70	85	14.17	16.80
	Bamboo -fenced	10	3	2.02	0.59
Roof Type	Tile	135	124	27.33	24.51
	Tin	215	267	43.52	52.77
	Pucca	130	88	26.32	17.39
	straw	14	27	2.83	5.33
Ownership	Own	490	502	99.19	99.21
	Rental	4	4	0.81	0.79
Toilet Type	Open	293	310	59.31	61.26
	Semi pucca	6	27	1.22	5.34
	septic	195	169	39.47	33.40

Table 4.6.1: Frequencies of Self Reported Morbidity of the Studied Samples

Morbidity Status		Frequency(n)		Percentage (%)	
		Male	Female	Male	Female
Ill during last Month to one year	Yes	121	121	24.49	23.91
	No	373	385	75.51	76.09

Table 4.7.1 Frequency and Percentage of the Subjects doing Regular Physical Exercise or not

WHETHER EXERCISES REGULARLY				
Exercise Status	Frequency (n)		Percentage (%)	
	Male	Female	Male	Female
YES	35	4	7.09	0.79
NO	459	502	92.91	99.21
TOTAL	494	506	100.0	100.0

Table 4.7.2 Prevalence of Subjects doing Habitual Physical Activities of the Studied Samples

Activity	**Frequency(n)**		**Percentage (%)**	
	Male	Female	Male	Female
Walking	492	506	99.60	100
Cycling	412	73	83.40	14.43

Table 4.7.3 Prevalence of Subjects by Habitual Physical Activity Level

Activity Level	**n (%)**	
	Male	Female
Moderate	492 (99.60)	506 (100)
Heavy	410(83.00)	73 (14.43)

4.8.1: Education and Occupation

4.8.1.1: Occupation and House Type of Males

Category	House Type		Total
	Own	Rental	
Manual	270	2	272
Non-Manual	220	2	222
Total	490	4	494

$\chi^2_{(df=1)} = 0.042, p = 0.838$

4.8.1.2: Occupation and House Type of Females

Category	House Type		Total
	Own	Rental	
Manual	191	1	192
Non-Manual	311	3	314
Total	502	4	506

$\chi^2_{(df=1)} = 0.287, p = 0.592$

4.8.1.3: Occupation and wall Type of Males

Category	Mud walled	Bamboo walled	Brick walled	Total
Manual	55	6	211	272
Non-Manual	15	4	203	222
Total	70	10	414	494

$\chi^2_{(df=2)} = 18.54, p = 0.000$

4.8.1.4: Occupation and wall Type of Females

Category	Mud walled	Bamboo walled	Brick walled	Total
Manual	47	1	144	192
Non-Manual	38	2	274	314
Total	85	3	418	506

$\chi^2_{(df=2)} = 13.06, p = 0.000$

4.8.1.5: Occupation and Roof Type of Males

Category	Tile	Tin	Pucca	Straw	Total
Manual	82	128	52	10	272
Non-Manual	53	87	78	4	222
Total	135	215	130	14	494

$\chi^2_{(df=3)} = 16.93, p = 0.001$

4.8.1.6: Occupation and Roof Type of Females

Category	Tile	Tin	Pucca	Straw	Total
Manual	55	97	25	15	192
Non-Manual	69	170	63	12	314
Total	124	267	88	27	506

$\chi^2_{(df=3)} = 9.41, p = 0.024$

4.8.1.7: Occupation and Sanitation of Males

Category	Open	Semi-Pucca	Septic	Total
Manual	189	3	80	272
Non-Manual	104	3	115	222
Total	293	6	195	494

$\chi^2_{(df=2)} = 26.15$, $p = 0.000$

4.8.1.8: Occupation and Sanitation of Females

Category	Open	Semi-Pucca	Septic	Total
Manual	154	4	34	192
Non-Manual	156	23	135	314
Total	310	27	169	506

$\chi^2_{(df=2)} = 47.07$, $p = 0.000$

4.8.2.1: Monthly Family Income Groups and House Type of Males

Category	Own	Rental	Total
MFIG I	66	2	68
MFIG II	134	2	136
MFIG III	104	0	104
MFIG IV	66	0	66
MFIG V	120	0	120
Total	490	4	494

$\chi^2_{(df=4)} = 6.95$, $p = 0.138$

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4.8.2.2: Monthly Family Income Groups and House Type of Females

Category	Own	Rental	Total
MFIG I	92	2	94
MFIG II	160	1	161
MFIG III	100	0	100
MFIG IV	56	0	56
MFIG V	94	1	95
Total	502	4	506

$\chi^2_{(df=4)} = 3.53$, $p = 0.474$

4.8.2.3: Monthly Family Income Groups and Wall Type of Males

Category	Mud walled	Bamboo walled	Brick walled	Total
MFIG I	22	5	41	68
MFIG II	26	3	107	136
MFIG III	12	1	91	104
MFIG IV	4	1	61	66
MFIG V	6	0	114	120
Total	70	10	414	494

$\chi^2_{(df=8)}$ = 49.023, $p = 0.000$

4.8.2.4: Monthly Family Income Groups and Wall Type of Females

Category	Mud walled	Bamboo walled	Brick walled	Total
MFIG I	33	2	59	94
MFIG II	35	0	126	161
MFIG III	6	1	93	100
MFIG IV	3	0	53	56
MFIG V	8	0	87	95
Total	85	3	418	506

$\chi^2_{(df=8)}$ = 50.297, $p = 0.000$

4.8.2.5: Monthly Family Income Groups and Roof Type of Males

Category	Tile	Tin	Pucca	Straw	Total
MFIG I	25	35	4	4	68
MFIG II	51	62	19	4	136
MFIG III	25	54	22	3	104
MFIG IV	15	31	19	1	66
MFIG V	19	33	66	2	120
Total	135	215	130	14	494

$\chi^2_{(df=12)} = 84.764$, $p = 0.000$

4.8.2.6: Monthly Family Income Groups and Roof Type of Females

Category	Tile	Tin	Pucca	Straw	Total
MFIG I	25	54	6	9	94
MFIG II	45	91	17	8	161
MFIG III	24	58	17	1	100
MFIG IV	13	27	13	3	56
MFIG V	17	37	35	6	95
Total	124	267	88	27	506

$\chi^2_{(df=12)} = 47.23$, $p = 0.000$

4.8.2.7: Monthly Family Income Groups and Sanitation of Males

Category	Open	Semi-Pucca	Septic	Total
MFIG I	47	1	20	68
MFIG II	96	3	37	136
MFIG III	55	1	48	104
MFIG IV	41	0	25	66
MFIG V	54	1	65	120
Total	293	6	195	494

$\chi^2_{(df=8)} = 25.822$, $p = 0.001$

4.8.2.8: Monthly Family Income Groups and Sanitation of Females

Category	Open	Semi-Pucca	Septic	Total
MFIG I	69	6	19	94
MFIG II	100	11	50	161
MFIG III	59	6	35	100
MFIG IV	33	6	21	56
MFIG V	49	2	44	95
Total	310	27	169	506

$\chi^2_{(df=8)} = 17.267$, $p = 0.27$

4.8.3.1: Monthly Per Capita Income Groups and House Type of Males

Category	Own	Rental	Total
MPCIG I	92	0	92
MPCIG II	199	3	202
MPCIG III	130	1	131
MPCIG IV	69	0	69
Total	490	4	494

$\chi^2_{(df=3)} = 2.47$, $p = 0.48$

4.8.3.2: Monthly Per Capita Income Groups and House Type of Females

Category	Own	Rental	Total
MPCIG I	126	2	128
MPCIG II	214	0	214
MPCIG III	124	1	125
MPCIG IV	38	1	39
Total	502	4	506

$\chi^2_{(df=3)} = 4.24$, $p = 0.236$

4.8.3.3: Monthly Per Capita Income Groups and Wall Type of Males

Category	Mud walled	Bamboo walled	Brick walled	Total
MPCIG I	26	4	62	92
MPCIG II	35	5	162	202
MPCIG III	3	1	127	131
MPCIG IV	6	0	63	69
Total	70	10	414	494

$\chi^2_{(df=6)} = 40.33$, $p = 0.000$

4.8.3.4: Monthly Per Capita Income Groups and Wall Type of Females

Category	Mud walled	Bamboo walled	Brick walled	Total
MPCIG I	49	2	77	128
MPCIG II	27	1	186	214
MPCIG III	4	0	121	125
MPCIG IV	5	0	34	39
Total	85	3	418	506

$\chi^2_{(df=6)} = 66.02$, $p = 0.000$

4.8.3.5: Monthly Per Capita Income Groups and Roof Type of Males

Category	Tile	Tin	Pucca	Straw	Total
MPCIG I	28	48	12	4	92
MPCIG II	63	94	36	9	202
MPCIG III	31	55	45	0	131
MPCIG IV	13	18	37	1	69
Total	135	215	130	14	494

$\chi^2_{(df=9)} = 52.04$, $p = 0.000$

4.8.3.6: Monthly per Capita Income Groups and Roof Type of Females

Category	Tile	Tin	Pucca	Straw	Total
MPCIG I	32	77	7	12	128
MPCIG II	59	113	33	9	214
MPCIG III	27	65	29	4	125
MPCIG IV	6	12	19	2	39
Total	124	267	88	27	506

$\chi^2_{(df=9)} = 48.37$, $p = 0.000$

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4.8.3.7: Monthly Per Capita Income Groups and Sanitation of Males

Category	Open	Semi-Pucca	Septic	Total
MPCIG I	60	2	30	92
MPCIG II	128	3	71	202
MPCIG III	73	0	58	131
MPCIG IV	32	1	36	69
Total	293	6	195	494

$\chi^2_{(df=6)} = 11.41$, $p = 0.076$

4.8.3.8: Monthly per Capita Income Groups and Sanitation of Females

Category	Open	Semi-Pucca	Septic	Total
MPCIG I	92	13	23	128
MPCIG II	122	11	81	214
MPCIG III	74	3	48	125
MPCIG IV	22	0	17	39
Total	310	27	169	506

$\chi^2_{(df=6)} = 25.45$, $p = 0.000$

Figure 4.1: Percentage of Manual and Non-Manual Occupation of the Studied Sample.

Figure 4.2: Percentage of Educational Status of the Subjects

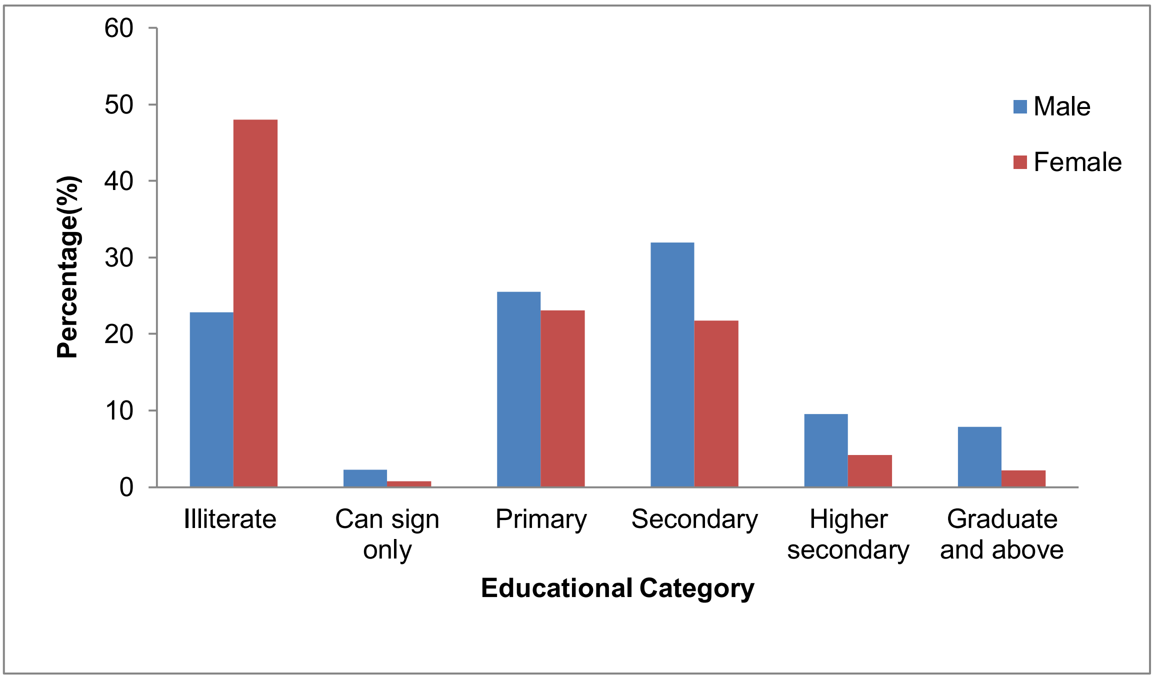


Figure 4.3: Mean Values of the Income Variables of Males and Females

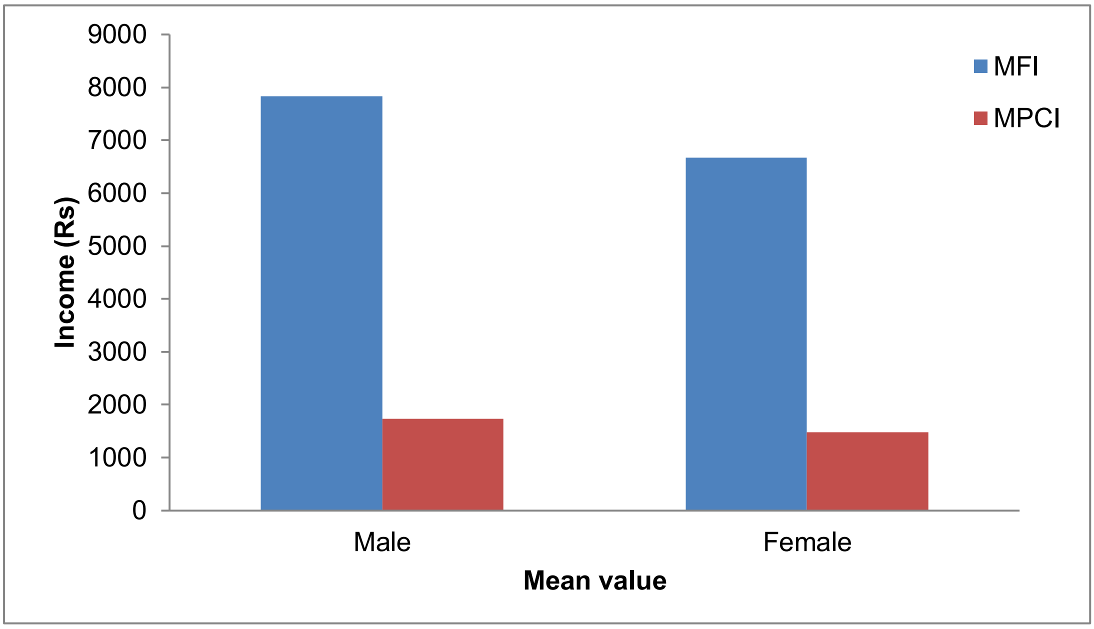


Figure 4.4: Percentage of the Monthly Family Income Groups (MFIG) of the Present Samples

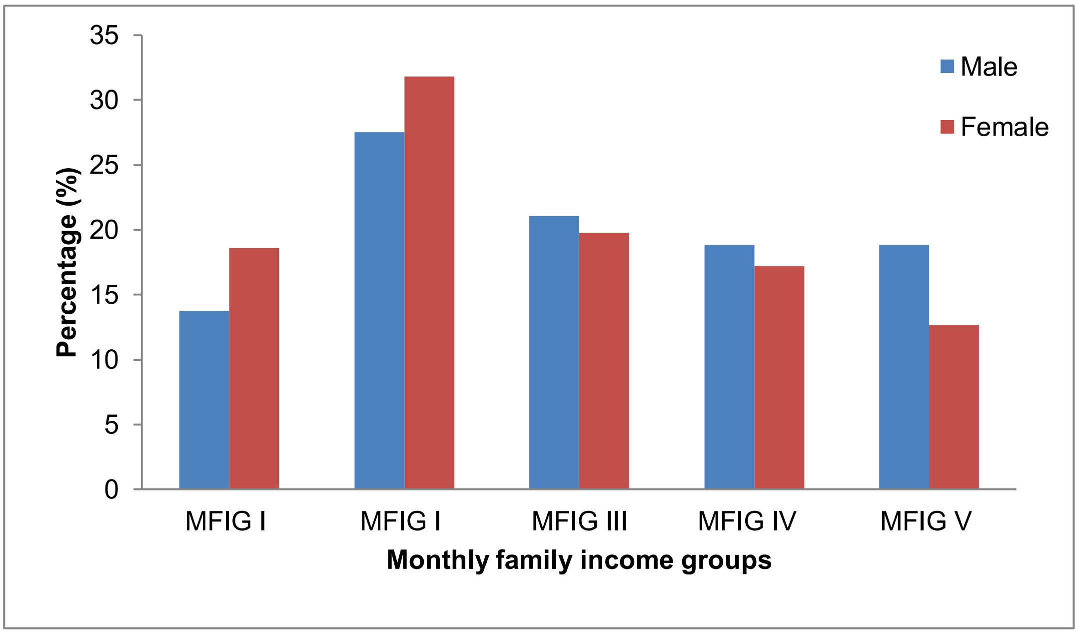


Figure 4.5: Percentage of the Monthly per Capita Income Groups (MPCIG) of Present Samples

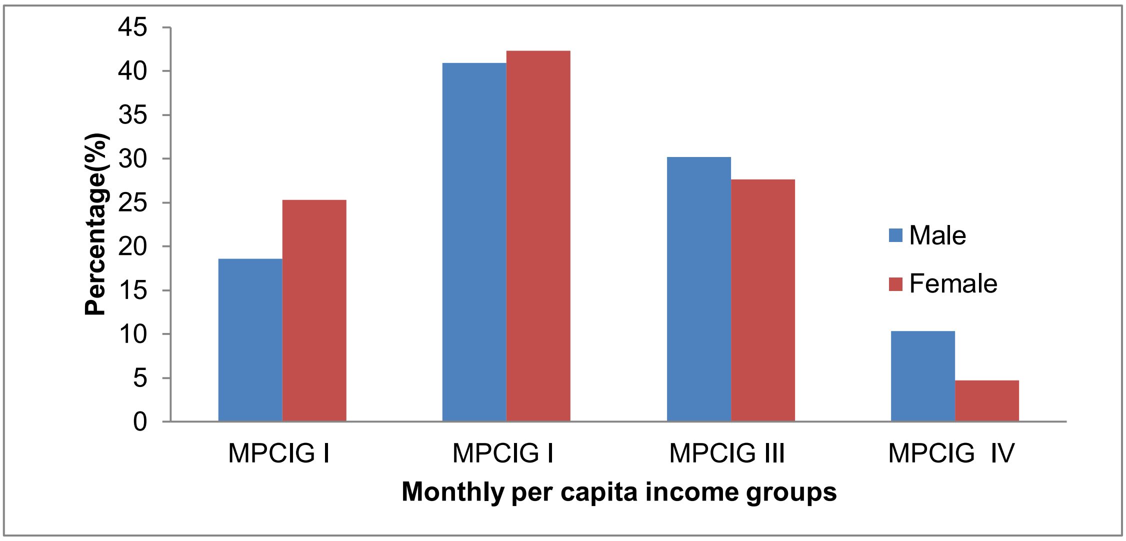


Figure 4.6: Percentage of the Subjects According to the Housing Characteristics

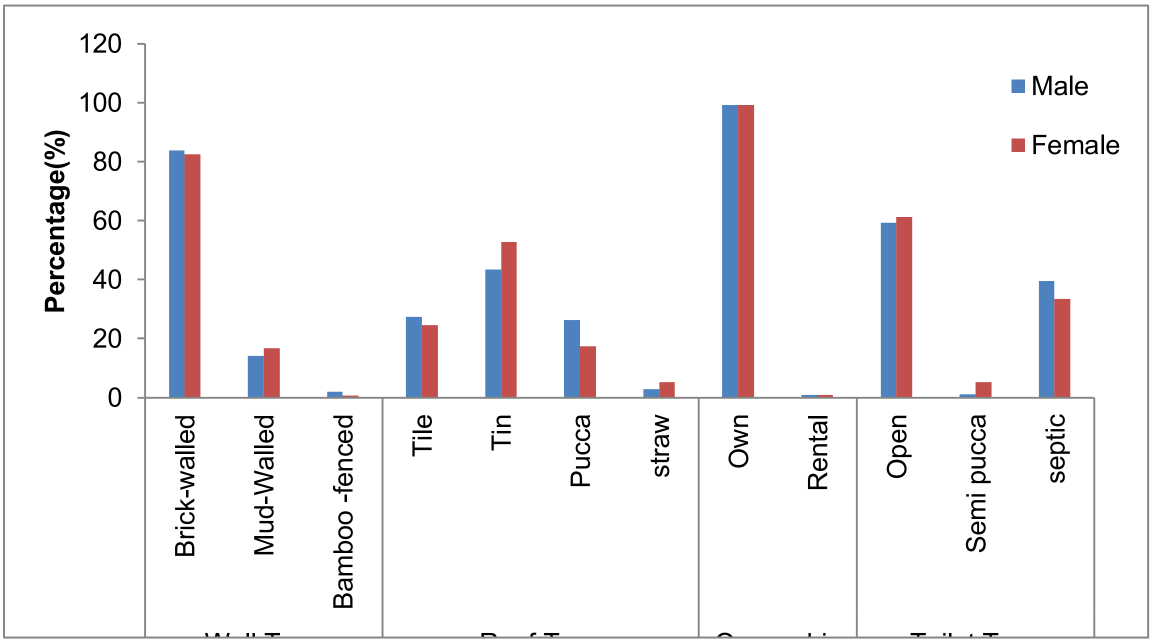


Figure 4.7: Percentage of Self Reported Morbidity of the Studied Samples

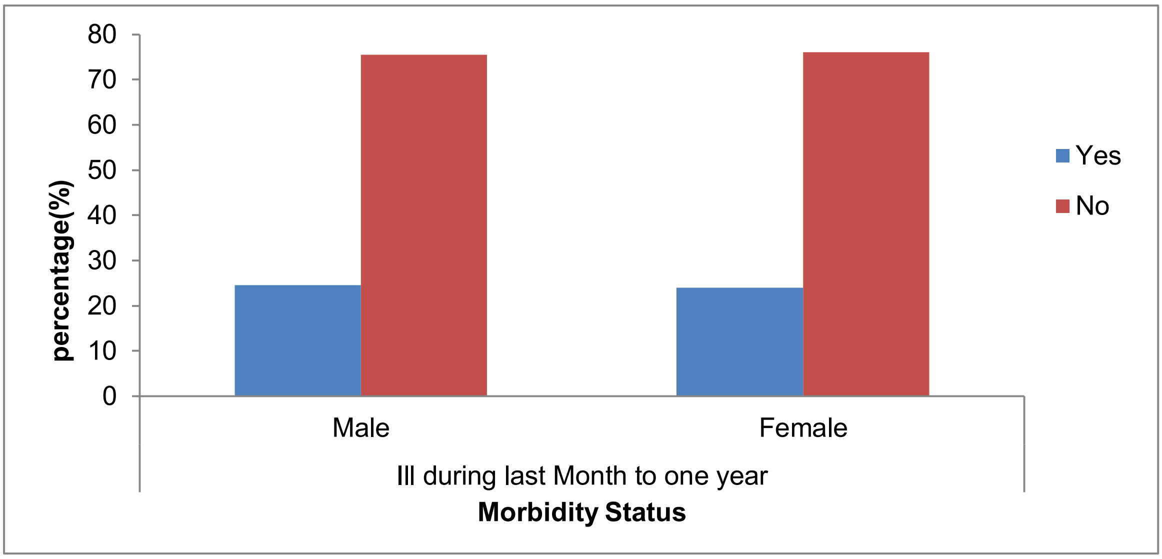


Figure 4.8: Frequency and Percentage of the Subjects doing Regular Physical Exercise or not

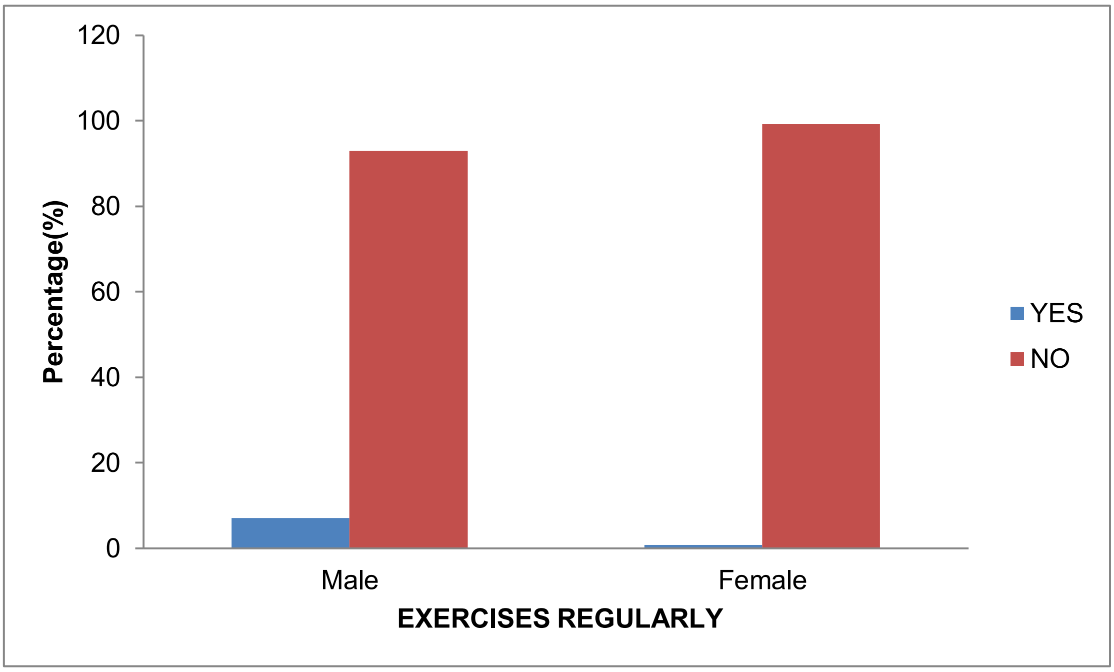


Figure 4.9: Prevalence of Subjects doing Habitual Physical Activities of the Studied Samples

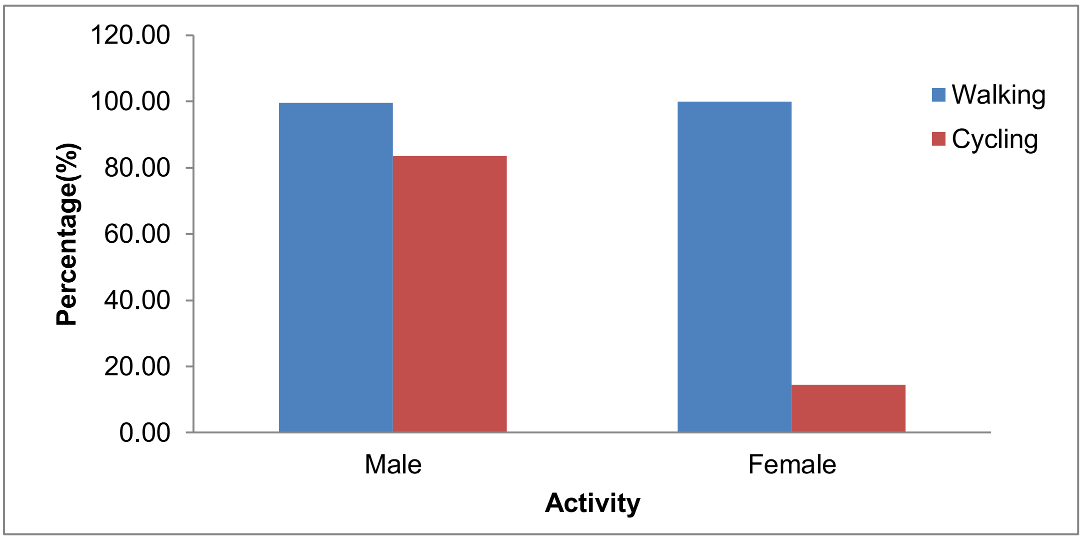


Figure 4.10: Prevalence of Subjects by Habitual Physical Activity Level

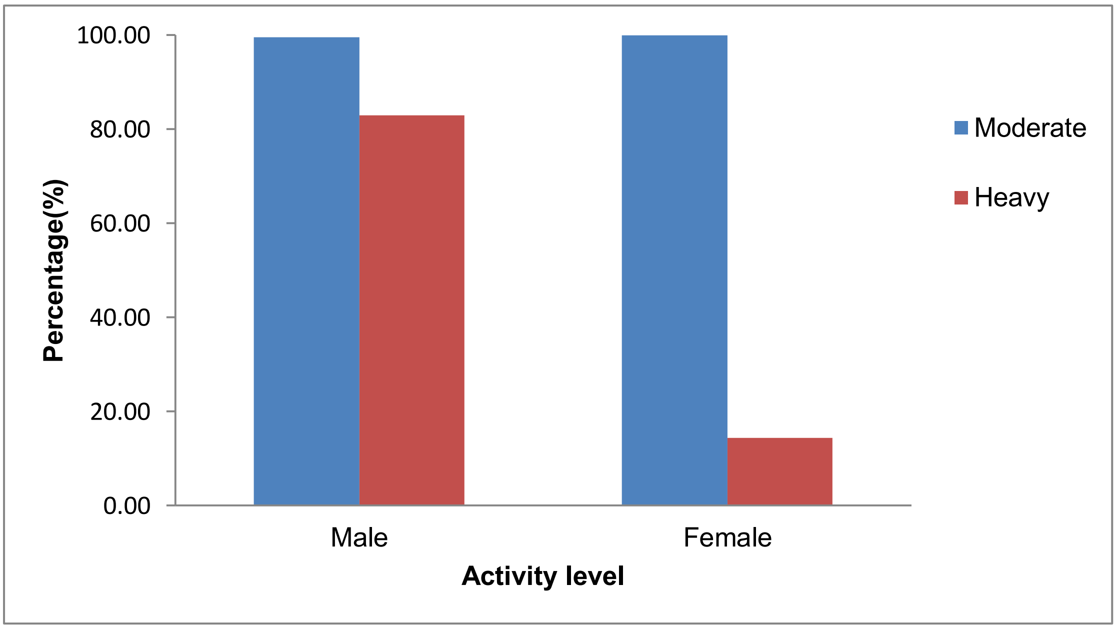


Figure 4.11: Occupation and House Type of Males

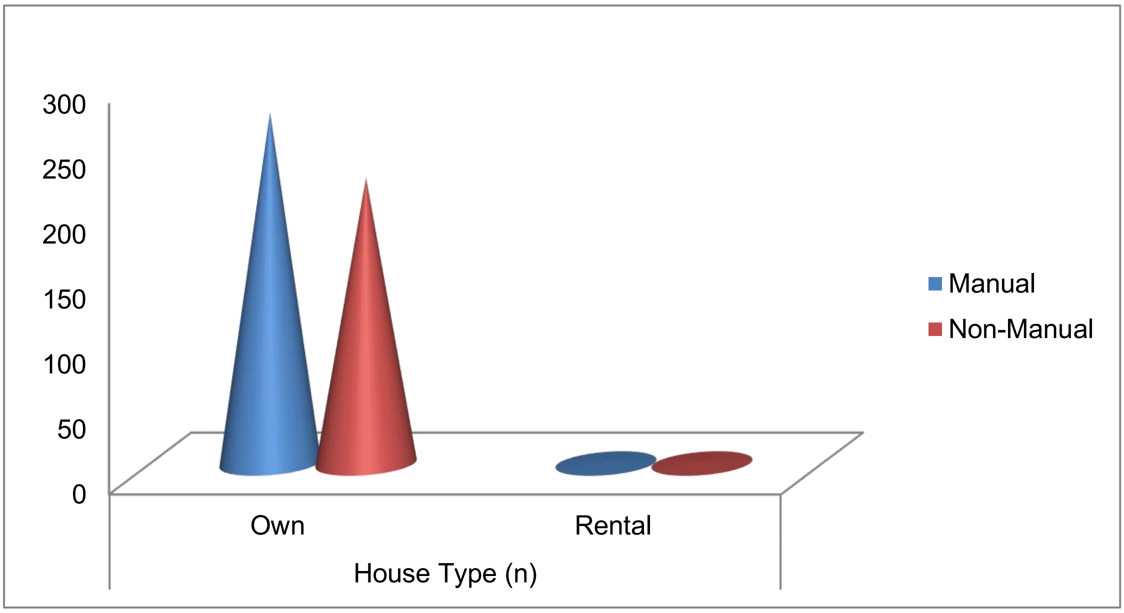


Figure 4.12: Occupation and House Type of Females

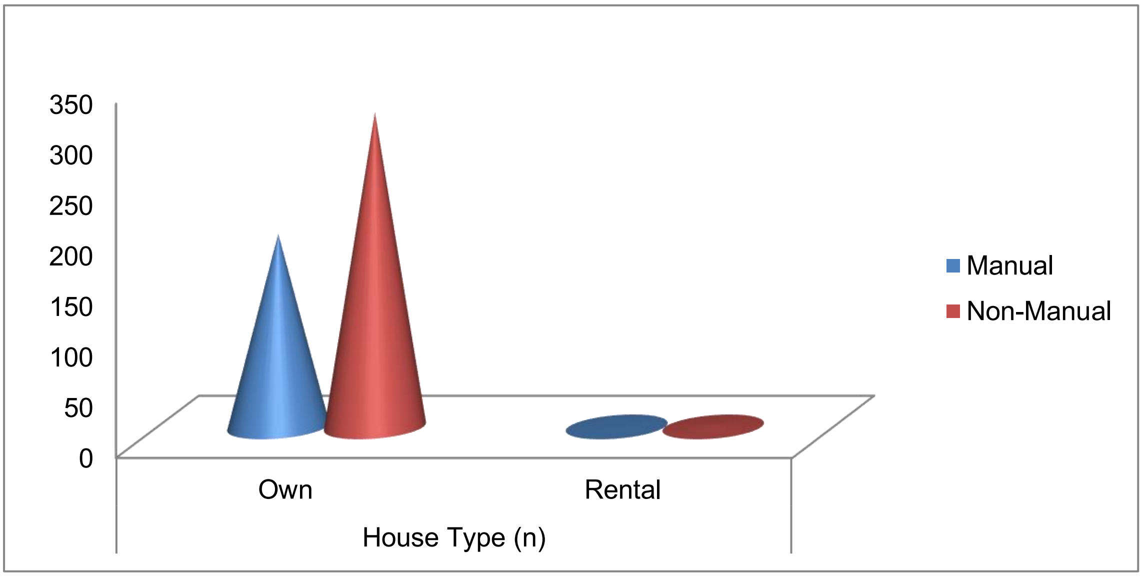


Figure 4.13: Wall Type by Occupational category of the Adult Slum Dwellers

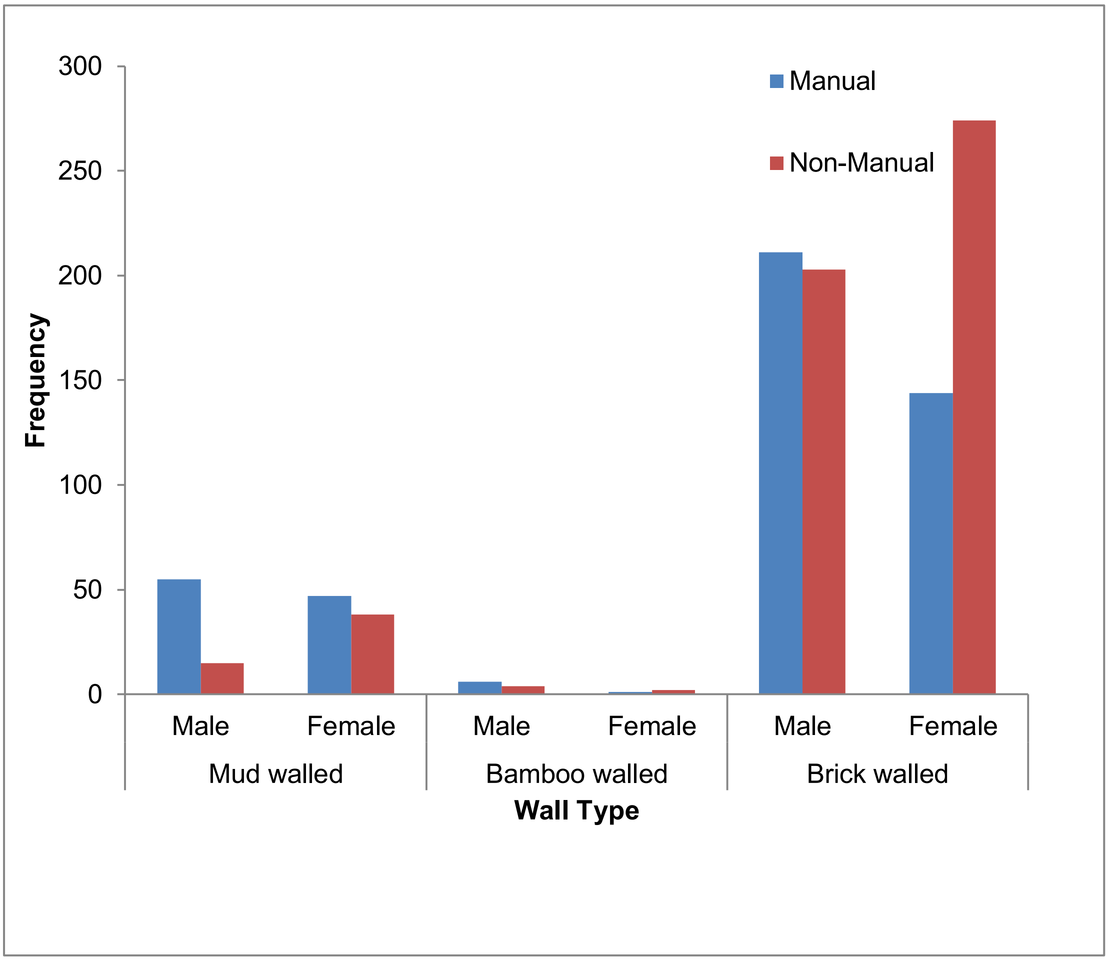


Figure 4.14: Occupation and Roof Type of Males

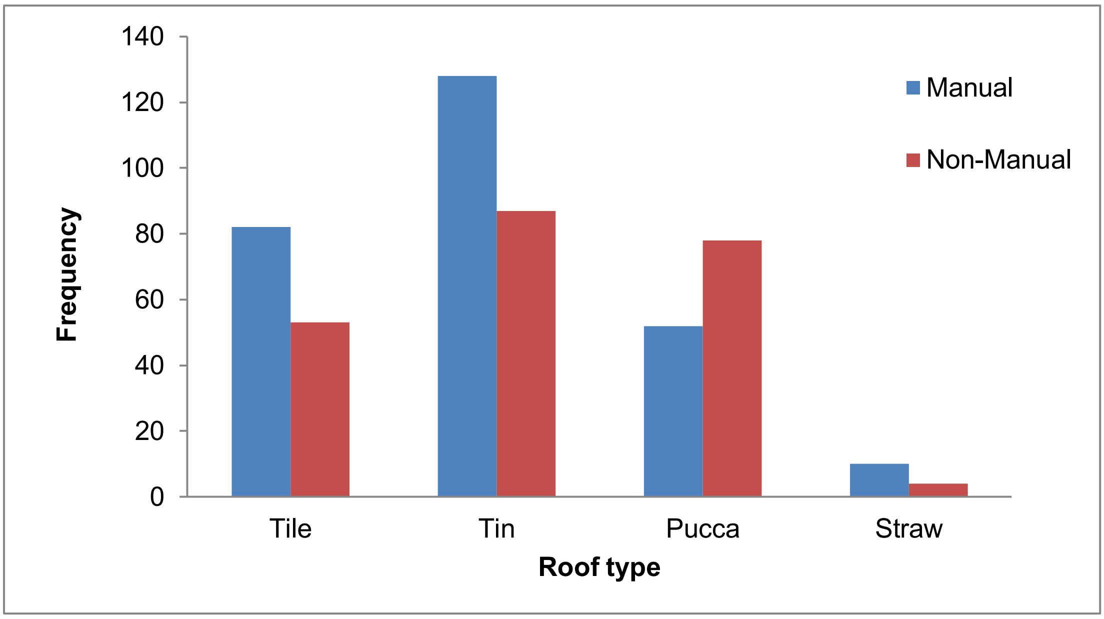


Figure 4.15: Occupation and Roof Type of Females

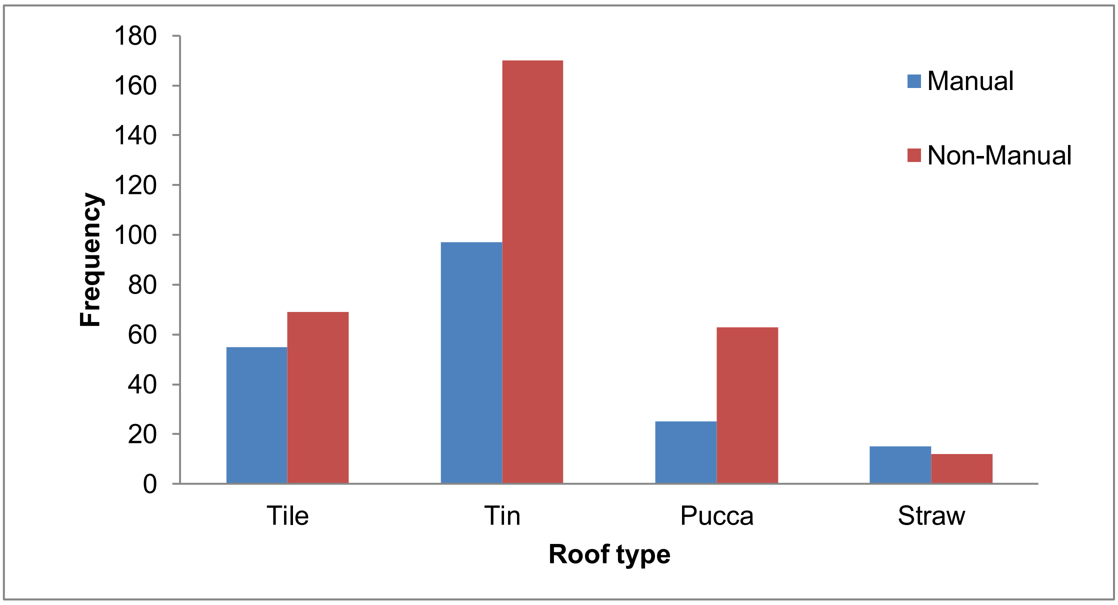


Figure 4.16: Occupation and Sanitation of Males

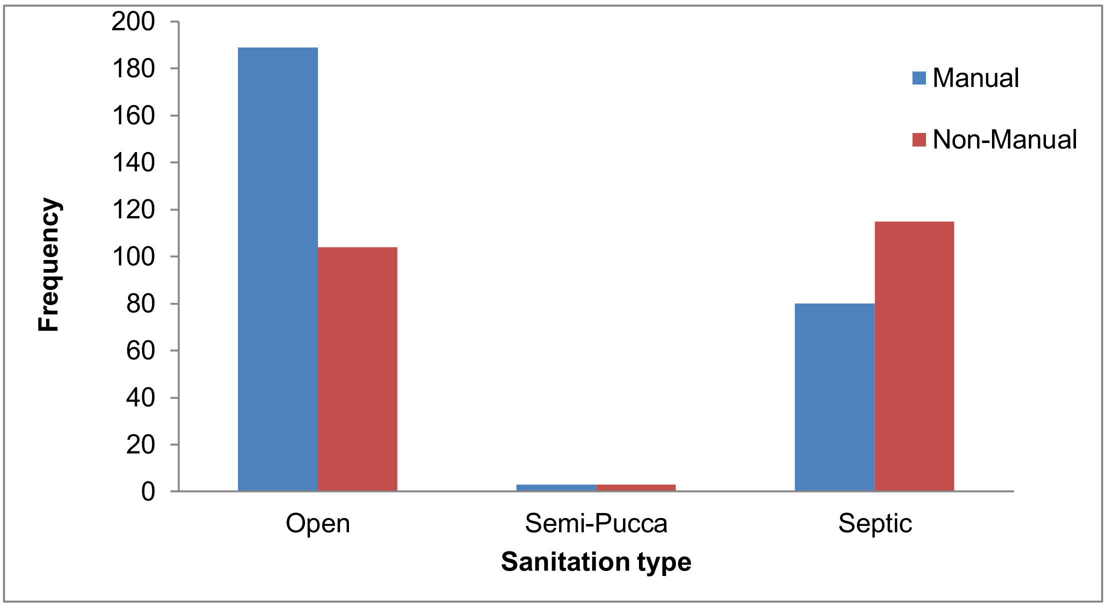


Figure 4.17: Occupation and Sanitation of Females

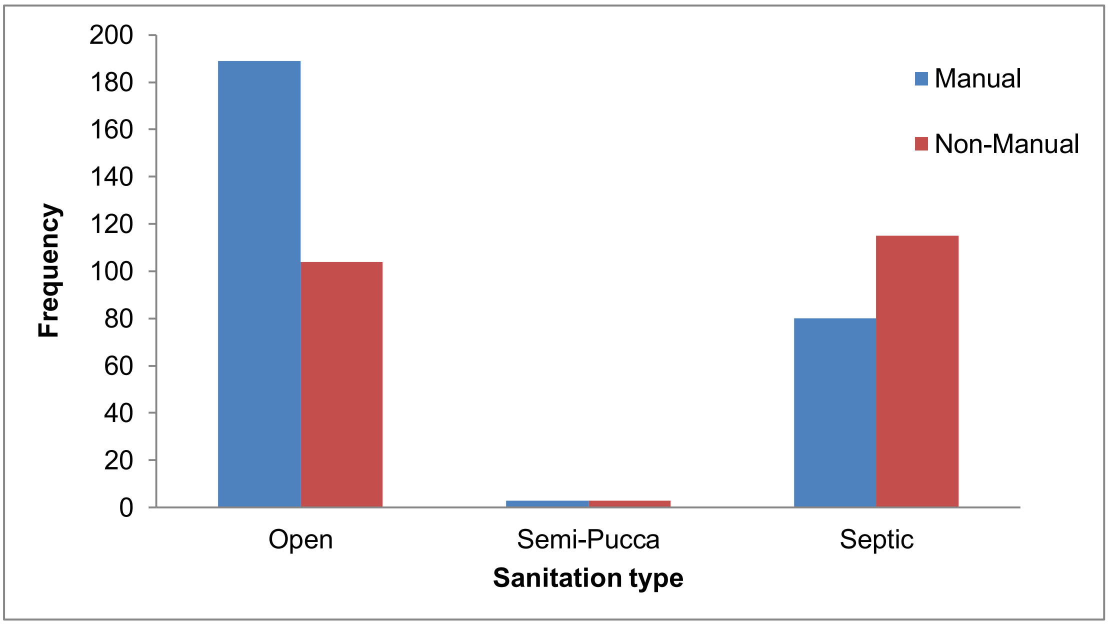


Figure 4.18: Frequency of Monthly Family Income Groups and Wall Type of Males

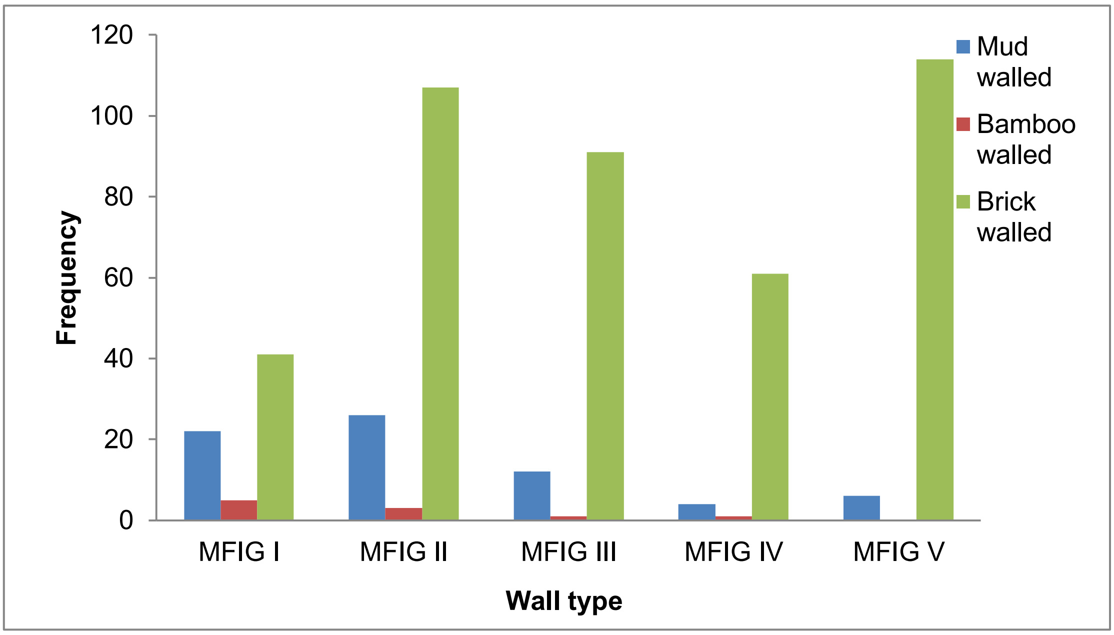


Figure 4.19: Frequency of Monthly Family Income Groups and Wall Type of Females

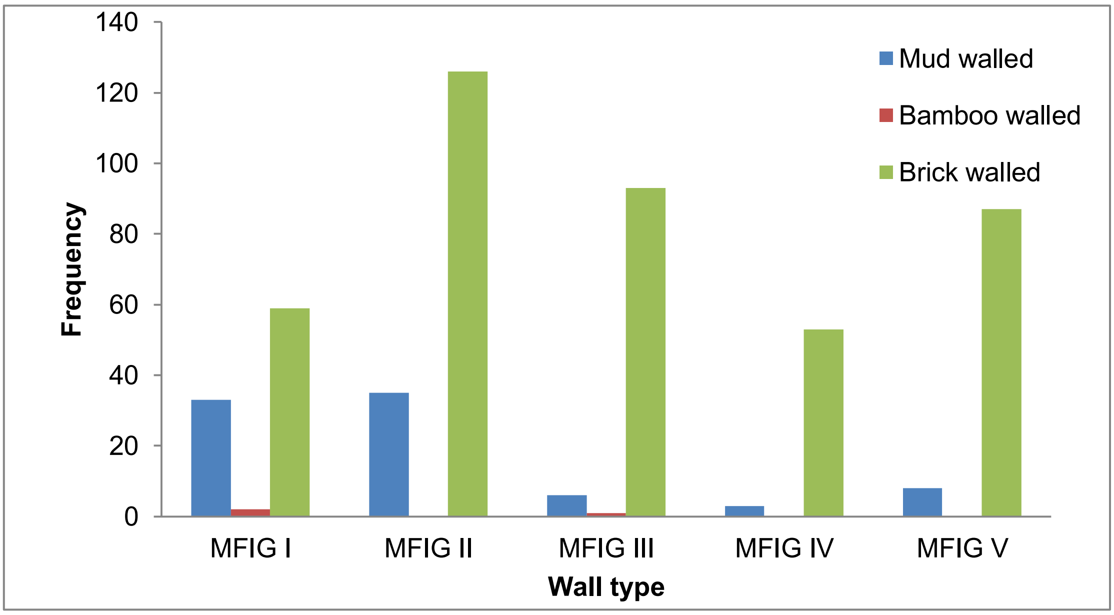


Figure 4.20: Frequency of Monthly Family Income Groups and Roof Type of Males

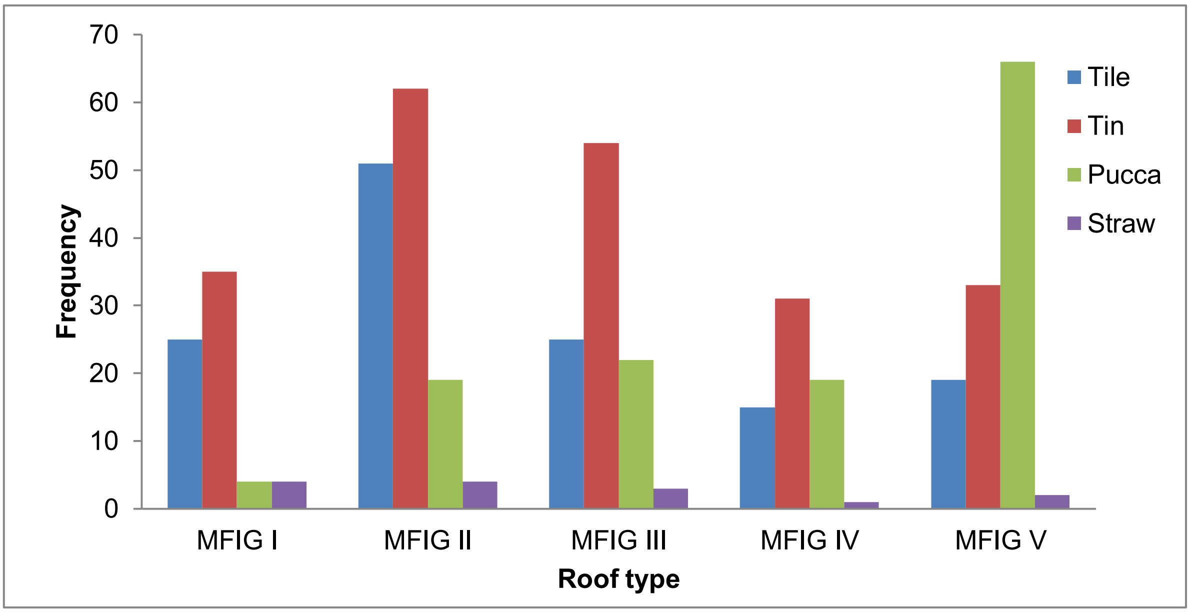


Figure 4.21: Frequency of Monthly Family Income Groups and Roof Type of Females

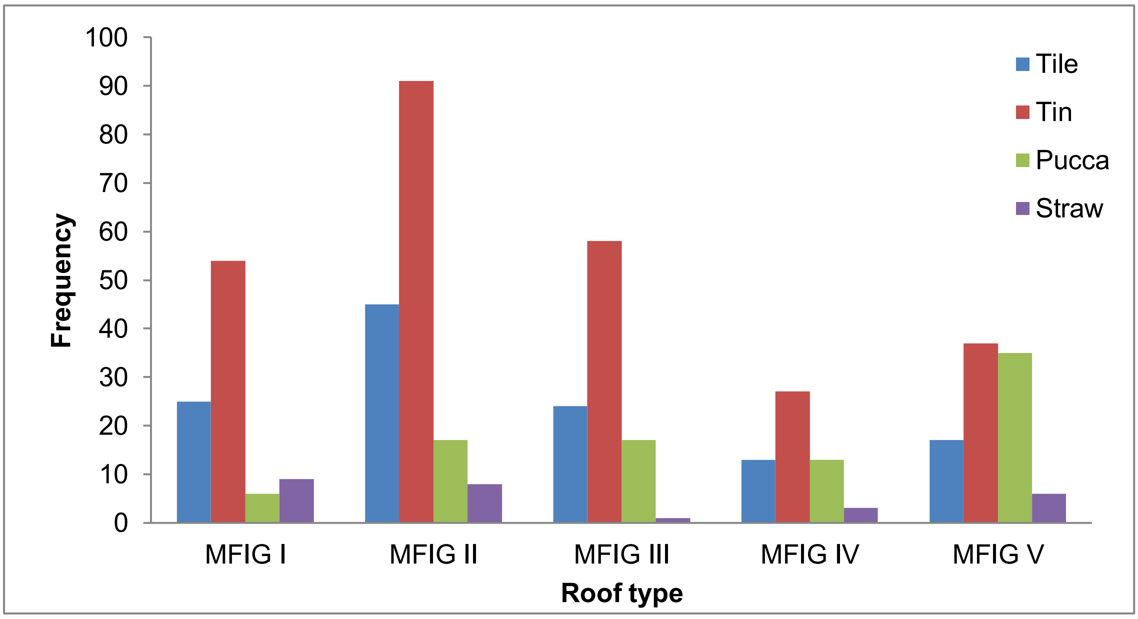


Figure 4.22: Frequency of Monthly Family Income Groups and Sanitation of Males

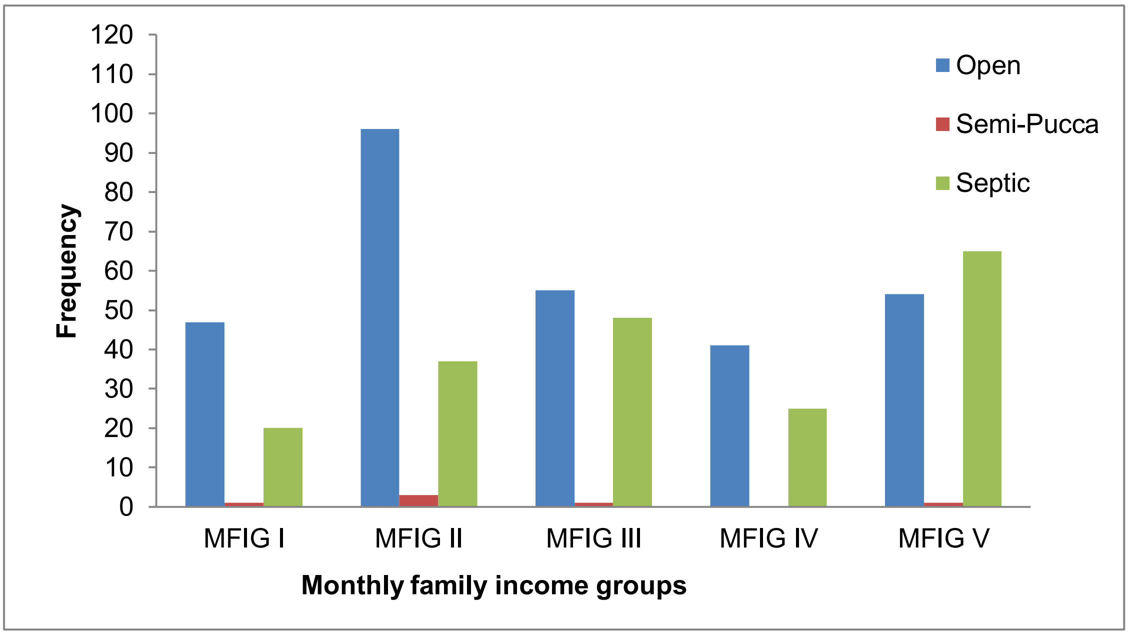


Figure 4.23: Frequency of Monthly Family Income Groups and Sanitation of Females

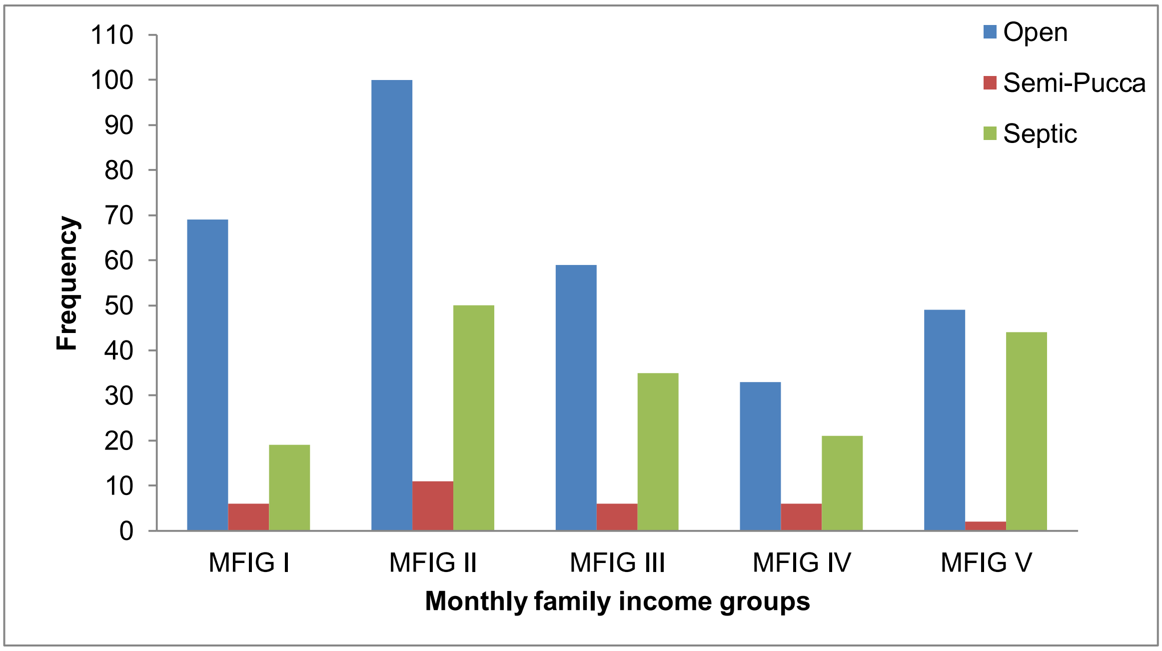


Figure 4.24: Frequency of Monthly Per Capita Income Groups and Wall Type of Males

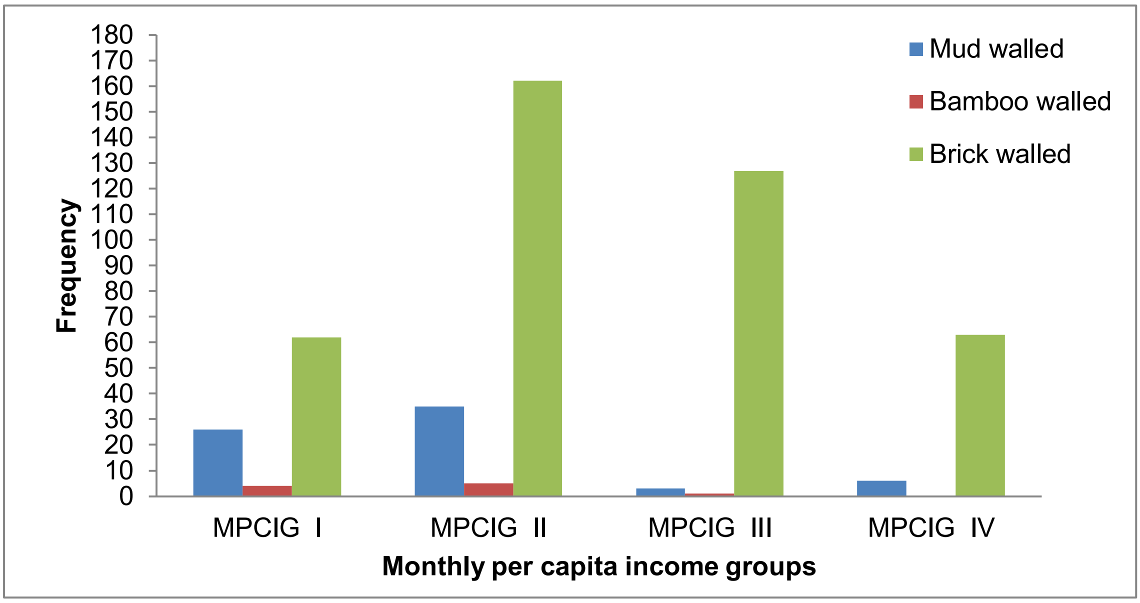


Figure 4.25: Frequency of Monthly Per Capita Income Groups and Wall Type of Females

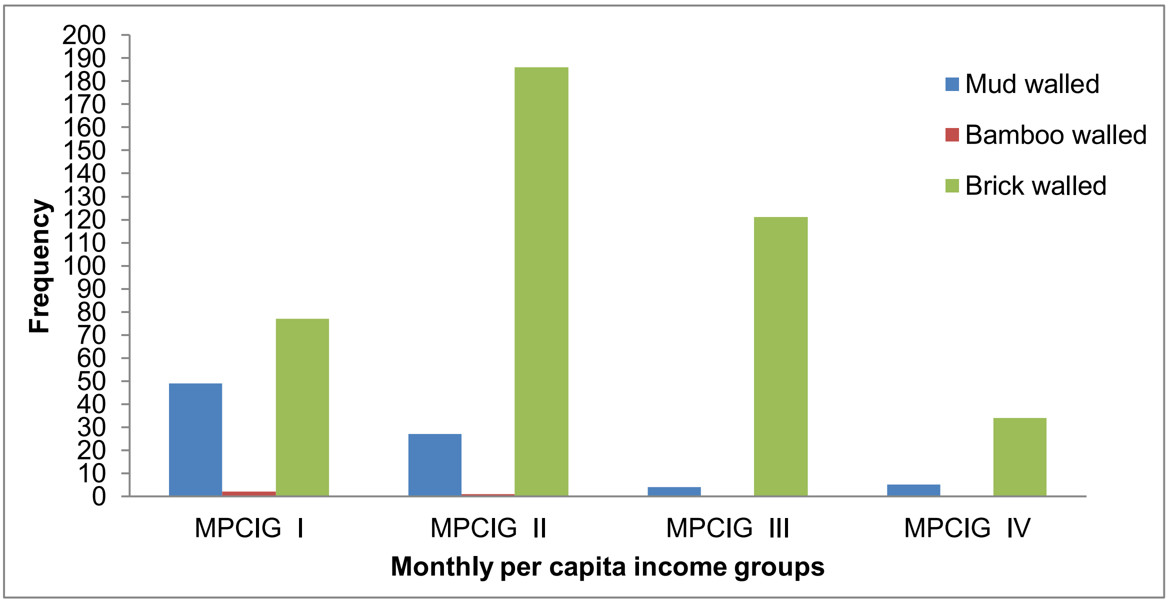


Figure 4.26: Frequency of Monthly Per Capita Income Groups and Roof Type of Males

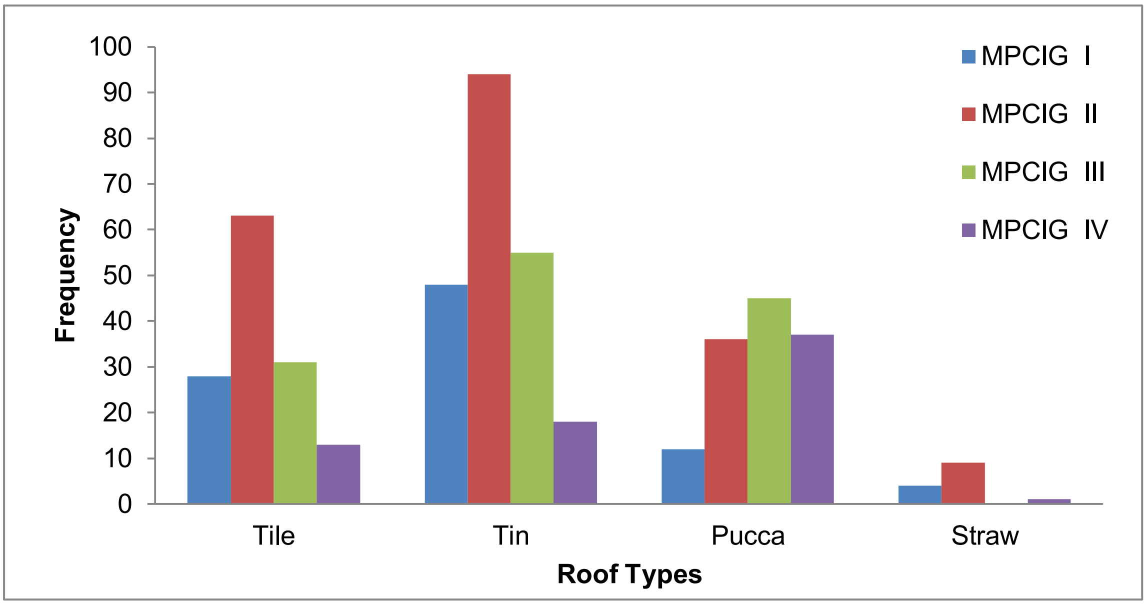


Figure 4.27: Frequency of Monthly Per Capita Income Groups and Roof Type of Females

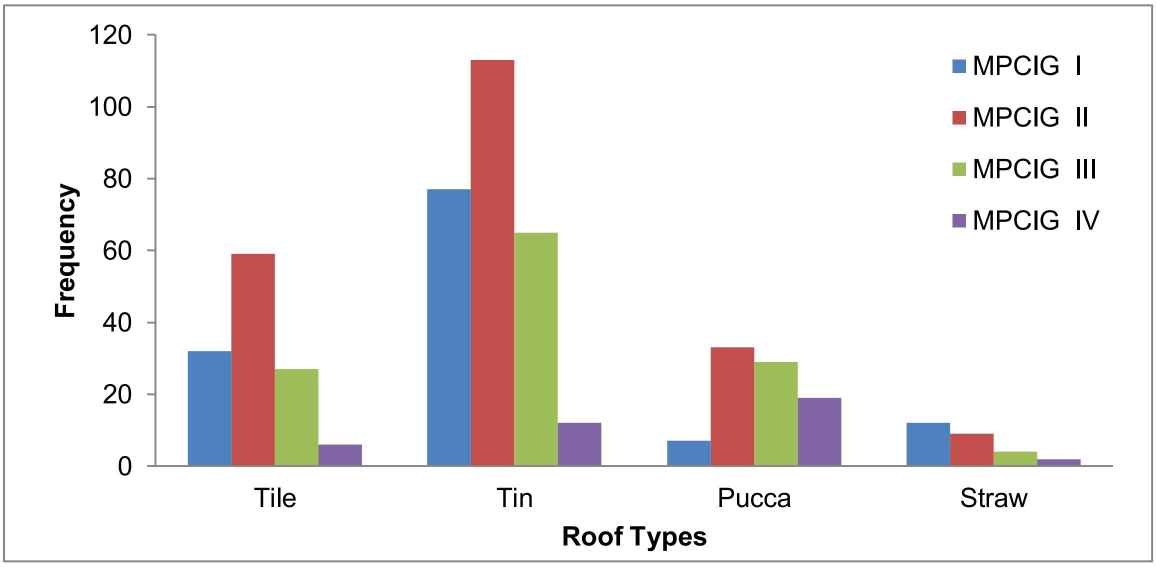


Figure 4.28: Frequency of Monthly Per Capita Income Groups and Sanitation of Males

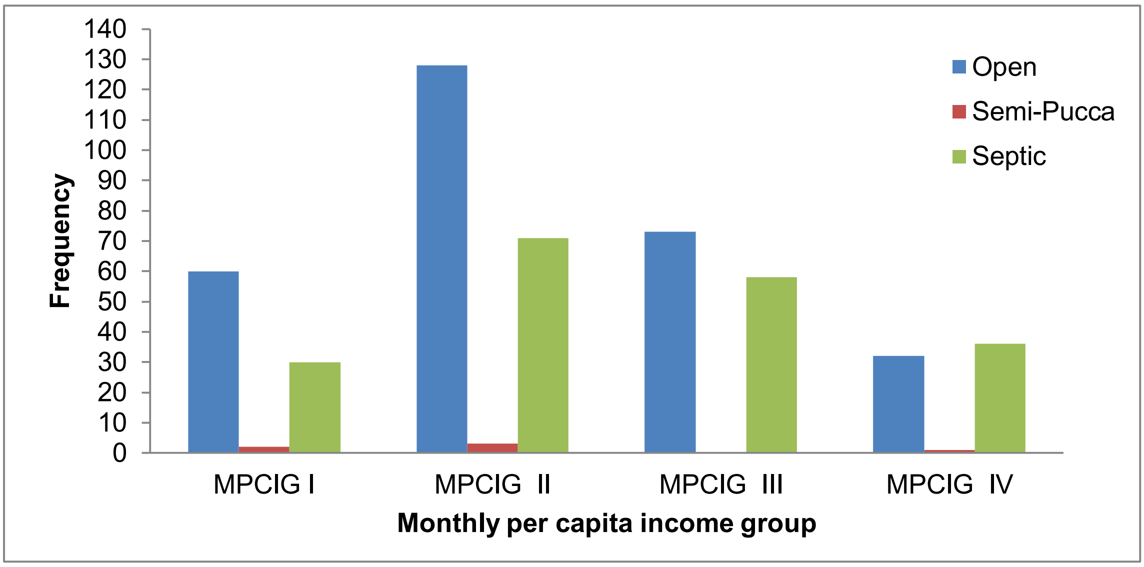
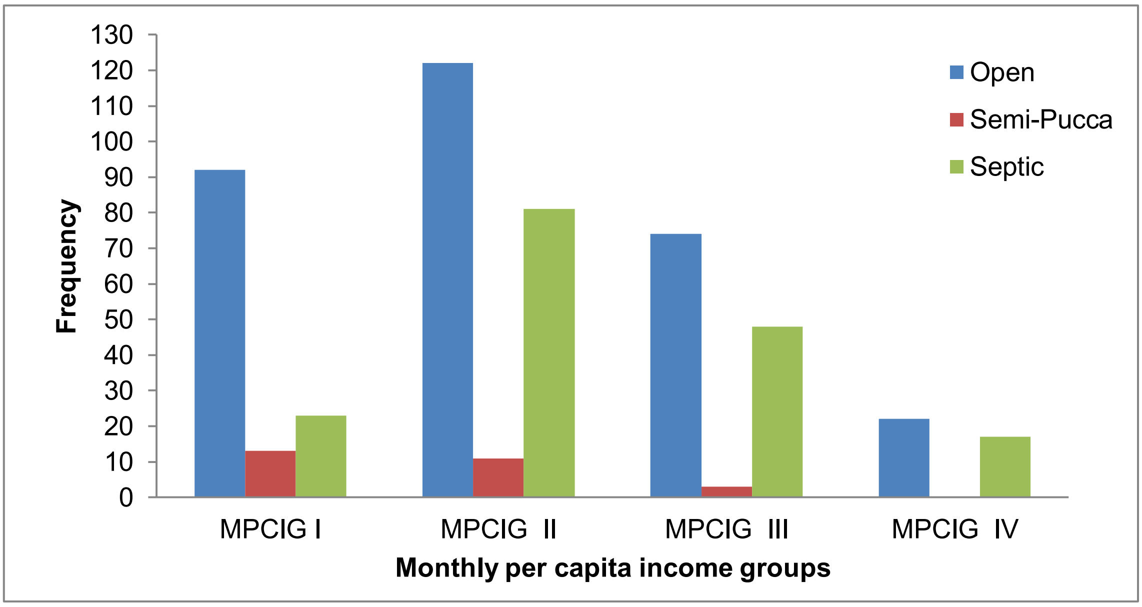


Figure 4.29: Frequency of Monthly Per Capita Income Groups and Sanitation of Females



CHAPTER – V

RESULTS II

ANTHROPOMETRIC CHARACTERISTICS

(WITH 5 TABLES AND 9 FIGURES IN THE TEXT)

V

RESULTS II

ANTHROPOMETRIC CHARACTERISTICS:

Anthropometric characteristics of the subjects are presented through the mean, standard deviation (SD) and 25th, 50th, and 75th percentile values of each anthropometrical variable. ***Table 5.1*** presents the mean, SD and quartile values of HT, WT, SHT, HTAC, all circumference and all skin fold measurements of males. The mean (SD) height of the males are 160.56 (7.88) cm. The mean (SD) weight of the males are 55.37(10.22) kg. The mean (SD) SHT and HTAC of the males were 81.18 (4.69) cm and 133.91(6.79) cm respectively.

The mean (SD) of MUAC, CC, WC and HC of males were 23.90 (2.92) cm, 83.03 (7.62) cm, 76.61(9.91) cm and 84.15 (7.47) cm.

The mean (SD) of males of TSF, BSF, SUBSF, SUPSF, MCSF and ATSF were 7.44 (3.59), 4.99 (2.83), 12.08 (5.34), 10.58(5.22), 9.38(4.63) and 11.40 (5.98) mm, respectively.

Table 5.2 presents the mean, SD and quartile values of HT, WT, SHT, HTAC, all circumference and all skin fold measurements of females. The mean (SD) height of females are 148.64 (6.37) cm. The mean (SD) weight of females are 48.46 (10.00) kg. The mean (SD) SHT and HTAC of the females were 74.95 (4.00) cm and 123.22(5.44) cm respectively.

The mean (SD) of MUAC, CC, WC and HC of females were 22.88 (3.11) cm, 81.96 (9.72) cm, 77.15 (12.35) cm and 86.05 (9.27) cm.

The mean (SD) of females of TSF, BSF, SUBSF, SUPSF, MCSF and ATSF were 12.63 (5.23), 7.12 (3.60), 14.94 (6.85), 14.04(6.64), 14.13(5.73) and 20.42 (8.85) mm, respectively.

The sex differences of all the anthropometric variables except waist circumference of slum dwellers are statistically significant at the 0.05 level (***Table 5.3***, **Fig 5.1, Fig 5.2 and Fig 5.3)**.

Table 5.4 **(Fig 5.4, Fig 5.5, and Fig 5.6)** shows mean (SD) values of anthropometric variables according to age groups of males. The mean (SD) height of males, decreased significantly from 161.95(7.24) cm the lowest age group (18-29.9 years) to 156.41(7.25) cm the next age group (50-59.9 years), and then increased 157.94(7.98) cm the eldest age group (>60 years). The mean (SD) WT of males increased from 55.23 (9.38) kg in the age group 18-29.9 to 57.80(11.73) kg in the age group 30-39.9, then it started decreasing and ended up to 52.80 (9.45) kg in the eldest age group. The mean (SD) SHT of males decreased from 82.13 (4.37) cm in the lowest age group 18-29.9 years to 78.45(5.28) cm in the eldest age group >60 years. The mean (SD) HTAC of males, decreased from 134.88(6.28) cm the lowest age group (18-29.9 years) to 130.35(6.82) cm the next age group (50-59.9 years), and then increased 131.79(6.97) cm the eldest age group (>60 years). The mean differences of HT, WT, SHT and HTAC between age groups of males are statistically significant at the level 0.05.

The mean MUAC of males, slightly increased from 24.03(2.73) cm the lowest age group (18-29.9 years) to 24.14(3.12) cm the next age group (30-39.9 years), and then decreased the next age groups, lastly it is increased 23.30(3.21) cm the eldest age group (>60 years). The mean (SD) CC of males, slightly increased from 82.23(7.02) cm the lowest age group (18-29.9 years) to 84.74(8.23) cm the next age group (30-39.9 years), and then decreased the next age groups, lastly it is increased 83.49(6.96) cm the eldest age group (>60 years). The mean (SD) WC of males increased from 74.44 (8.42) cm in the lowest age group (18-29.9 years) upto 79.02 (11.43) cm in the eldest age group (>60 years). The mean (SD) HC of males increased from 83.52 (6.53) cm in the age group 18-

29.9 to 85.77(8.03) cm in the age group (30-39.9 years), then it started decreasing and ended up to 83.10 (8.02) cm in the eldest age group. The mean differences of WC between age groups of males are statistically significant at the level 0.05 but the mean differences of MUAC, CC and HC between age groups of males are not statistically significant at the level 0.05.

The mean (SD) TSF of males, increased from 6.98(3.06) mm the lowest age group (18-29.9 years) upto 8.26(4.05) mm the next age group (50-59.9 years), and then decreased 7.47(2.75) mm the eldest age group (>60 years). The mean (SD) BSF of males, increased from 4.66(2.09) mm the lowest age group (18-29.9 years) to 5.60(4.93) mm the next age group (40-49.9 years), and then decreased 4.70(2.12) mm from the next age group to the eldest age group (>60 years). The mean (SD) SUBSF of males, increased from 11.44(4.82) mm the lowest age group (18-29.9 years) to 13.28(5.74) mm the next age group (30-39.9 years), and then decreased 11.47(4.37) mm from the next age groups to the eldest age group (>60 years). The mean (SD) SUPSF of males, increased from 9.81(5.01) mm the lowest age group (18-29.9 years) to 11.54(5.03) mm the next age group (30-39.9 years), and then decreased next age groups and then it is increased 11.13(5.46) mm the eldest age group (>60 years). The mean (SD) MCSF of males, increased from 9.63(4.61) mm the lowest age group (18-29.9 years) to 9.78(4.90) mm the next age group (30-39.9 years), and then decreased the next age groups and then increased 8.82(4.50) mm the eldest age group (>60 years). The mean (SD) ATSF of males, increased from 11.32(5.85) mm the lowest age group (18-29.9 years) to 12.50(6.31) mm the next age group (30-39.9 years), and then decreased 10.72(5.79) mm the next age group (40-49.9 years), then it is increased 11.37(7.29) mm in the age group (50-50.9) and then again decreased 10.18 (4.23) the eldest age group (>60 years). The mean differences of SUBSF and SUPSF between age groups of males are statistically significant at the level 0.05 but the mean differences of TSF, BSF, MCSF and ATSF between age groups of males are not statistically significant at the level 0.05.

Table 5.5 **(Fig 5.7, Fig 5.8, and Fig 5.9)** shows mean (SD) values of anthropometric variables according to age groups of females. The mean (SD) height of females, increased significantly from 149.24(7.01) cm the lowest age group (18-29.9 years) to 149.42(5.28) cm the next age group (30-39.9 years), and decreased 146.15(7.21) cm in the next age groups upto the eldest age group (>60 years). The mean (SD) WT of females increased from 47.34 (9.64) kg in the age group 18-29.9 years to 49.69(10.71) kg in the age group 30-39.9 years, then it started decreasing and ended upto 46.52 (12.06) kg in the eldest age group. The mean (SD) SHT of females increased from 75.18 (3.98) cm in the lowest age group 18-29.9 years to 75.72(3.40) cm in the next age group(30-39.9 years), then it is decreased 73.37(3.94) cm in the age group (40-49.9years), then slightly increased 73.50(4.14) cm in the age group of (50-59.9 years), then it is slightly decreased 73.24(4.60) cm in the eldest age group (>60 years). The mean (SD) HTAC of females, increased from 123.32(5.64) cm the lowest age group (18-29.9 years) to 124.12(5.20) cm the next age group (30-39.9 years), and then decreased in the next age groups, then slightly increased 122.20(5.83) cm the eldest age group (>60 years). The mean differences of HT and SHT between age groups of females are statistically significant at the level 0.05 but the mean differences of WT and HTAC between age groups of females are not statistically significant at the level 0.05.

The mean MUAC of females, increased from 22.45(3.09) cm the lowest age group (18-29.9 years) to 23.34(2.86) cm the next age group (40-49.9 years), and then decreased 22.65(3.94) cm the next age groups to the eldest age group (>60 years). The mean (SD) CC of females, increased from 80.66(8.57) cm the lowest age group (18-29.9 years) to 83.82(9.87) cm the next age group (50-59.9 years), and then decreased 80.66(12.03) cm the eldest age group (>60 years). The mean (SD) WC of females increased from 74.70(11.06) cm in the lowest age group (18-29.9 years) to 81.04 (12.86) cm in the next age groups (50-59.9 years), then it is decreased 79.44(13.44)cm in the eldest age group (>60 years). The mean (SD) HC of females increased from 83.76 (8.34) cm in the age group 18-29.9years to 88.22(9.25) cm in the age group (40-49.9 years), then it started decreasing and ended up to 87.05 (10.79) cm in the eldest age group. The mean differences of WC and HC between age groups of females are statistically significant at the level 0.05 but the mean differences of MUAC and CC between age groups of females are not statistically significant at the level 0.05.

The mean (SD) TSF of females, increased from 12.37(5.59) mm the lowest age group (18-29.9 years) to 13.16(5.04) mm the next age group (30-39.9 years), then decreased 11.21(4.73) mm upto the eldest age group (>60 years). The mean (SD) BSF of females, increased from 6.83(3.79) mm the lowest age group (18-29.9 years) to 7.54(3.32) mm the next age group (40-49.9 years), and then it is decreased 6.51(3.58) mm upto the eldest age group (>60 years). The mean (SD) SUBSF of females, increased from 14.27(6.94) mm the lowest age group (18-29.9 years) to 15.20(7.29) mm the next age group (30-39.9 years), and then decreased 15.02(5.93) mm in the next age group (40-49.9years), then increased 16.90(6.87) mm in the age group (50-59.9 years), then again decreased 14.50(6.88) mm the eldest age group (>60 years). The mean (SD) SUPSF of females, increased from 13.40(6.90) mm the lowest age group (18-29.9 years) to 15.37(5.82) mm the next age group (50-59.9 years), and then decreased 12.47(5.74) mm the eldest age group (>60 years). The mean (SD) MCSF of females, decreased from 15.00(6.33) mm the lowest age group (18-29.9 years) to 13.74(5.16) mm the next age group (40-49.9 years), and then increased 14.05(4.89) mm in the next age group (50-59.9 years) and then increased 11.67(5.62) mm the eldest age group (>60 years). The mean (SD) ATSF of females, increased from 21.13(9.15) mm the lowest age group (18-29.9 years) to 21.80(8.86) mm the next age group (30-39.9 years), and then decreased 14.88(8.09) mm upto the eldest age group (>60 years). The mean differences of MCSF and ATSF between age groups of females are statistically significant at the level 0.05 but the mean differences of TSF, BSF, SUBSF and SUPSF between age groups of females are not statistically significant at the level 0.05.

Table 5.1: Mean, standard deviation (SD) and quartile values of Anthropometric variables of Males

VARIABLES	Mean	SD	Percentiles		
			25	50	75
HT (cm)	160.65	7.88	156.20	160.85	165.60
WT (KG)	55.37	10.22	48.00	54.50	61.00
SHT (cm)	81.18	4.69	77.90	81.10	84.40
HTAC (cm)	133.91	6.79	129.30	134.20	138.23
Circumferences (cm)					
MUAC (cm)	23.91	2.92	21.98	23.50	26.00
CC (cm)	83.03	7.62	77.40	82.00	88.03
WC (cm)	76.61	9.91	69.35	75.50	83.00
HC (cm)	84.15	7.47	79.00	83.25	88.90
Skin folds (mm)					
TSF (mm)	7.44	3.59	5.0	6.40	9.33
BSF (mm)	4.99	2.83	3.30	4.20	5.70
SUBSF (mm)	12.08	5.34	8.18	10.50	15.20
SUPSF (mm)	10.58	5.22	6.60	9.30	13.63
MCSF (mm)	9.38	4.63	6.10	8.50	11.33
ATSF (mm)	11.40	5.98	7.20	9.60	14.43

Table 5.2: Mean, standard deviation (SD) and quartile values of Anthropometric variables of Females

VARIABLES	Mean	SD	Percentiles		
			25	50	75
HT (cm)	148.64	6.37	144.98	149.00	152.40
WT (KG)	48.46	10.00	41.00	47.00	55.10
SHT (cm)	74.95	4.00	72.30	75.10	77.50
HTAC (cm)	123.22	5.44	119.98	123.20	126.50
Circumferences (cm)					
MUAC (cm)	22.88	3.11	20.50	22.60	25.00
CC (cm)	81.96	9.72	75.00	80.60	88.40
WC (cm)	77.15	12.35	68.00	77.00	86.20
HC (cm)	86.05	9.27	79.00	85.50	91.85
Skin folds (mm)					
TSF (mm)	12.63	5.23	8.50	12.05	15.53
BSF (mm)	7.12	3.60	4.50	6.20	8.90
SUBSF (mm)	14.94	6.85	9.40	14.10	19.50
SUPSF (mm)	14.04	6.64	8.60	13.55	18.20
MCSF (mm)	14.13	5.73	9.90	13.35	17.80
ATSF (mm)	20.42	8.85	13.68	19.85	26.20

Table 5.3: Mean, standard deviation (SD) and t-values of Anthropometric variables of slum dwellers

VARIABLES	Males		Females		t- value
	Mean	SD	Mean	SD	
HT (cm)	160.65	7.88	148.64	6.37	26.49*
WT (KG)	55.37	10.22	48.46	10.00	10.80*
SHT (cm)	81.18	4.69	74.95	4.00	22.57*
HTAC (cm)	133.91	6.79	123.22	5.44	27.43*
Circumferences (cm)					
MUAC (cm)	23.91	2.92	22.88	3.11	5.37*
CC (cm)	83.03	7.62	81.96	9.72	1.96*
WC (cm)	76.61	9.91	77.15	12.35	0.76**
HC (cm)	84.15	7.47	86.05	9.27	3.58*
Skin folds (mm)					
TSF (mm)	7.44	3.59	12.63	5.23	18.37*
BSF (mm)	4.99	2.83	7.12	3.60	10.43*
SUBSF (mm)	12.08	5.34	14.94	6.85	7.38*
SUPSF (mm)	10.58	5.22	14.04	6.64	9.17*
MCSF (mm)	9.38	4.63	14.13	5.73	14.41*
ATSF (mm)	11.40	5.98	20.42	8.85	18.91*

*-significant at 0.05 level
**- not significant at 0.05 level

Table 5.4: Mean (SD) values of anthropometric variables according to age Groups of Males

VARIABLES	AGE GROUPS					
	18-29.9	**30-39.9**	**40-49.9**	**50-59.9**	**≥ 60**	**F**
HT (cm)	161.95 (7.24)	161.49 (9.36)	159.30 (6.05)	156.41 (7.25)	157.94 (7.98)	7.37*
WT (kg)	55.23 (9.38)	57.80 (11.73)	54.85 (10.44)	53.63 (10.43)	52.80 (9.45)	2.60*
SHT (cm)	82.13 (4.37)	81.50 (4.69)	80.87 (4.14)	78.54 (4.56)	78.45 (5.28)	10.80*
HTAC(cm)	134.88 (6.28)	134.74 (7.43)	132.93 (6.25)	130.35 (6.82)	131.79 (6.97)	6.42*
CIRCUMFERENCES (cm)						
MUAC (cm)	24.03 (2.73)	24.14 (3.12)	24.07 (3.05)	23.09 (2.87)	23.30 (3.21)	1.69**
CC (cm)	82.23 (7.02)	84.74 (8.23)	83.17 (8.44)	82.65 (8.24)	83.49 (6.96)	2.07**
WC (cm)	74.44 (8.42)	78.40 (10.21)	78.66 (10.28)	78.71 (12.19)	79.02 (11.43)	5.73*
HC (cm)	83.52 (6.35)	85.77 (8.03)	84.54 (8.13)	84.20 (8.84)	83.10 (8.02)	1.93**
SKINFOLDS (mm)						
TSF (mm)	6.98 (3.06)	7.73 (3.71)	8.07 (5.02)	8.26 (4.05)	7.47 (2.75)	2.22**
BSF (mm)	4.66 (2.09)	5.29 (2.90)	5.60 (4.93)	5.42 (2.70)	4.70 (2.12)	2.22**
SUBSF (mm)	11.44 (4.82)	13.28 (5.74)	12.78 (5.82)	12.30 (6.65)	11.47 (4.37)	2.63*
SUPSF (mm)	9.81 (5.01)	11.54 (5.03)	11.18 (5.34)	11.02 (5.90)	11.13 (5.46)	2.61*
MCSF (mm)	9.63 (4.61)	9.78 (4.90)	8.97 (4.64)	8.30 (4.10)	8.82 (4.50)	1.28**
ATSF (mm)	11.32 (5.85)	12.50 (6.31)	10.72 (5.79)	11.37 (7.29)	10.18 (4.23)	1.56**

*-significant at 0.05 level
**- not significant at 0.05 level

Table 5.5: Mean (SD) values of anthropometric variables according to age Groups Females

VARIABLES	AGE CATEGORIES					
	18-29.9	**30-39.9**	**40-49.9**	**50-59.9**	**≥ 60**	**F**
HT (cm)	149.24 (7.01)	149.42 (5.38)	149.00 (5.68)	146.43 (5.59)	146.15 (7.21)	4.55*
WT (kg)	47.34 (9.64)	49.69 (10.71)	49.51 (9.57)	49.38 (7.79)	46.52 (12.06)	1.89**
SHT (cm)	75.18 (3.98)	75.62 (3.40)	73.37 (3.94)	73.50 (4.14)	73.24 (4.60)	5.43*
HTAC(cm)	123.32 (5.64)	124.12 (5.20)	123.20 (5.50)	121.86 (4.55)	122.20 (5.28)	2.13**
CIRCUMFERENCES (cm)						
MUAC (cm)	22.45 (3.09)	23.25 (3.21)	23.34 (2.86)	22.96 (2.35)	22.65 (3.94)	1.97**
CC (cm)	80.66 (8.57)	82.71 (10.71)	83.10 (8.94)	83.82 (9.87)	80.66 (12.03)	2.08**
WC (cm)	74.70 (11.06)	77.07 (13.11)	78.58 (12.14)	81.04 (12.86)	79.44 (13.44)	4.03*
HC (cm)	83.78 (8.34)	86.55 (9.65)	88.22 (9.25)	88.00 (8.65)	87.05 (10.79)	5.17*
SKINFOLDS (mm)						
TSF (mm)	12.37 (5.59)	13.16 (5.04)	13.08 (5.26)	12.81 (4.53)	11.21 (4.73)	1.51**
BSF (mm)	6.83 (3.79)	7.32 (3.87)	7.54 (3.22)	7.47 (2.72)	6.51 (3.58)	1.21**
SUBSF (mm)	14.27 (6.94)	15.20 (7.29)	15.02 (5.93)	16.90 (6.87)	14.50 (6.88)	1.68**
SUPSF (mm)	13.40 (6.90)	14.56 (7.39)	14.63 (5.83)	15.37 (5.82)	12.47 (5.74)	2.05**
MCSF (mm)	15.00 (6.33)	14.10 (5.36)	13.74 (5.16)	14.05 (4.89)	11.67 (5.62)	3.47*
ATSF (mm)	21.13 (9.15)	21.80 (8.86)	20.88 (8.40)	19.02 (7.41)	14.88 (8.09)	6.40*

*-significant at 0.05 level
**- not significant at 0.05 level

Figure 5.1: Mean values of Height (cm), Weight (kg), Sitting Height (cm) and Height Acromion (cm) of adults slum dwellers

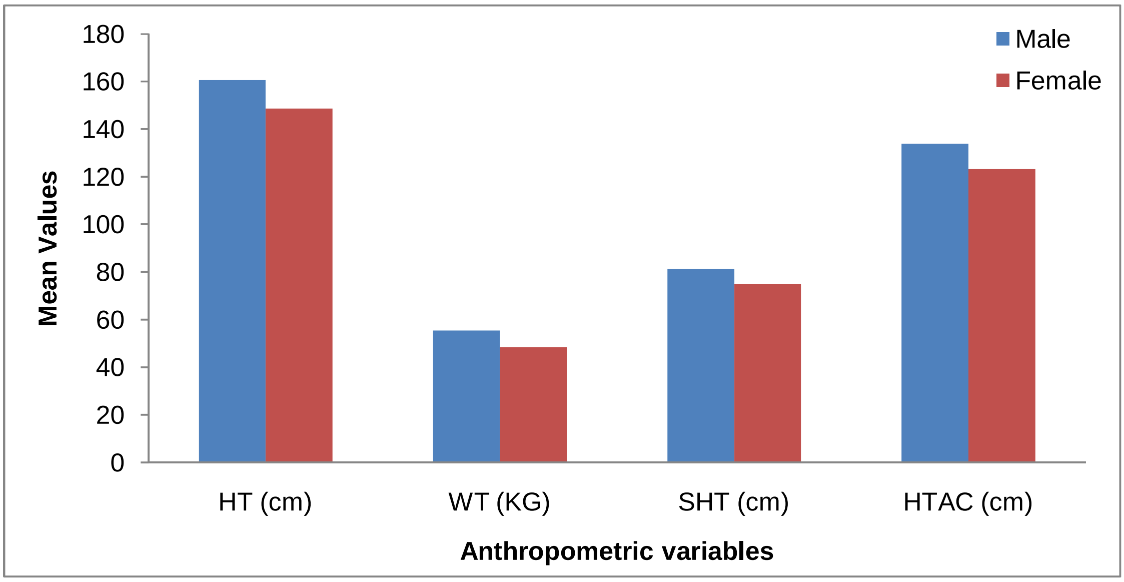


Figure 5.2: Mean values of Mid-upper arm circumference (cm), Chest Circumference (cm), Waist Circumference (cm) and Hip Circumference (cm) of adults slum dwellers

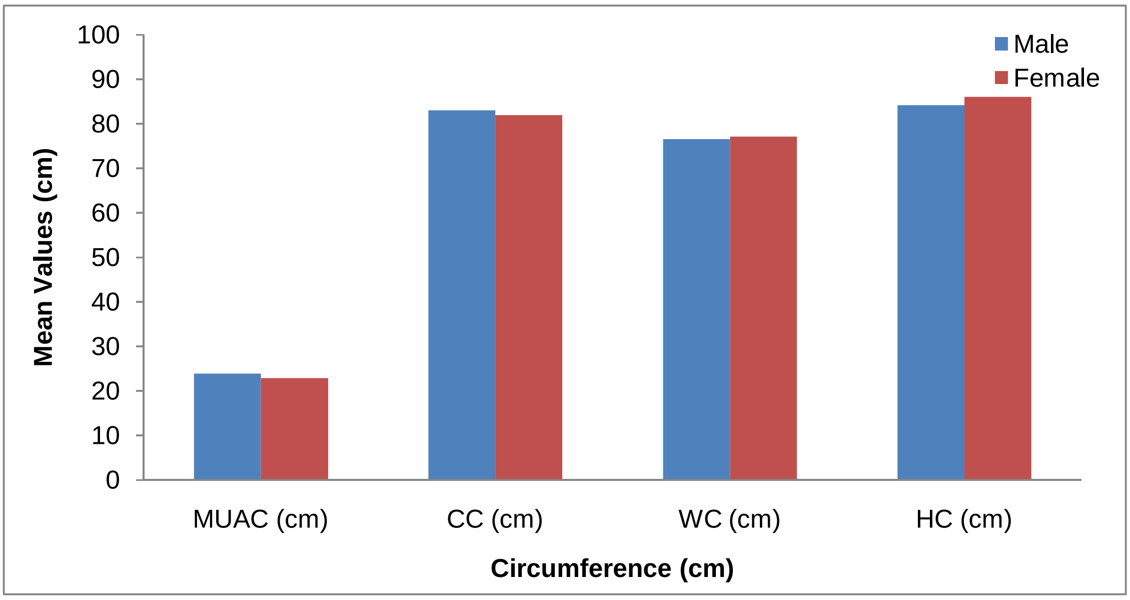


Figure 5.3: Mean values of Triceps Skinfold (mm), Biceps Skinfolds (mm), Subscapular Skinfolds (mm), Suprailliac Skinfold (mm), Medial Calf Skinfolds (mm) and Anterior Thigh Skinfold (mm) of adults slum dwellers

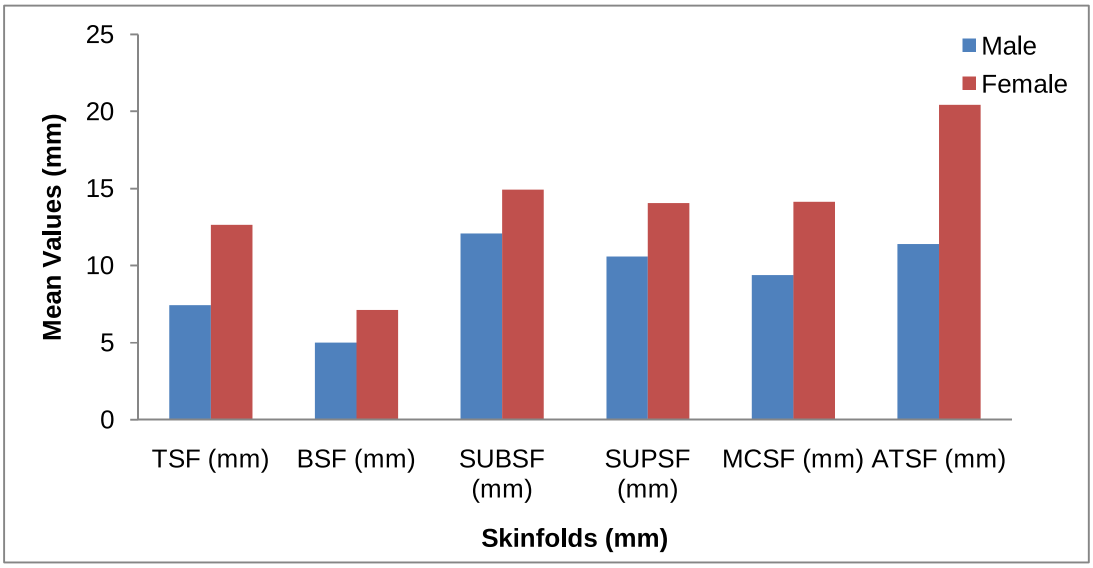


Figure 5.4: Mean values of Height (cm), Weight (kg), Sitting Height (cm) and Height Acromion (cm) according to age Groups of males

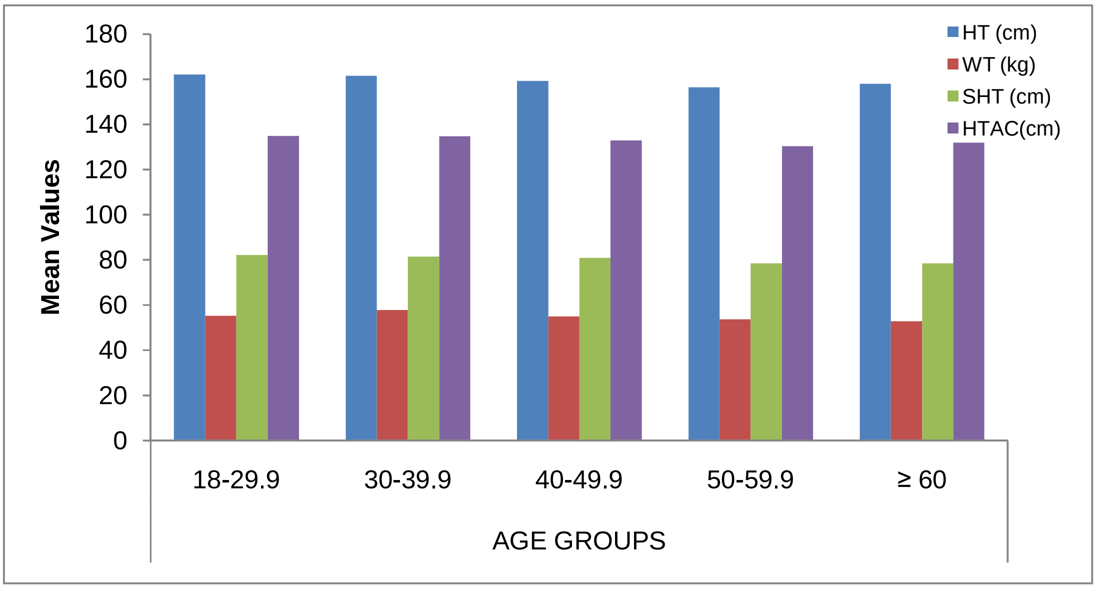


Figure 5.5: Mean values of Mid-upper arm circumference (cm), Chest Circumference (cm), Waist Circumference (cm) and Hip Circumference (cm) according to age groups of males

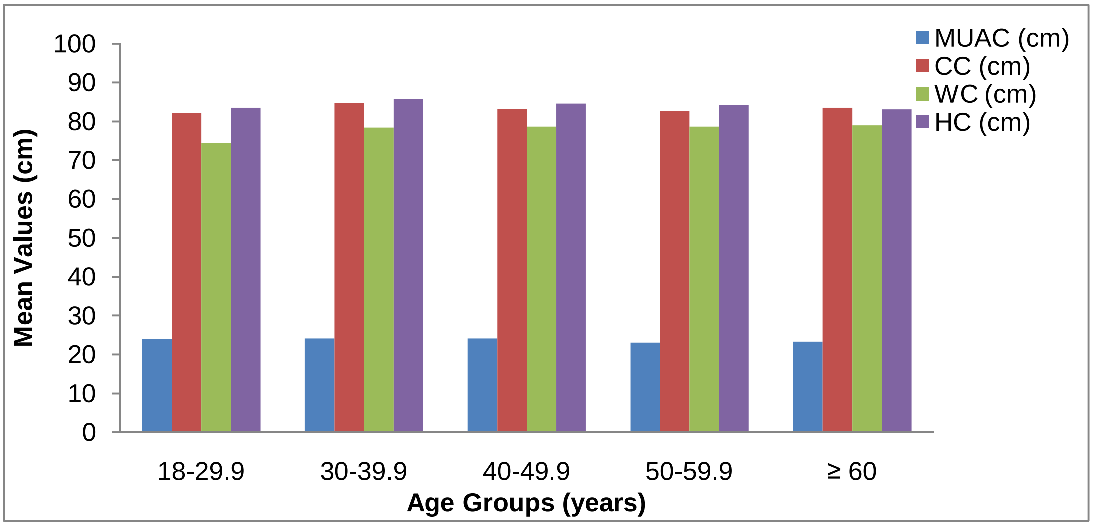


Figure 5.6: Mean values of Triceps Skinfold (mm), Biceps Skinfolds (mm), Subscapular Skinfolds (mm), Suprailliac Skinfold (mm), Medial Calf Skinfolds (mm), and Anterior Thigh Skinfold (mm) according to age groups of males

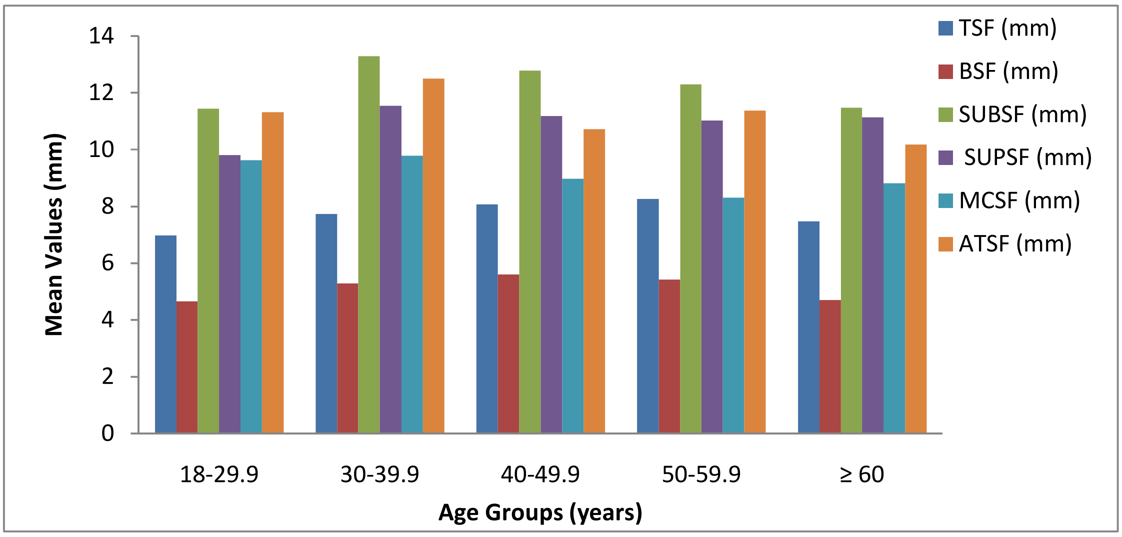


Figure 5.7: Mean values of Height (cm), Weight (kg), Sitting Height (cm) and Height Acromion (cm) according to age Groups of females

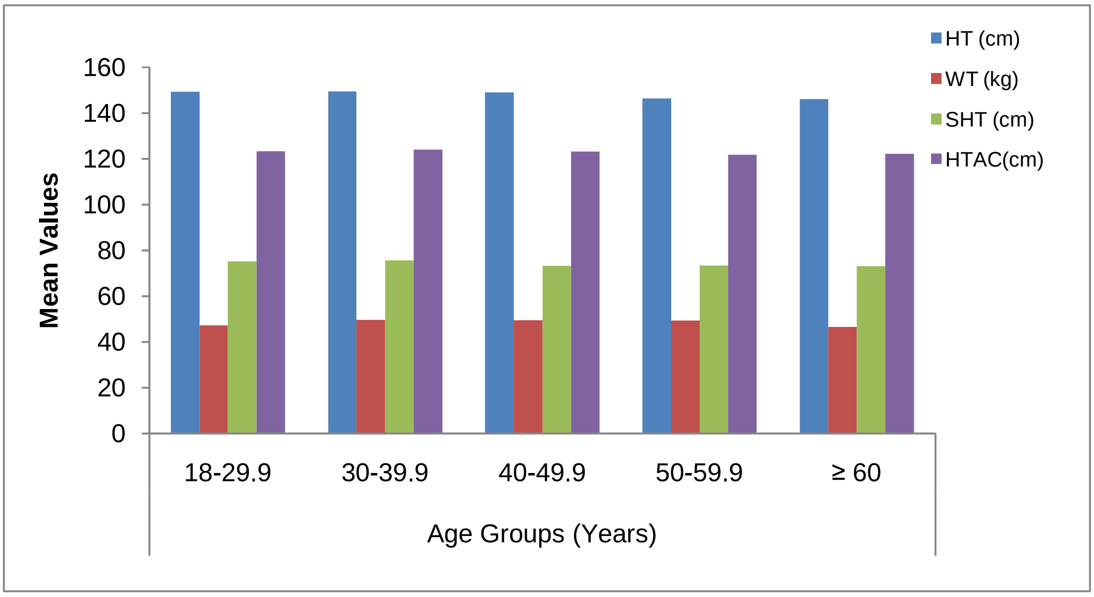


Figure 5.8: Mean values of Mid-upper arm circumference (cm), Chest Circumference (cm), Waist Circumference (cm) and Hip Circumference (cm) according to age groups of females:

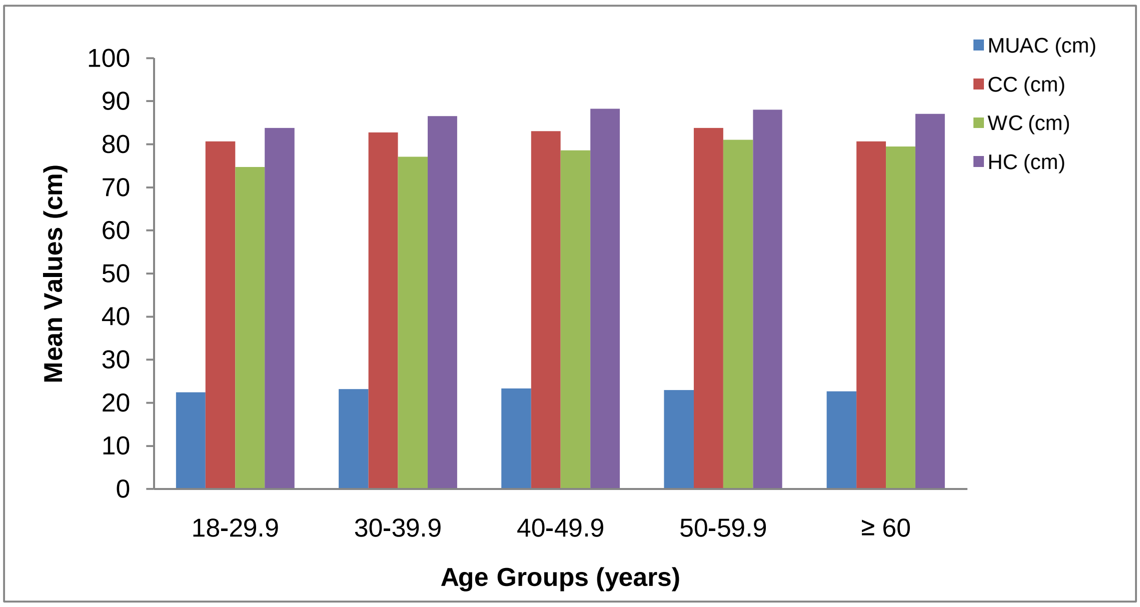
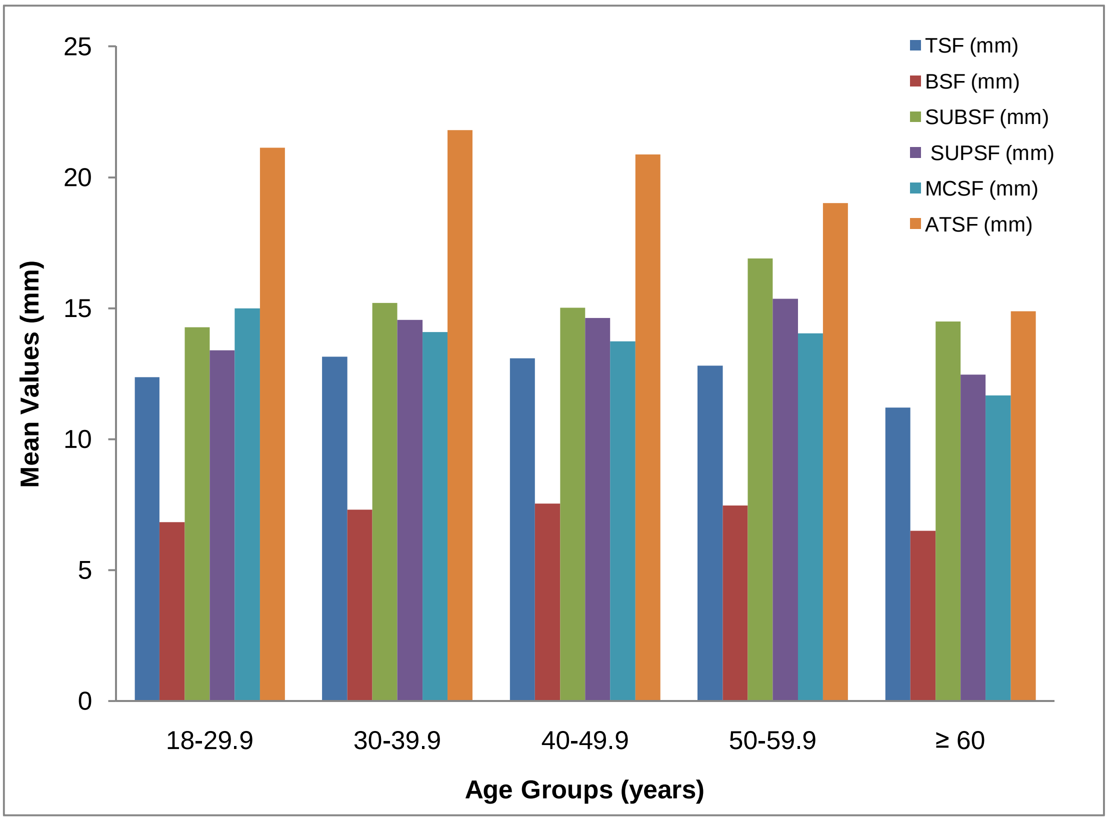


Figure 5.9: Mean values of Triceps Skinfold (mm), Biceps Skinfolds (mm), Subscapular Skinfolds (mm), Suprailliac Skinfold (mm), Medial Calf Skinfolds (mm) and Anterior Thigh Skinfold (mm) according to age groups of females



CHAPTER – VI

RESULTS III

ADIPOSITY AND BODY COMPOSITION CHARACTERISTICS

(WITH 10 TABLES AND 6 FIGURES IN THE TEXT)

VI

RESULTS III

6.1 ADIPOSITY MEASUREMENTS:

Table 6.1.1 presents the mean, SD and 25th, 50th, and 75th percentile values of adiposity measurements of males.The mean (SD) BMI, WHR, WHTR and CI of male slum dwellers were 21.45 (3.67), 0.91(0.07), 0.48(0.06) and 1.20(0.10) respectively. The mean (SD) SumALSF, SumSFT, SumSFEx, SumSFLEx and SumSFUEx of males were 55.87 (23.62) and 22.66 (9.89), 33.21(15.06), 20.79(10.04) and 12.42(5.94) respectively.

Table 6.1.2 presents the mean, SD and 25th, 50th, and 75th percentile values of adiposity measurements of females. The mean (SD) BMI, WHR, WHTR and CI of female slum dwellers were 21.93 (4.35), 0.89(0.08), 0.52(0.08) and 1.24(0.18) respectively. The mean (SD) SumALSF, SumSFT, SumSFEx, SumSFLEx and SumSFUEx of females were 83.27 (31.44) and 28.98 (12.76), 54.39(20.47), 34.54(13.43) and 19.74(8.20) respectively.

The sex differences of all the adiposity measurements except body mass index of slum dwellers are statistically significant at the 0.05 level (***Table 6.1.3, Fig 6.1***).

Table 6.1.4 (Fig 6.2) presents mean (SD) values of adiposity measurements according to age groups of males. The mean (SD) BMI (kg/m^2) of males, increased from 21.06(3.47) the lowest age group (18-29.9 years) to 22.12(3.80) the next age group (30-39.9 years), and then decreased 21.55(3.48) the next age group (40-49.9 years), then increased 21.23(3.96) the elder age group (>60 years). The mean (SD) WHR of males increased from 0.89 (0.06) in the age group 18-29.9 upto 0.95(0.11) in the age eldest age group (>60 years). The mean (SD) WHTR of males increased from 0.46 (0.05) in the lowest age group 18-29.9 years to 0.89(0.06) in the next age group (30-39.9 years), then decreased 0.49(0.06) next age group (40-49.9 years), then it is increased 0.50(0.08) upto eldest age group (>60 years). The mean (SD) CI of males, increased from 1.17(0.08) the lowest age group (18-29.9 years) upto 1.26(0.11) the eldest age group (>60 years). The mean differences of WHR, WHTR and CI between age groups of males are statistically significant at the level 0.05 but the mean differences of BMI between age groups of males are not statistically significant at the level 0.05.

The mean (SD) SumALSF of males, increased from 53.86(22.36) the lowest age group (18-29.9 years) to 60.12(24.85) the next age group (30-39.9 years), and then decreased 57.31(25.63) in the age group (40-49.9 years) upto 53.77(19.97) the elder age group (>60 years). The mean (SD) SumSFT of males increased from 21.26 (9.30) in the age group (18-29.9 years) to 24.82(10.12) in the next age group (30-39.9 years), then decreased 23.95(10.08) in the age group of (40-49.9 years), to 23.32(11.79), in the age group (50-59.9 years), then increased 23.60(9.23) in the eldest age group (>60 years). The mean (SD) SumSFEX of males increased from 32.60(14.11) in the lowest age group (18-29.9 years) to 35.30(15.74) in the next age group (30-39.9 years), then decreased 33.36(18.11) in the age group (40-49.9 years) upto 31.17(11.96) in the eldest age group (>60 years). The mean (SD) SumSFLEX of males increased from 20.95(9.93) in the lowest age group (18-29.9 years) to 22.28(10.16) in the next age group (30-39.9 years), then decreased 19.69(9.84) in the age group (40-49.9 years) upto 19.00(8.17) in the eldest age group (>60 years). The mean (SD) SumSFUEX of males, increased from 11.65(4.79) the lowest age group (18-29.9 years) upto 13.68(6.16) in the age group of (50-59.9 years), then decreased 12.17(4.45) in the eldest age group (>60 years). The mean differences of SumSFT and SumSFUEX between age groups of males are statistically significant at the level 0.05 but the mean differences of SumALSF, SumSFEX and SumSFLEX between age groups of males are not statistically significant at the level 0.05.

Table 6.1.5 (Fig 6.3) presents mean (SD) values of adiposity measurements according to age groups of females. The mean (SD) BMI (kg/m^2) of males, increased from 21.29(4.41) the lowest age group (18-29.9 years) to 23.05(3.55) the age group (50-59.9

years), and then decreased 21.69(4.90), the elder age group (>60 years). The mean (SD) WHR of females increased from 0.89 (0.08) in the age group 18-29.9 years to 0.92(0.09), the age group of 50-59.9 years, then decreased 0.91(0.07) in the age eldest age group (>60 years). The mean (SD) WHTR of females increased from 0.50 (0.08) in the lowest age group 18-29.9 years upto 0.54(0.08) in the eldest age group (>60 years). The mean (SD) CI of females, increased from 1.22(0.12) the lowest age group (18-29.9 years) upto 1.30(0.12) the eldest age group (>60 years). The mean differences of WHTR and CI between age groups of females are statistically significant at the level 0.05 but the mean differences of BMI and WHR between age groups of females are not statistically significant at the level 0.05.

The mean (SD) SumALSF of females, increased from 83.01(33.84) the lowest age group (18-29.9 years) to 86.15(33.01) the next age group (30-39.9 years), and then decreased 84.90(28.12) in the age group (40-49.9 years), then increased 85.50(23.52) in the age group (50-59.9 years), upto 71.23(30.43) the elder age group (>60 years). The mean (SD) SumSFT of females increased from 27.67 (13.26) in the age group (18-29.9 years) to 29.76(14.08) in the next age group (30-39.9 years), then decreased 29.65(10.67) in the age group of (40-49.9 years), then increased 32.27(11.44), in the age group (50-59.9 years), then decreased 26.96(12.11) in the eldest age group (>60 years). The mean (SD) SumSFEXof females increased from 55.34(22.22) in the lowest age group (18-29.9 years) to 56.39(20.55) in the next age group (30-39.9 years), then decreased 55.24(18.89) in the age group (40-49.9 years) upto 44.27(19.48) in the eldest age group (>60 years). The mean (SD) SumSFLEXof females increased from 36.13(14.25) in the lowest age group (18-29.9 years) to 35.90(13.27) in the next age group (30-39.9 years), then decreased 34.62(12.29) in the age group (40-49.9 years) upto 26.55(13.10) in the eldest age group (>60 years). The mean (SD) SumSFUEX of females, increased from 19.20(8.81) the lowest age group (18-29.9 years) upto 20.32(6.55) in the age group of (50-59.9 years), then decreased 17.72(7.82) in the eldest age group (>60 years). The mean differences of SumSFEX and SumSFLEX between age groups of females are statistically significant at the level 0.05 but the mean differences of SumALSF, SumSFT and SumSFUEX between age groups of females are not statistically significant at the level 0.05.

6.2 BODY COMPOSITION CHARACTERISTICS:

Body composition characteristics of the subjects are presented through the mean, standard deviation (SD) and 25th, 50th, and 75th percentile values of each body composition variable of males and females. ***Table*** **6.2.1** depicts the overall mean, standard deviation (SD) and quartile values of body composition variables of males. The mean (SD) of PBF, FM, FFM, FMI, and FFMI of males were 13.36(5.58), 7.75 (4.61), 47.62 (7.16), 2.99 (1.17), 18.46 (2.64), respectively ***Table*** **6.2.2** show the mean (SD) PBF, FM, FFM, FMI, and FFMI of females were 20.67 (7.45), 10.54 (5.72), 37.92 (5.83), 4.75 (2.48), 17.18 (2.62), respectively. The sex differences of all the body composition measurements of slum dwellers are statistically significant at the 0.05 level (***Table 6.2.3, Fig 6.4)***.

Table **6.2.4** ***(Fig 6.5)*** presents the age specific mean (SD) values of the body composition variables of males. The mean (SD) of PBF (%) values of males increased 13.21(5.28) from the lowest age group (18-29.9 years) to 13.87(5.90) in the next age group (30-39.9 years), then decreased 13.57(6.53) in the age group (40-49.9 years), upto 12.97(4.96) the elder age group (>60 years). The mean (SD) of FM (kg) values of males increased 7.58(4.36) from the lowest age group (18-29.9 years) to 8.46(5.05) in the next age group (30-39.9 years), then decreased 7.82(5.30) in the age group (40-49.9 years), upto 7.20(3.77) the elder age group (>60 years). The mean (SD) of FFM (kg) values of males increased 47.65(6.69) from the lowest age group (18-29.9 years) to 49.34(8.07) in the next age group (30-39.9 years), then decreased 47.03(7.10) in the age group (40-49.9 years), upto 45.60(6.40) the elder age group (>60 years). The mean (SD) of FMI values of males increased 2.88(1.58) from the lowest age group (18-29.9 years) to 3.20(1.84) in the next age group (30-39.9 years), then decreased 3.05(1.93) in the age group (40-49.9 years), upto 2.90(1.54) the elder age group (>60 years). The mean (SD) of FFMI values of males increased 18.18(2.62) from the lowest age group (18-29.9 years) to 18.92(2.65) in the next age group (30-39.9 years), then decreased 18.50(2.34) in the age group (40-49.9 years), then increased 18.91(3.01) in the age group (50-59.9), then decreased 18.33(2.68) the elder age group (>60 years). The mean differences of FFM between age groups of males are statistically significant at the level 0.05 but the mean differences of PBF, FM, FMI and FFMI between age groups of males are not statistically significant at the level 0.05.

Table* 6.2.5 *(Fig 6.6) presents the age specific mean (SD) values of the body composition variables of females. The mean (SD) of PBF (%) values of females decreased 21.12(8.30) from the lowest age group (18-29.9 years) to 20.72(6.94) in the age group (40-49.9 years), then increased 20.74(5.56) in the age group (50-59.9 years), then decreased 17.82(7.01) the elder age group (>60 years). The mean (SD) of FM (kg) values of females increased 10.58(6.38) from the lowest age group (18-29.9 years) to 11.04(5.81) in the next age group (30-39.9 years), then decreased 10.69(5.25) in the age group (40-49.9 years), upto 8.93(5.48) the elder age group (>60 years). The mean (SD) of FFM (kg) values of females increased 36.78(5.08) from the lowest age group (18-29.9 years) to 38.92(5.51) in the age group (50-59.9 years), then decreased 37.59(7.30) the elder age group (>60 years). The mean (SD) of FMI values of females increased 4.73(2.71) from the lowest age group (18-29.9 years) to 4.93(2.57) in the next age group (30-39.9 years), then decreased 4.80(2.32) in the age group (40-49.9 years), then increased 4.89(1.73) in the age group (50-59.9 years), then decreased 4.31(2.36) the elder age group (>60 years). The mean (SD) of FFMI values of females increased 16.65(2.66) from the lowest age group (18-29.9 years) upto 18.16(2.47) in the age group (50-59.9 years), then decreased 17.56(2.93) the elder age group (>60 years). The mean differences of FFM and FFMI between age groups of females are statistically significant at the level 0.05 but the mean differences of PBF, FM and FMI between age groups of females are not statistically significant at the level 0.05.

Table 6.1.1 Mean, standard deviation and quartile values of adiposity measurements of Males

VARIABLES	Mean	SD	Percentiles		
			25	50	75
BMI (kg/m^2)	21.45	3.67	18.92	20.85	23.60
WHR	0.91	0.07	0.86	0.91	0.95
WHTR	0.48	0.06	0.43	0.47	0.51
CI	1.20	0.10	1.14	1.20	1.25
SumALSF (mm)	55.87	23.62	37.43	49.25	69.00
SumSFT (mm)	22.66	9.89	15.00	19.90	28.80
SumSFEx (mm)	33.21	15.06	22.40	29.55	41.33
SumSFLEx (mm)	20.79	10.04	13.40	18.25	26.23
SumSFUEx (mm)	12.42	5.94	8.40	10.70	14.98

Table 6.1.2 Mean, standard deviation and quartile values of adiposity measurements of Females

VARIABLES	Mean	SD	Percentiles		
			25	50	75
BMI (kg/m^2)	21.93	4.35	18.50	21.31	24.75
WHR	0.89	0.08	0.84	0.90	0.95
WHTR	0.52	0.08	0.46	0.52	0.58
CI	1.24	0.18	1.15	1.25	1.33
SumALSF (mm)	83.27	31.44	57.98	81.60	103.73
SumSFT (mm)	28.98	12.76	17.80	28.80	37.25
SumSFEx (mm)	54.39	20.47	38.68	53.40	66.70
SumSFLEx (mm)	34.54	13.43	24.70	33.80	42.80
SumSFUEx (mm)	19.74	8.20	13.28	18.55	25.13

Table 6.1.3: Mean, standard deviation and t- value of adiposity measurements of slum dwellers

VARIABLES	Males		Females		t - Value
	Mean	SD	Mean	SD	
BMI (kg/m^2)	21.45	3.67	21.93	4.35	1.89**
WHR	0.91	0.07	0.89	0.08	3.21*
WHTR	0.48	0.06	0.52	0.08	9.03*
CI	1.20	0.10	1.24	0.18	5.83*
SumALSF (mm)	55.87	23.62	83.27	31.44	15.61*
SumSFT (mm)	22.66	9.89	28.98	12.76	8.77*
SumSFEx (mm)	33.21	15.06	54.39	20.47	18.62*
SumSFLEx (mm)	20.79	10.04	34.54	13.43	18.38*
SumSFUEx (mm)	12.42	5.94	19.74	8.20	16.22*

*- Significant at the level 0.05
**- Not significant at the level 0.05

Table 6.1.4: Mean (SD) values of adiposity measurements according to age Groups of Males

	AGE CATEGORIES					
DERIVED VARIABLES	**18-29.9**	**30-39.9**	**40-49.9**	**50-59.9**	**≥ 60**	**F**
BMI (kg/m^2)	21.06 (3.47)	22.12 (3.80)	21.55 (3.48)	21.95 (4.21)	21.23 (3.96)	1.80**
WHR	0.89 (0.06)	0.91 (0.06)	0.93 (0.07)	0.93 (0.08)	0.95 (0.11)	11.14*
WHTR	0.46 (0.05)	0.89 (0.06)	0.49 (0.06)	0.50 (0.08)	0.50 (0.08)	10.56*
CI	1.17 (0.08)	1.21 (0.10)	1.23 (0.10)	1.23 (0.11)	1.26 (0.11)	12.90*
SumALSF (mm)	53.86 (22.36)	60.12 (24.85)	57.31 (25.63)	56.67 (26.94)	53.77 (19.97)	1.45**
SumSFT (mm)	21.26 (9.30)	24.82 (10.12)	23.95 (10.08)	23.32 (11.79)	23.60 (9.23)	2.81*
SumSFEx (mm)	32.60 (14.11)	35.30 (15.74)	33.36 (18.11)	33.35 (16.57)	31.17 (11.96)	0.81**
SumSFLEx (mm)	20.95 (9.93)	22.28 (10.61)	19.69 (9.84)	19.67 (10.94)	19.00 (8.17)	1.27**
SumSFUEx (mm)	11.65 (4.79)	13.02 (6.09)	13.67 (9.27)	13.68 (6.16)	12.17 (4.45)	2.53*

*- Significant at the level 0.05
**- Not significant at the level 0.05

Table 6.1.5: Mean (SD) values of derived variables according to age Groups of Females

	AGE CATEGORIES					
DERIVED VARIABLES	**18-29.9**	**30-39.9**	**40-49.9**	**50-59.9**	**≥ 60**	**F**
BMI (kg/m^2)	21.29 (4.41)	22.23 (4.58)	22.25 (3.96)	23.05 (3.55)	21.69 (4.90)	2.24**
WHR	0.89 (0.08)	0.89 (0.08)	0.89 (0.08)	0.92 (0.09)	0.91 (0.07)	2.19**
WHTR	0.50 (0.08)	0.52 (0.09)	0.53 (0.08)	0.55 (0.09)	0.54 (0.08)	5.93*
CI	1.22 (0.12)	1.23 (0.13)	1.25 (0.13)	1.28 (0.15)	1.30 (0.12)	5.79*
SumALSF (mm)	83.01 (33.84)	86.15 (33.01)	84.90 (28.12)	85.50 (23.52)	71.23 (30.43)	2.17**
SumSFT (mm)	27.67 (13.26)	29.76 (14.08)	29.65 (10.67)	32.27 (11.44)	26.96 (12.11)	1.90**
SumSFEx (mm)	55.34 (22.22)	56.39 (20.55)	55.24 (18.89)	53.62 (14.71)	44.27 (19.48)	3.45*
SumSFUEx (mm)	36.13 (14.025)	35.90 (13.27)	34.62 (12.29)	33.08 (10.70)	26.55 (13.10)	5.57*
SumSFLEx (mm)	19.20 (8.81)	20.48 (8.22)	20.62 (7.84)	20.32 (6.55)	17.72 (7.82)	1.53**

*- Significant at the level 0.05
**- Not significant at the level 0.05

Table 6.2.1: Mean, standard deviation (SD) and quartile values of body composition measures of Males

VARIABLES	Mean	SD	Percentiles		
			25	50	75
PBF (%)	13.36	5.58	9.38	12.25	16.46
FM (kg)	7.75	4.61	4.69	6.38	9.80
FFM (kg)	47.62	7.16	42.15	47.29	52.16
FMI (Kg/m^2)	2.99	1.71	1.83	2.47	3.74
FFMI (Kg/m^2)	18.46	2.64	16.70	18.13	19.84

Table 6.2.2: Mean, standard deviation (SD) and quartile values of body composition measures of Females

VARIABLES	Mean	SD	Percentiles		
			25	50	75
PBF (%)	20.67	7.45	14.95	20.15	25.20
FM (kg)	10.54	5.72	6.26	9.38	13.21
FFM (kg)	37.92	5.83	33.59	37.65	41.80
FMI (Kg/m^2)	4.75	2.48	2.81	4.22	6.04
FFMI (Kg/m^2)	17.18	2.62	15.33	16.92	18.71

Table 6.2.3: Mean, standard deviation (SD) and t- value of body composition measures of slum dwellers

VARIABLES	Males		Females		t- value
	Mean	SD	Mean	SD	
PBF (%)	13.36	5.58	20.67	7.45	17.57*
FM (kg)	7.75	4.61	10.54	5.72	8.52*
FFM (kg)	47.62	7.16	37.92	5.83	23.48*
FMI (Kg/m^2)	2.99	1.71	4.75	2.48	13.13*
FFMI (Kg/m^2)	18.46	2.64	17.18	2.62	7.70*

*- Significant at the level 0.05
**- Not significant at the level 0.05

Table 6.2.4: Age specific mean (SD) values of body composition variables of Males

AGE CATEGORIES						
VARIABLE	18-29.9	30-39.9	40-49.9	50-59.9	≥ 60	F
PBF (%)	13.21 (5.28)	13.87 (5.90)	13.57 (6.53)	13.17 (5.75)	12.97 (4.96)	0.34**
FM (kg)	7.58 (4.36)	8.46 (5.05)	7.82 (5.30)	7.40 (4.59)	7.20 (3.77)	0.93**
FFM(kg)	47.65 (6.69)	49.34 (8.07)	47.03 (7.10)	46.23 (7.44)	45.60 (6.40)	2.99*
FMI (Kg/m^2)	2.88 (1.58)	3.20 (1.84)	3.05 (1.93)	3.03 (1.86)	2.90 (1.54)	0.72**
FFMI (Kg/m^2)	18.18 (2.62)	18.92 (2.65)	18.50 (2.34)	18.91 (3.01)	18.33 (2.68)	1.81**

*- Significant at the level 0.05
**- Not significant at the level 0.05

Table 6.2.5: Age specific mean (SD) values of body composition variables of Females

	AGE CATEGORIES					
VARIABLE	**18-29.9**	**30-39.9**	**40-49.9**	**50-59.9**	**≥ 60**	**F**
PBF (%)	21.12 (8.30)	21.04 (7.26)	20.72 (6.94)	20.74 (5.56)	17.82 (7.01)	2.02**
FM (kg)	10.58 (6.38)	11.04 (5.81)	10.69 (5.25)	10.46 (3.71)	8.93 (5.48)	1.20**
FFM(kg)	36.76 (5.08)	38.65 (6.08)	38.82 (5.93)	38.92 (5.51)	37.59 (7.30)	3.40*
FMI (Kg/m^2)	4.73 (2.71)	4.93 (2.57)	4.80 (2.32)	4.89 (1.73)	4.13 (2.36)	0.96**
FFMI (Kg/m^2)	16.56 (2.66)	17.30 (2.55)	17.45 (2.32)	18.16 (2.47)	17.56 (2.93)	5.26*

*- Significant at the level 0.05
**- Not significant at the level 0.05

Figure 6.1: Mean values of adiposity measurements of adults slum dwellers

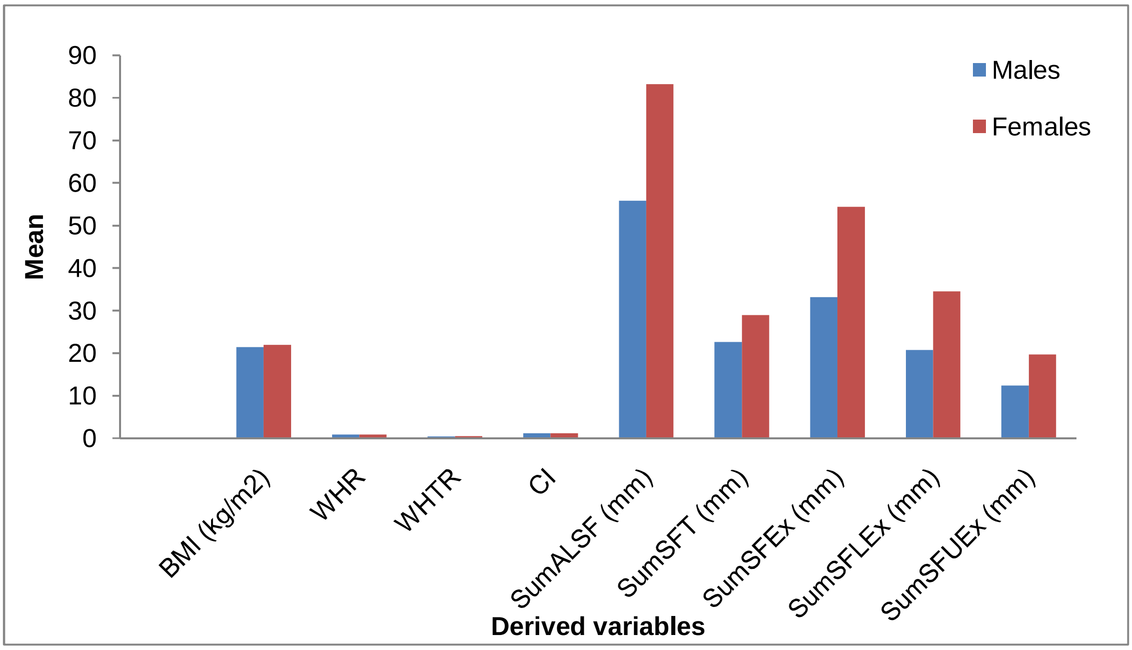


Figure 6.2: Mean values of adiposity measurements according to age Groups of Males slum dwellers

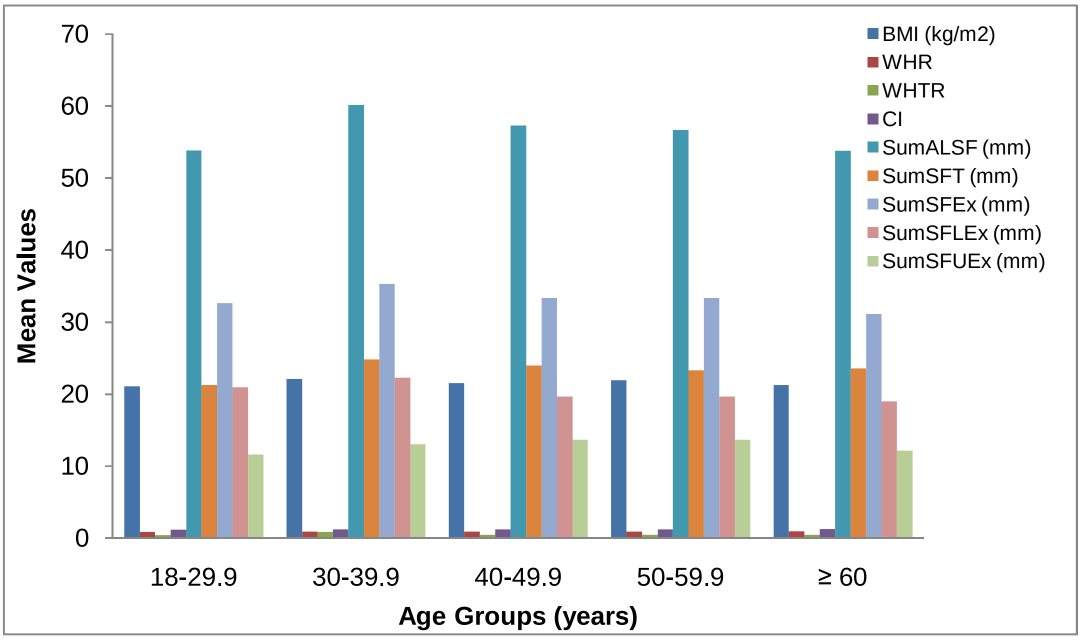


Figure 6.3: Mean values of adiposity measurements according to age Groups of Females slum dwellers

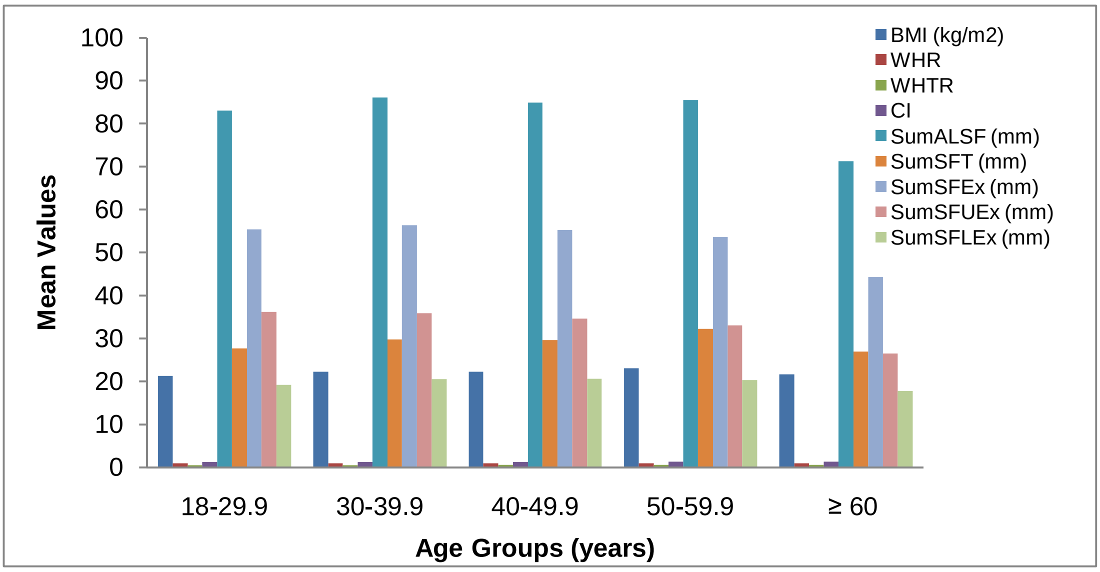


Figure 6.4: Mean value of body composition measures of adults slum dwellers

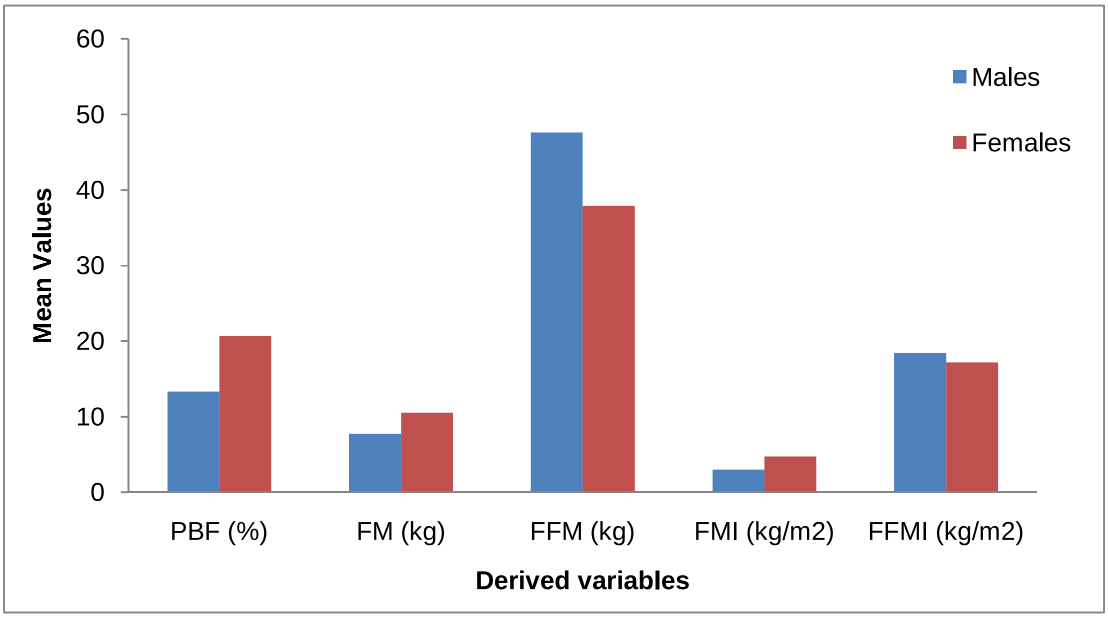


Figure 6.5: Age specific mean values of body composition of Male slum dwellers

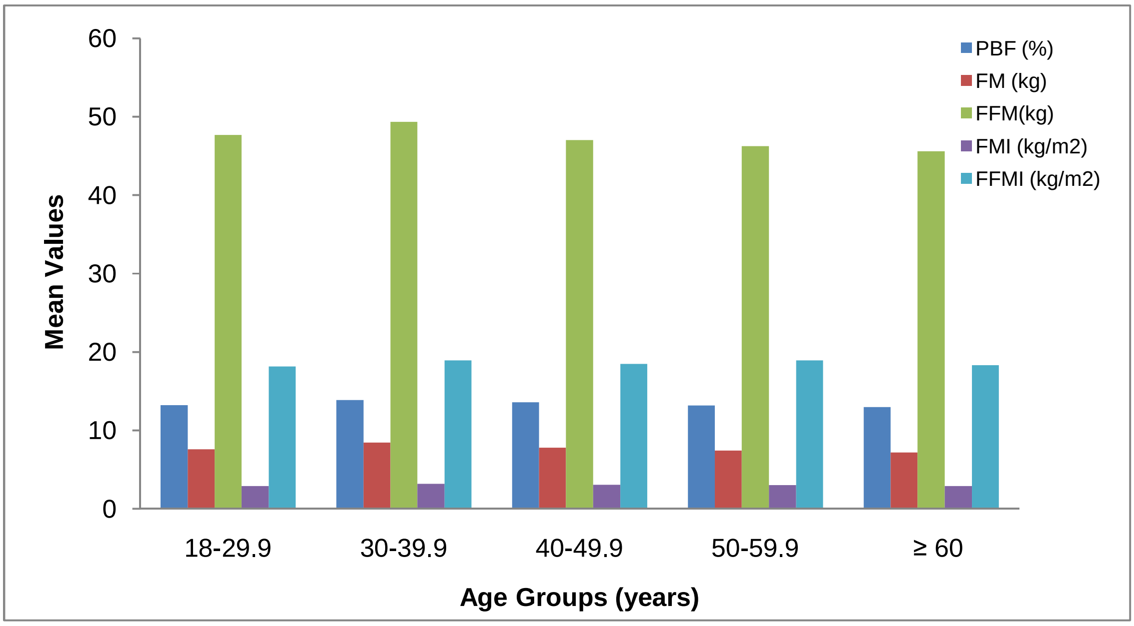
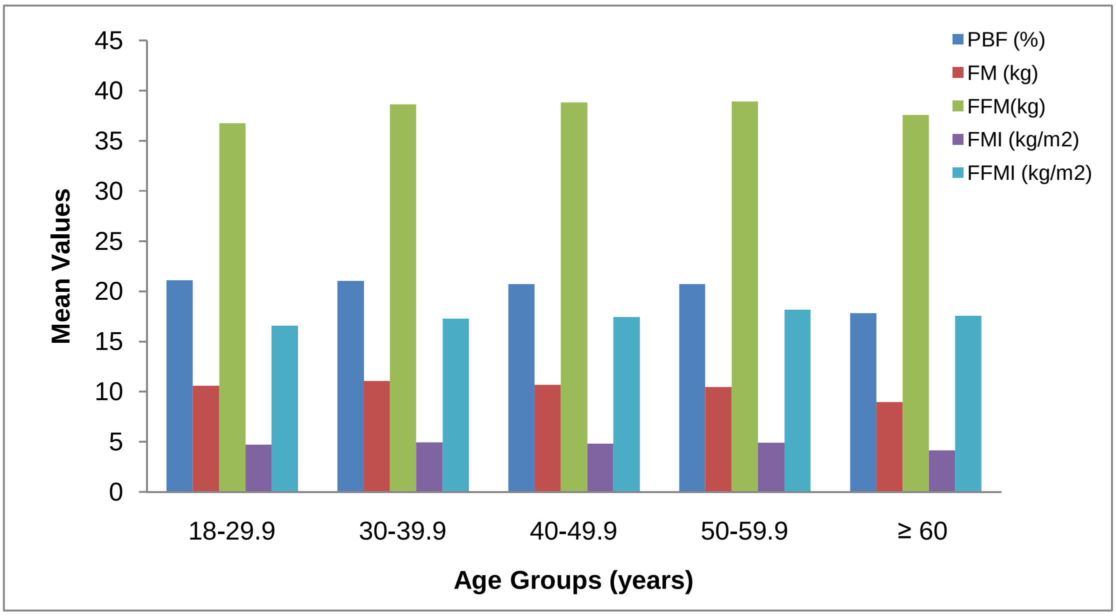


Figure 6.6: Age specific mean values of body composition of Females slum dwellers



CHAPTER – VII

RESULTS- IV

NUTRITIONAL STATUS

(WITH 10 TABLES AND 10 FIGURES IN THE TEXT)

VII

RESULTS- IV

7.1.1 Nutritional status by body mass index (BMI):

Table 7.1.1(Fig 7.1) presented the absolute numbers (n) and percent frequencies of male and female slum dwellers in different nutritional statuses based on BMI values. The classification is based on the recommendation of the World Health Organization (WHO) for the international adult populations (WHO, 1995). 20.85% of the males were underweight or chronic energy deficiency (CED), 12.55% of males were overweight and 2.63% were obese. The rest 63.97% of them were in the normal BMI range. 24.31% of the females were underweight or chronic energy deficient (CED), 19.57% were overweight and 3.95 % were obese. The rest of 52.17% them were in the normal BMI range.

The age group-wise distribution of males belonging to different nutritional statuses (WHO, 1995) was studied and the result is presented in ***table 7.1.2 (Fig 7.2)***. The highest percentage of CED of males were (34.09%) in the eldest age group (>60 years) and the lowest percentage of CED of males were (15.24%) in the age group of 30-39.9 years. The highest rate of overweight of males were (19.05%) in the age groups (30-39.9 years) and the lowest rate of overweight of males were (9.24%) in the youngest age groups (18-29.9 years). The highest rate of obese of males were (8.70%) in the age groups (50-59.9 years) and the lowest rate of obese of males were (1.68%) in the youngest age groups

(18-29.9 years). There is significant age group differences (χ^2= 21.72, p = *0.041*) in nutritional status based on BMI of adult male slum dwellers.

The age group-wise distribution of females belonging to different nutritional statuses (WHO, 1995) was studied and the result is presented in ***table 7.1.3 (Fig 7.3)***.The highest percentage of CED of females were (31.18%) in the eldest age group (18-29.9 years) and the lowest percentage of CED of females were (10.91%) in the age group of 50-59.9 years. The highest rate of overweight of females were (25.45%) in the age groups (50-59.9 years) and the lowest rate of overweight of females were (16.67%) in the youngest age groups (18-29.9 years). The highest rate of obese of females were (6.72%) in the age groups (30-39.9 years) and the lowest rate of obese of females were (2.15%) in the youngest age groups (18-29.9 years). There is no significant age group differences (χ^2= 17.56, p = *0.13*) in nutritional status based on BMI of adult female slum dwellers.

7.2 Nutritional status by mid-upper arm circumference (MUAC):

Table 7.2.1 **(Fig 7.4)** presents the frequencies of nutritional status according to the values of MUAC of adults males and females. The percentage of undernutrition (MUAC< 23 cm) of males were 40.49 % and females were 51.78%. The percentage of normal (MUAC> 23 cm) of males were 59.51 % and females were 48.22%.

Table 7.2.2 **(Fig 7.5)** presents the frequencies of nutritional status based on MUAC of males according to age group. The highest percentage of undernutrition (MUAC< 23 cm) of males were 56.82 % in the elder age group of > 60 years. The lowest percentage of undernutrition (MUAC> 23 cm) of males were 41.60 in the lowest age groups of 18-29.9 years The percentage undernutrition of MUAC of males were increasing with advancement of age groups. The highest percentage of normal (MUAC> 23 cm) of males were 58.14 % in the youngest age group18-29.9 years. The lowest percentage of normal (MUAC> 23 cm) of males were 43.18 % in the eldest age group >60 years. The percentage normal of MUAC of males were decreasing with advancement of age groups.

There is significant age group differences (χ^2= 148.3, *p = 0.000*) in nutritional status based on mid upper arm circumference of adult male slum dwellers.

Table 7.2.3 **(Fig 7.6)** presents the frequencies of nutritional status based on MUAC of females according to age group. The highest percentage of undernutrition (MUAC< 23 cm) of females were 63.44 % in the youngest age group of 18-29.9 years. The lowest percentage of undernutrition (MUAC> 23 cm) of females were 49.09% in the age groups of 50-59.9 years The percentage undernutrition of MUAC of females were decreasing with advancement of age groups but except the eldest age group (60.42%). The highest percentage of normal (MUAC> 23 cm) of females were 50.91 % in the age group 50-59.9 years. The lowest percentage of normal (MUAC> 23 cm) of females were 36.56 % in the lowest age group 18-29.9 years. The percentage normal of MUAC of females were increasing with advancement of age groups except in the elder age group (39.58%). There is significant age group differences (χ^2= 193.2, *p = 0.000*) in nutritional status based on mid upper arm circumference of adult female slum dwellers.

7.3 Relationship with Nutritional status and Occupation:

***Table 7.3*.1 (Fig 7.7)** Table presents the relationship between nutritional status and occupation of males slum dwellers. The Present studied sample who were manual worker the prevalence of CED (n=63), normal (n=169), overweight (n=36) and obese (n=4). The Present studied sample who were non-manual worker the prevalence of CED (n=43), normal (n=145), overweight (n=25) and obese (n=9). There is no significant occupation difference ($\chi^2_{(df=3)}$ = 4.50, *p = 0.212) in nutritional status among male slum dwellers of Midnapore town.*

***Table 7.3*.2 (Fig 7.8)** Table presents the relationship between nutritional status and occupation of female slum dwellers. The Present studied sample who were manual worker the prevalence of CED (n=53), normal (n=103), overweight (n=29) and obese (n=7). The Present studied sample who were non-manual worker the prevalence of CED (n=73), normal (n=160), overweight (n=69) and obese (n=12). There is no significant occupation difference ($\chi^2_{(df=3)}$ = 3.99, *p = 0.26) in nutritional status among female slum dwellers of Midnapore town.*

7.4 Relationship with nutritional status and Education:

Table 7.4.1 **(Fig 7.9)** Table presents the relationship between nutritional status and education of male slum dwellers. The Present studied sample who were illiterate the prevalence of CED (n=32), normal (n=70) overweight (n=9) and obese (n=2). The Present studied sample who were can sign only the prevalence of CED (n=4), normal (n=5) overweight (n=1) and obese (n=1). The Present studied sample who had primary education the prevalence of CED (n=26), normal (n=84) overweight (n=12) and obese (n=4). The Present studied sample who had secondary education the prevalence of CED (n=28), normal (n=101) overweight (n=26) and obese (n=3). The Present studied sample who had higher secondary education the prevalence of CED (n=10), normal (n=29) overweight (n=6) and obese (n=2). The Present studied sample who were graduate and above the prevalence of CED (n=6), normal (n=24) overweight (n=7) and obese (n=2). There is no significant education difference ($\chi^2_{(df=15)}$ = 14.59, *p = 0.482) in nutritional status among male slum dwellers of Midnapore town.*

Table 7.4.2 **(Fig 7.10)** Table presents the relationship between nutritional status and education of females slum dwellers. The Present studied sample who were illiterate the prevalence of CED (n=61), normal (n=131), overweight (n=44) and obese (n=7). The Present studied sample who were can sign only the prevalence of CED (n=2), normal (n=1) and obese (n=1). The Present studied sample who had primary education the prevalence of CED (n=31), normal (n=61) overweight (n=22) and obese (n=3). The Present studied sample who had secondary education the prevalence of CED (n=21), normal (n=59) overweight (n=24) and obese (n=6). The Present studied sample who had higher secondary education the prevalence of CED (n=7), normal (n=6) overweight (n=6) and obese (n=2). The Present studied sample who were graduate and above the prevalence of CED (n=4), normal (n=5) and overweight (n=2). There is no significant education difference ($\chi^2_{(df=15)}$ = 18.03, *p = 0.261) in nutritional status among female slum dwellers of Midnapore town.*

Table: 7.1.1: Overall frequency (%) of nutritional status by BMI (who 1995) of Males and Females.

Nutritional Categories	Frequency (n)		Percentage (%)		Cumulative (%)	
	Male	Female	Male	Female	Male	Female
CED III (BMI < 16 kg/m^2)	9	23	1.82	4.55	1.82	4.55
CED II (BMI < 16-16.9 kg/m^2)	24	28	4.86	5.33	6.68	10.08
CED I (BMI 17.0-18.4 kg/m^2)	70	72	14.17	14.23	20.85	24.31
Normal (BMI 18.5-24.9 kg/m^2)	316	264	63.97	52.17	84.82	76.48
Overweight (BMI 25-29.9 kg/m^2)	62	99	12.55	19.57	97.37	96.05
Obese (BMI $\geq$30 kg/m^2)	13	20	2.63	3.95	100	100
Total	494	506	100	100	---	---

Table 7.1.2: Frequency (%) of nutritional status by BMI (WHO 1995) According to age groups of Males

Age (Years)	Nutritional Status (%)			
	CED (BMI 18.4kg/m^2)	NORMAL (BMI 18.5-24.9 kg/m^2)	OVERWEIGHT (BMI 25-29.9 kg/m^2)	OBESE (BMI >30kg/m^2)
18-29.9(n=238)	**50(21.01)**	162(68.07)	22(9.24)	4(1.68)
30-39.9(n=105)	16(15.24)	67(63.81)	20(19.05)	2(1.90)
40-49.9(n=61)	12(19.67)	40(65.57)	**7(11.48)**	**2(3.28)**
50-59.9(n=46)	10(21.74)	25(54.35)	7(15.21)	4(8.70)
≥ 60(n=44)	**15(34.09)**	20(45.46)	8(18.18)	1(2.27)
All age (n=494)	**103(20.85)**	**314(63.56)**	**64(12.96)**	**13(2.63)**

$\chi^2_{(df=12)} = 21.72$, $p = 0.041$

Table 7.1.3: Frequency (%) of nutritional status by BMI (WHO 1995) According to age groups of Females

Age (Years)	Nutritional Status (%)			
	CED (BMI 18.4kg/m^2)	NORMAL (BMI 18.5-24.9 kg/m^2)	OVERWEIGHT (BMI 25-29.9 kg/m^2)	OBESE (BMI >30kg/m^2)
18-29.9(n=186)	**58(31.18)**	93(50.00)	31(16.67)	4(2.15)
30-39.9(n=119)	28(23.53)	59(49.58)	24(20.17)	8(6.72)
40-49.9(n=98)	17(17.35)	56(57.14)	**21(21.43)**	**4(4.08)**
50-59.9(n=55)	6(10.91)	33(60.00)	14(25.45)	2(3.64)
≥ 60(n=48)	**14(29.17)**	23(47.92)	9(18.75)	2(4.16)
All age (n=506)	**123(24.30)**	**264(52.18)**	**99(19.57)**	**20(3.95)**

$\chi^2_{(df=12)} = 17.56$, $p = 0.13$

Table 7.2.1: Overall frequencies (%) of Nutritional Status by MUAC of Males and Females

Categories	Frequency (n)		Percentage (%)	
	Male	Female	Male	Female
Undernourished (MUAC <23 cm)	200	262	40.49	51.78
Normal (MUAC ≥ 23 cm)	294	244	59.51	48.22
Total	494	506	100	100

Table 7.2.2: Frequencies of Nutritional Status by MUAC across Age Groups of Males

Age group	Undernutrition (MUAC < 23cm) (%)	Normal (MUAC ≥ 23cm) (%)
18-29.9(n=238)	99(41.60)	139(58.40)
30-39.9(n=105)	45(42.86)	60(57.14)
40-49.9(n=61)	27(44.26)	34(53.74)
50-59.9(n=46)	25(54.35)	21(45.65)
≥ 60(n=44)	25(56.82)	19(43.18)
Total	221(44.74)	273(55.26)

$\chi^2_{(df=3)} = 148.3$, $p = 0.000$

Table 7.2.3: Frequencies of Nutritional Status by MUAC across Age Groups of Females

Age group	Undernutrition (MUAC < 23cm) (%)	Normal (MUAC ≥ 23cm) (%)
18-29.9(n=186)	118(63.44)	68(36.56)
30-39.9(n=119)	61(51.26)	58(48.74)
40-49.9(n=98)	49(50.00)	49(50.00)
50-59.9(n=55)	27(49.09)	28(50.91)
≥ 60(n=48)	29(60.42)	19(39.58)
Total	284(56.13)	222(43.87)

$\chi^2_{(df=3)} = 193.2$, $p = 0.00$

7.3: Relationship with Nutritional status and Occupation

7.3.1: Nutritional status based on occupation of male slum dwellers

Occupation	Nutritional Status				Total
	CED	Normal	Overweight	Obese	
Manual	63	169	36	4	272
Non-Manual	43	145	25	9	222
Total	106	314	61	13	494

$\chi^2_{(df=3)} = 4.50$, $p = 0.212$

7.3.2: Nutritional status based on occupation of female slum dwellers

Occupation	Nutritional Status				Total
	CED	Normal	Overweight	Obese	
Manual	53	103	29	7	192
Non-Manual	73	160	69	12	314
Total	126	263	98	19	506

$\chi^2_{(df=3)} = 3.99$, $p = 0.26$

7.4: Relationship with nutritional status and Education

7.4.1: Nutritional status based on Education of male slum dwellers

Education	Nutritional Status				Total
	CED	Normal	Overweight	Obese	
Literate	32	70	9	2	113
Can sign only	4	5	1	1	11
primary	26	84	12	4	126
Secondary	28	101	26	3	158
Higher Secondary	10	29	6	2	47
Graduate and above	6	24	7	2	39
Total	106	313	61	13	494

$\chi^2_{(df=15)} = 14.59$, $p = 0.482$

7.4.2: Nutritional status based on Education of female slum dwellers

Education	Nutritional Status				Tot al
	CED	Normal	Overweight	Obese	
Literate	61	131	44	7	243
Can sign only	2	1	0	1	4
primary	31	61	22	3	117
Secondary	21	59	24	6	110
Higher Secondary	7	6	6	2	21
Graduate and above	4	5	2	0	11
Total	126	263	98	19	506

$\chi^2_{(df=15)} = 18.03$, $p = 0.261$

Figure: 7.1: Overall percentage (%) of nutritional status by BMI (who 1995) of adult slum dwellers

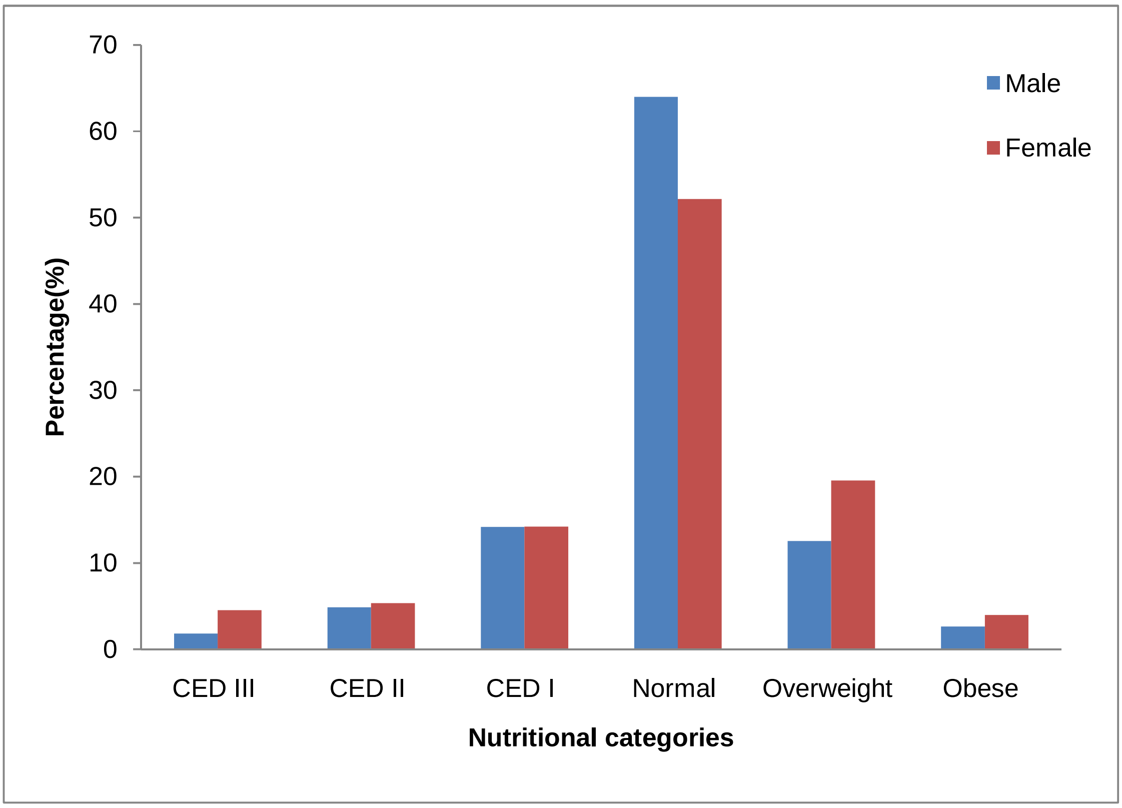


Figure 7.2: Percentage (%) of nutritional status by BMI (WHO 1995) According to age groups of Males

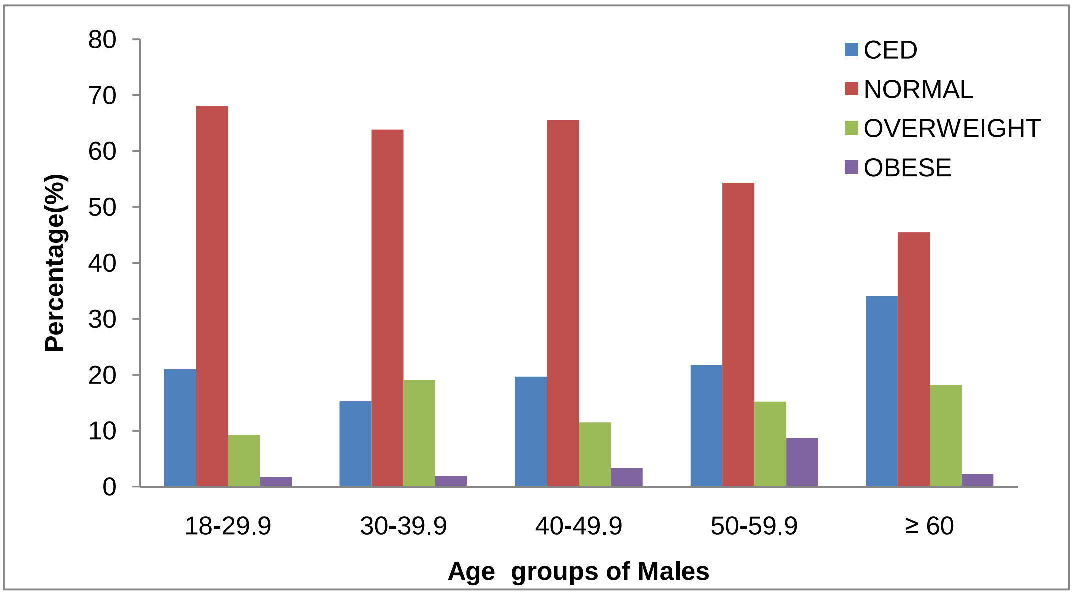


Figure 7.3: Percentage (%) of nutritional status by BMI (WHO 1995) According to age groups of Females

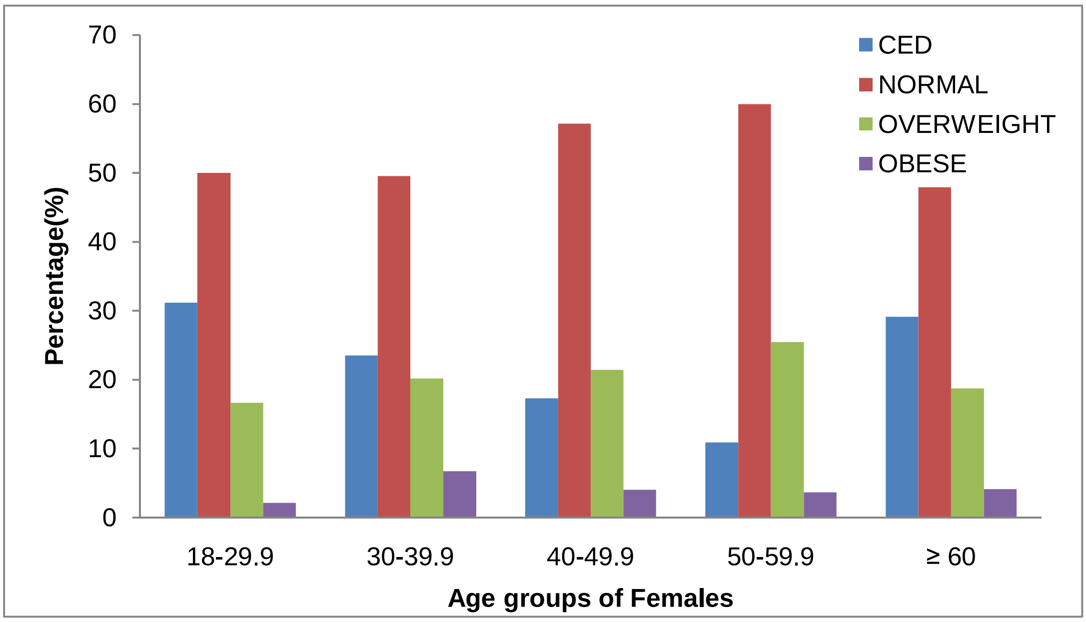


Figure 7.4: Overall Percentage (%) of Nutritional Status by MUAC of adult slum dwellers

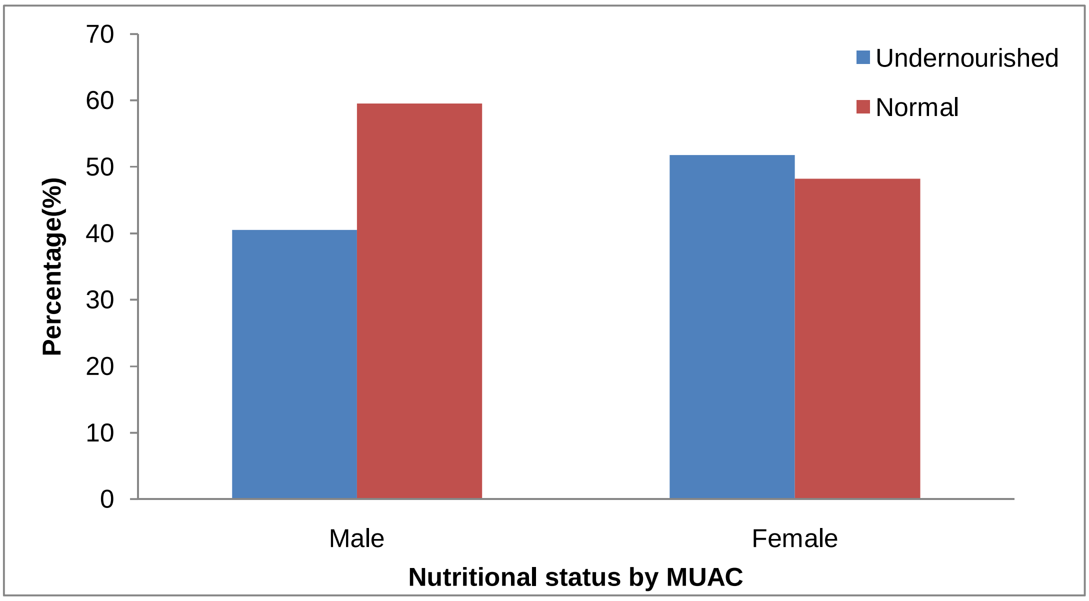


Figure 7.5: Percentage of Nutritional Status by MUAC across Age Groups of Males

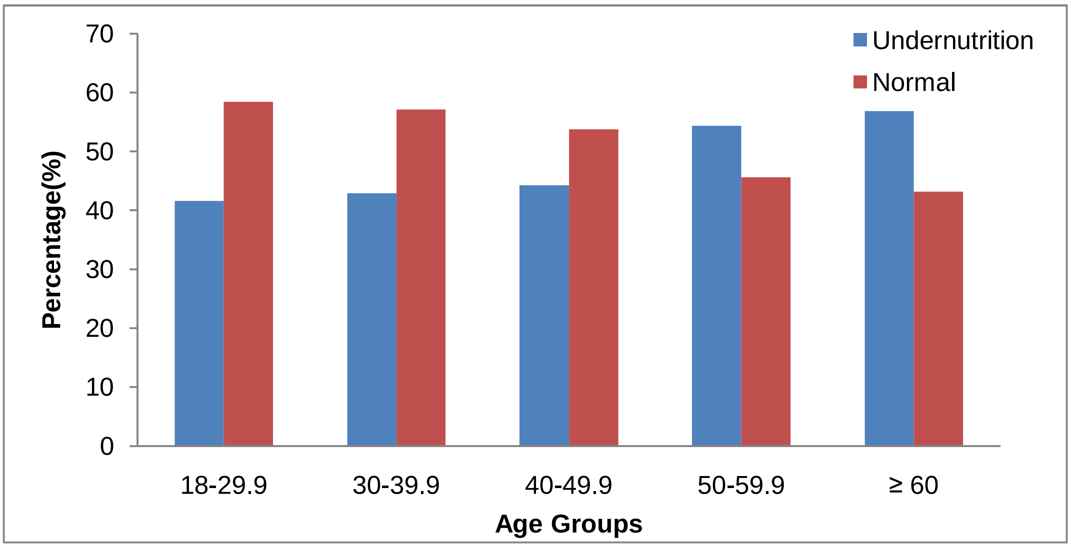


Figure 7.6: Percentage of Nutritional Status by MUAC across Age Groups of Females

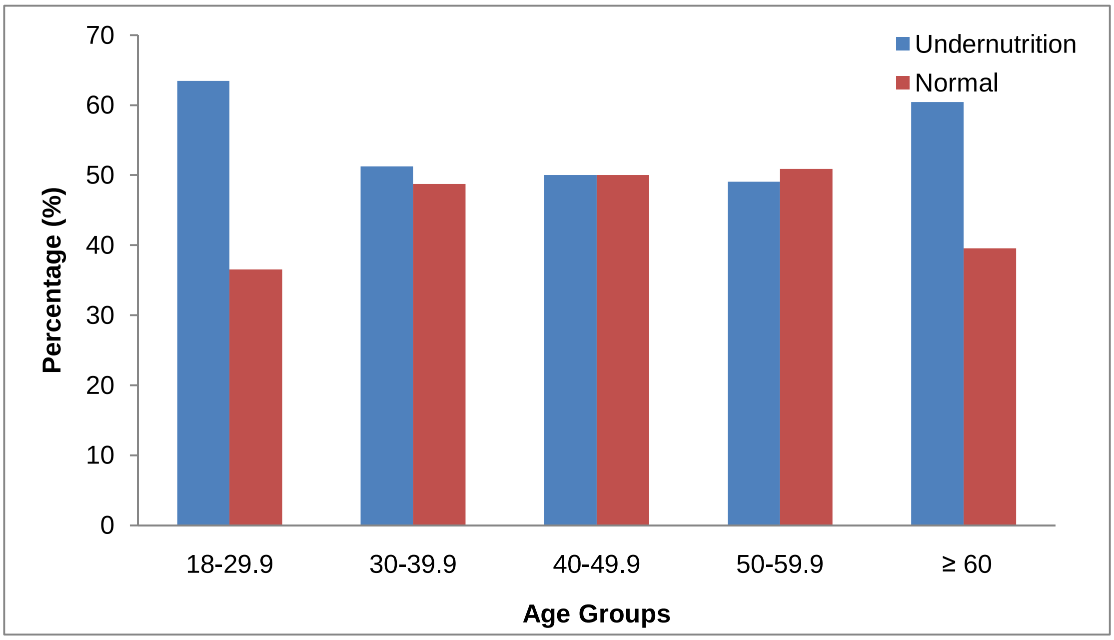


Figure 7.7: Nutritional status based on occupation of male slum dwellers

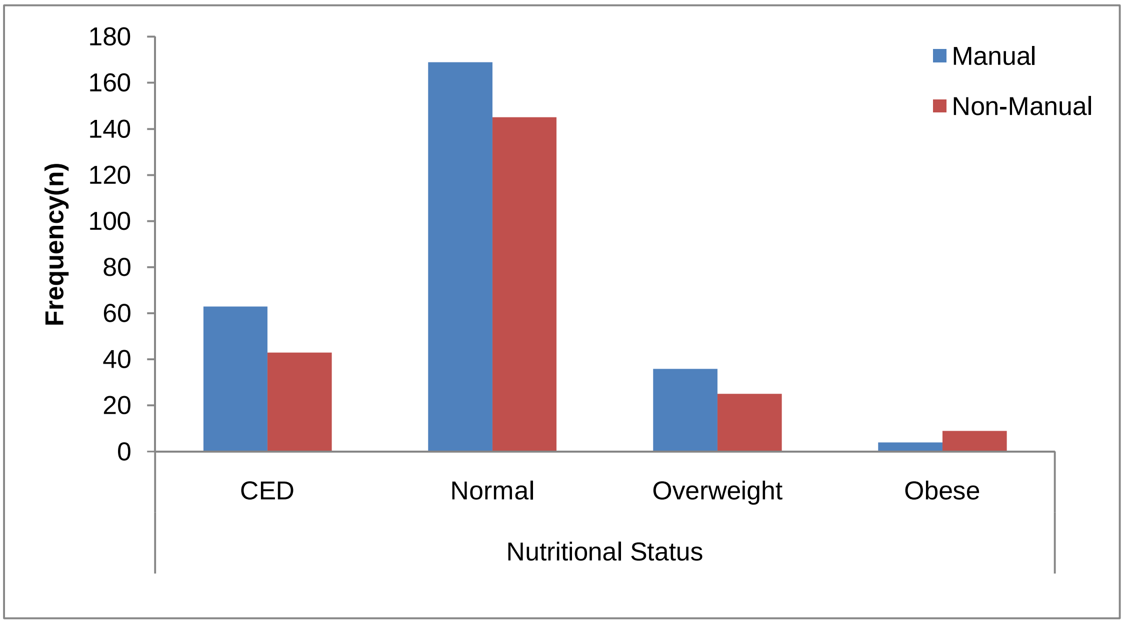


Figure 7.8: Nutritional status based on occupation of female slum dwellers

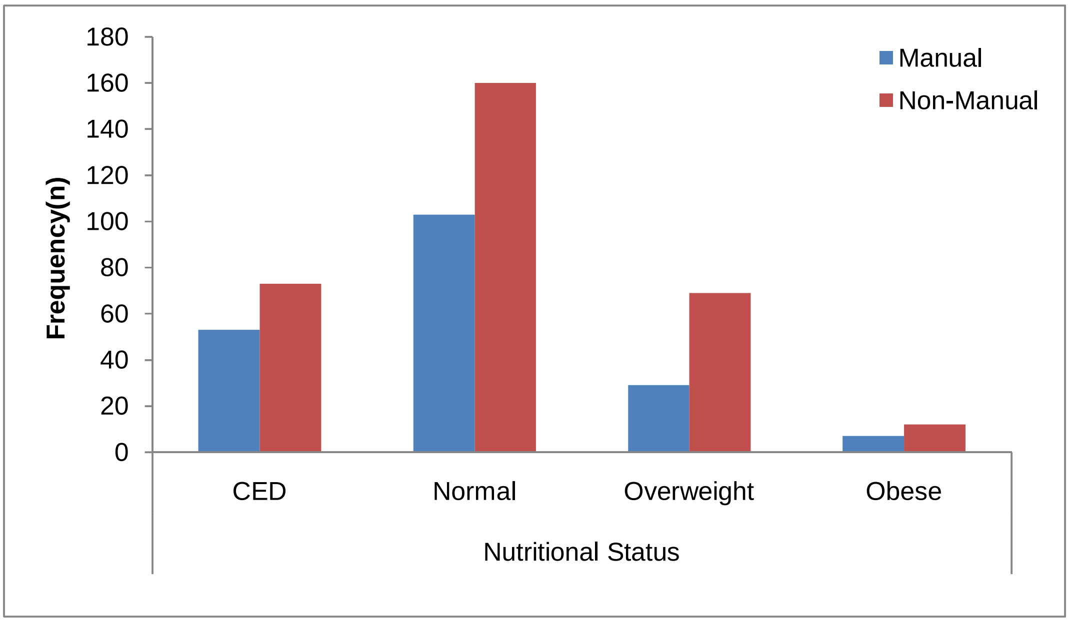


Figure 7.9: Nutritional status based on Education of male slum dwellers

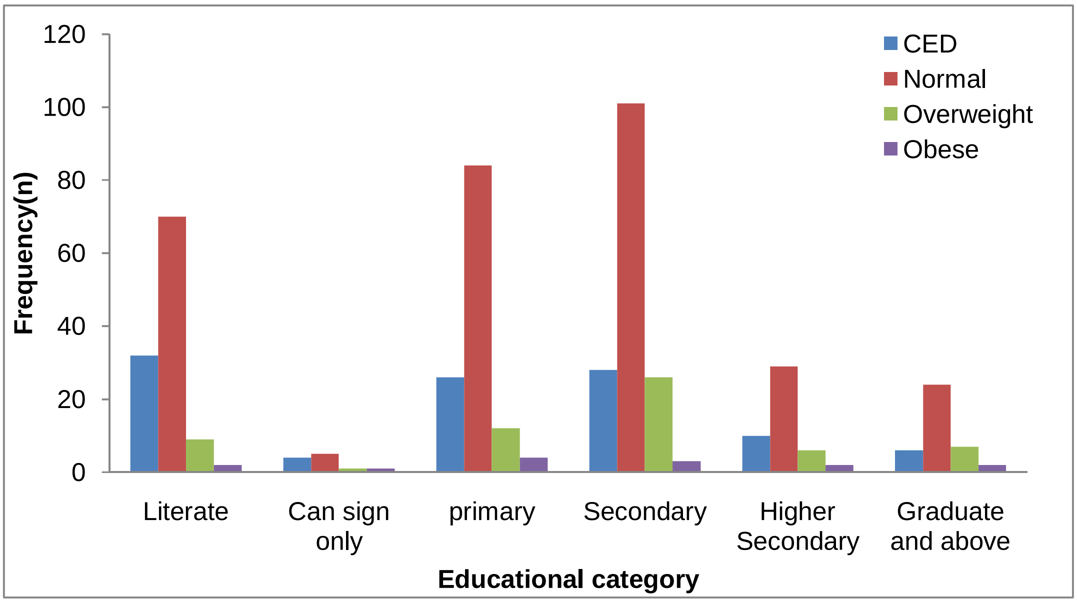
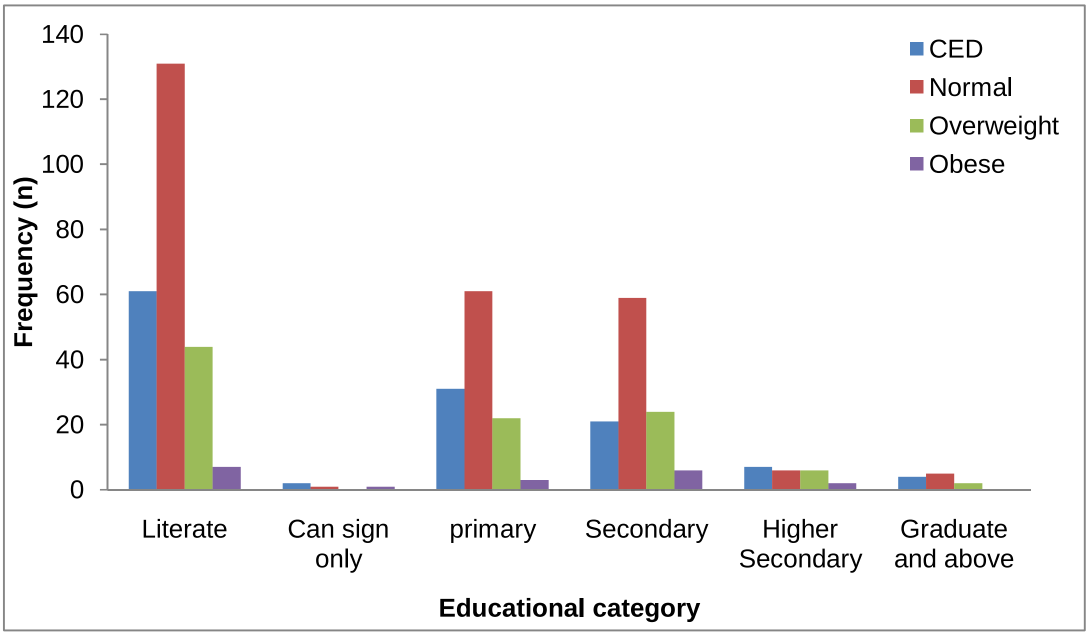


Figure 7.10: Nutritional status based on Education of female slum dwellers



CHAPTER – VIII

DISCUSSION

(WITH 10 TABLES AND 44 FIGURES IN THE TEXT)

VIII

Discussion

8.1: ANTHROPOMETRIC OBSERVATION

Anthropometry is the single most portable, universally acceptable, inexpensive, and non-invasive method available to assess the size, proportions, and composition of the human body (WHO 1995). Chronic Energy Deficiency (CED) has been defined as a state of ‘steady’ or body energy stores. A BMI < 18.5 kg/m2 is widely used as a practical measure underweight in which an individual is in energy balance irrespective of a loss in body weight (Khongsdier 2005). CED is caused by inadequate intake of energy and accompanied by high level of physical activities and infections (Shetty and James 1994, Shetty et al 1994). It is also associated with reduced work capacity (Pryer 1993, Durnin 1994), performance and productivity (Garcia and Kennedy 1994, Shetty and James 1994, Strickland and Ulijaszek 1994) and also behavioural changes (Kusin et al 1994).

The findings of the present research investigation constitute the most comprehensive and imperative anthropometric information of the adult slum dwellers to date, which will be useful as a comparative database for other population on studies in India. Similarly, present study will increase the data bank from this part of the world. It will definitely help the researchers worldwide to compare their study with the present one to understand the inter intra population variation. Furthermore, it will also help to build up ethnic specific cut-off standards of growth measures and help the policy makers to prepare plans accordingly for overcoming the situation.

Different anthropometric variables of the present study (sample) are agrees, in general, with the earlier studies (Bose et al. 2005, Chakraborty et al. 2008, Chakraborty R 2011, Dewangan et al. 2010, Das et al. 2013, Dutta Banik S, 2016). Mean differences of different anthropometric characteristics between present samples and other studies are statistically significant (P<0.01).

A detailed comparative evaluation of respective anthropometric characteristics was done with best available published documents. However, some anthropometric variables (e.g height acromion of both sexes and chest circumference and anterior thigh skinfold of females).

Comparative study **(Table 8.1)** of different anthropometric variables of adult male slum dwellers of present study with earlier findings reveals that the mean value of height **(Fig 8.1)** of adult male slum dwellers is lower than Kolkata slum dwellers (Chakraborty R, 2011) and tribal people of north east India (Dewangan et al. 2010). However, present mean value of height is higher than Bathudies people of Orissa (Bose et al. 2005), Mundas people of Paschim Medinipur (Das et al. 2013) and Savaras people of Orissa (Chakraborty et al. 2008). The variance in height of males among these studies were statistically significant ($p<0.01$).

The mean value of weight **(Fig 8.2)** of adult male slum dwellers is lower than the tribal people of north east India reported by Dewangan et al. (2010) but the present mean value of weight is higher than Kolkata slum dwellers (Chakraborty R. 2011), Bathudies of Orissa (Bose et al.2005), Mudas of Paschim Medinipur, West Bengal (Das et al.2013), and Savaras of Orissa (Chakraborty et al.2008). The variance in weight of males among these studies were statistically significant ($P<0.01$).

The mean value of sitting height **(Fig 8.3)** of adult male slum dwellers is higher than Bathudies and Savaras of Orissa reported by Bose et al. (2005) and chakraborty et al. (2008). The variance in sitting height of males among these studies were statistically significant ($P<0.01$).

The mean value of mid-upper-arm-circumference **(Fig 8.4)** of adult male slum dwellers of the present study is lower than the recent study in Kolkata slum dwellers (Chakraborty R. 2011) but the mean value of mid-upper-arm-circumference of adult male slum dwellers of the present study is higher than another studies in tribal people (Bathudies and Mundas) of Orissa (Bose et al. 2005) and Paschim Medinipur, West

Bengal (Das et al. 2013). The variance in mid-upper arm circumference of males among these studies were statistically significant (P<0.01).

The mean value of chest circumference **(Fig 8.5)** of adult male slum dwellers of the present study is higher than the another studies in tribal people (Bathudies and Mundas) of Orissa (Bose et al. 2005) and Paschim Medinipur, West Bengal (Das et al. 2013). The variance in chest circumference of males among these studies were statistically significant (P<0.01).

The mean value of waist circumference **(Fig 8.6)** of adult male slum dwellers of the present study is lower than the another study in Bathudies of Orissa reported by Bose et al. (2005) but the mean value of waist circumference of adult male slum dwellers of the present study is higher than another studies in Kolkata slum dwellers reported by Chakraborty R. (2011) and tribal people (Mundas) of Paschim Medinipur, West Bengal (Das et al. 2013). The variance in waist circumference of males among these studies were statistically significant (P<0.01).

The mean value of hip circumference **(Fig 8.7)** of adult male slum dwellers of the present study is higher than the studies in Kolkata slum dwellers (Chakraborty R. 2011) and Mundas of Paschim Medinipur, West Bengal (Das et al. 2013). The variance in hip circumference of males among these studies were statistically significant (P<0.01).

Comparative study **(Table 8.2)** of different anthropometric variables of adult female slum dwellers of present study with earlier findings reveals that the mean value of height **(Fig 8.8)** of adult female slum dwellers is lower than Bathudies of Orissa (Bose et al. 2005), Medical students of Cukurova University in Adana (Karakas et al. 2012), Oraons of Jalpaiguri of West Bengal (Roy et al. 2013) and rural communities of West Bengal (Nag et al. 2015) but the mean value of height of adult female slum dwellers is higher than another study in Nepali speeking adults of Naxalbari of Darjeeling, West Bengal (Dutta Banik S. 2016). The variance in height of females among these studies were statistically significant (p<0.01).

The mean value of weight **(Fig 8.9)** of adult female slum dwellers is lower than Medical students of Cukurova University in Adana (Karakas et al. 2012) and rural communities of West Bengal (Nag et al. 2013) but the mean value of weight of adult female slum dwellers is higher than another studies in Bathudies of Orissa (Bose et al. 2005) and Oraons of Jalpaiguri of West Bengal (Roy et al. 2013). The variance in weight of females among these studies were statistically significant ($p<0.01$).

The mean value of sitting height **(Fig 8.10)** of adult female slum dwellers is higher than other studies in Bathudies of Orissa (Bose et al. 2005) and Nepali speeking adults of Naxalbari of Darjeeling, West Bengal (Dutta Banik S. 2016). The variance in sitting height of females among these studies were statistically significant ($p<0.01$).

The mean value of mid-upper arm circumference **(Fig 8.11)** of adult female slum dwellers is lower than another study in rural communities of West Bengal (Nag et al. 2015) but the mean value of mid-upper arm circumference of adult female slum dwellers is higher than other studies in Bathudies of Orissa (Bose et al. 2005) and Oraons of Jalpaiguri of West Bengal (Roy et al. 2013). The variance in mid-upper arm circumference of females among these studies were statistically significant ($p<0.01$).

The mean value of waist circumference **(Fig 8.12)** of adult female slum dwellers is lower than another study in rural communities of West Bengal (Nag et al. 2015) but the mean value of waist circumference of adult female slum dwellers is higher than other studies in Bathudies of Orissa (Bose et al. 2005) and Medical students of Cukurova University in Adana (Karakas et al. 2012). The variance in waist circumference of females among these studies were statistically significant ($p<0.01$).

The mean value of hip circumference **(Fig 8.13)** of adult female slum dwellers is lower than other studies in Medical students of Cukurova University in Adana (Karakas et al. 2012) and rural communities of West Bengal (Nag et al. 2015) but the mean value of hip circumference of adult female slum dwellers is higher than another study in Bathudies of Orissa (Bose et al. 2005) and The variance in hip circumference of females among these studies were statistically significant ($p<0.01$).

Comparative study of different skinfold variables **(Table 8.3)** of adult male slum dwellers of present study with earlier findings reveals that the mean values of triceps skinfold, biceps skinfold and medial calf skinfold **(Fig 8.14, Fig 8.15, Fig 8.18)** of adult male slum dwellers is higher than other studies in Bathudies of Orissa (Bose et al, 2005), Kolkata slum dwellers (Chakraborty R. 2011), tribal people of Sabar in Orissa (Chakraborty et al. 2010), Mundas of Paschim Medinipur of West Bengal (Das et al. 2013) and Oraons of Jalpaiguri of West Bengal (Roy et al. 2013). The variance in triceps skinfolds of males among these studies were statistically significant ($p<0.01$).

The mean values of subscapular skinfold and suprailiac skinfold **(Fig 8.16, Fig 8.17)** of adult male slum dwellers is lower than another study in Kolkata slum dwellers (Chakraborty R. 2011) but the mean value of subscapular skinfold of adult male slum dwellers is higher than other studies in Bathudies of Orissa (Bose et al, 2005), Sabar of Orissa (Chakraborty et al. 2010), Mundas of Paschim Medinipur of West Bengal (Das et al. 2013) and Oraons of Jalpaiguri of West Bengal (Roy et al. 2013). The variance in subscapular skinfold and suprailiac skinfold of males among these studies were statistically significant ($p<0.01$).

The mean value of anterior thigh skinfold **(Fig 8.19)** of adult male slum dwellers is lower than another study in Kolkata slum dwellers (Chakraborty R. 2011) but the mean value of anterior thigh skinfold of adult male slum dwellers is higher than other studies in Bathudies of Orissa (Bose et al, 2005) and Mundas of Paschim Medinipur of West Bengal (Das et al. 2013). The variance in anterior thigh skinfold of males among these studies were statistically significant ($p<0.01$).

Comparative study of different skinfold variables **(Table 8.3)** of adult female slum dwellers of present study with earlier findings reveals that the mean values of triceps skinfold and subscapular skinfold **(Fig 8.20, Fig 8.22)** of adult female slum dwellers is higher than other studies in Bathudies of Orissa (Bose et al, 2005), Sabar of Orissa (Chakraborty et al. 2010), Oraons of Jalpaiguri of West Bengal (Roy et al. 2013) and Tribal people of Banswara District of Rajasthan (Ninama et al. 2016) . The variance in triceps skinfold and subscapular skinfold of females among these studies were statistically significant (p<0.01).

The mean values of biceps skinfold, suprailiac skinfold and medial calf skinfold **(Fig 8.21, Fig 8.23, Fig 8.24)** of adult female slum dwellers is higher than other studies in Bathudies of Orissa (Bose et al, 2005), Sabar of Orissa (Chakraborty et al. 2010) and Oraons of Jalpaiguri of West Bengal (Roy et al. 2013). The variance in biceps skinfold, suprailiac skinfold and medial calf skinfold of females among these studies were statistically significant (p<0.01).

9.2: ADIPOSITY AND BODY COMPOSITION

Central adiposity has been linked to increased risk of cardiovascular disease, hypertension and diabetes (Wang et al 2005, Rosenthal et al 2004, Pau and Ong 2005, Fernandez et al 2006). Waist circumference (WC), waist-to-hip ratio (WHR), and conicity index (CI) are reliable proxy measures of abdominal fat in contrast to BMI, which is a measure of overall adiposity (Kopelman 2000, Lee and Nieman 2003). The measurement of body composition is essential for understanding variation in human body dimension and adaptation, growth and nutritional status, fitness, work capacity, disease and its treatment (Norgan, 1995).

A detailed comparative evaluation of respective derived matric variables was done with best available published documents. However, some derived matric variables of adults slum dwellers of present findings could not evaluated because of non availability of comparable published data.

A comparative study of adiposity measurements of adult male slum dwellers of present study with other studies are presented in **Table 8.5**. Body mass index, an excellent indicator of nutritional status and generalized adiposity measures, shows that adult male slum dwellers of present study **(Fig 8.25)** have lower mean value than Kolkata college students (Sengupta et al. 2014) and Rural communities of West Bengal (Nag et al. 2015). However, three studies of West Bengal i.e. Kolkata slum dwellers (Chakraborty R.

2011), Mundas and Oraons of Paschim Medinipur (Das et al. 2013). Analysis variance in Body mass index of males among these studies were statistically significant (p<0.01).

On the other hand, waist hip ratio, a conventional and widely accepted indicator of central adiposity, of the adult male slum dwellers **(Fig 8.26)** shows similar mean values to Oraons of Paschim Medinipur reported by Das et al. 2013. The mean value of present samples is lower than Kolkata college students (Sengupta et al. 2014) but the mean value of present samples is higher than Kolkata slum dwellers (Chakraborty R. 2011), Mundas of Paschim Medinipur of West Bengal (Das et al. 2013) and Rural communities of West Bengal (Nag et al. 2015). Analysis of variance in waist hip ratio of males among these studies were statistically significant (p<0.01).

The mean values of waist height ratio and conicity index of the adult male slum dwellers **(Fig 8.27, Fig 8.28))** is higher than Kolkata slum dwellers (Chakraborty R. 2011), Mundas and Oraons of Paschim Medinipur of West Bengal (Das et al. 2013) and Kolkata college students (Sengupta et al. 2014). Analysis of variance in waist height ratio and conicity index of males among these studies were statistically significant (p<0.01).

A comparative study of adiposity measurements of adult female slum dwellers of present study with other studies are presented in **Table 8.6**. Body mass index of adult female slum dwellers of present study **(Fig 8.29)** have lower mean value than Kolkata college students (Sengupta et al. 2013), Rural communities of West Bengal (Nag et al. 2015) and Rural adult populations of Haryana (Verma et al. 2016). However, the mean value of body mass index of present study is higher than Bathudies of Orissa reported by Bose et al. 2005 and Fisher women of Araku of Andra Pradesh reported by Sengupta et al. 2014. Analysis of variance in Body mass index of females among these studies were statistically significant (p<0.01).

Waist hip ratio of adult female slum dwellers of present study **(Fig 8.30)** have lower mean value than Rural adult populations of Haryana (Verma et al. 2016). However, the mean value of waist hip ratio of present study is higher than Bathudies of Orissa (Bose et al. 2005), Kolkata college students (Sengupta et al. 2013), Fisher women of Araku of Andra Pradesh (Sengupta et al. 2014) and Rural communities of West Bengal (Nag et al.

2015). Analysis of variance in waist hip ratio of females among these studies were statistically significant ($p<0.01$).

Waist height ratio of adult female slum dwellers of present study **(Fig 8.31)** have lower mean value than Rural adult populations of Haryana (Verma et al. 2016). However, the mean value of waist height ratio of present study is higher than Kolkata college students (Sengupta et al. 2013) and Fisher women of Araku of Andra Pradesh (Sengupta et al. 2014). Analysis of variance in waist height ratio of females among these studies were statistically significant ($p<0.01$).

Conicity index of adult female slum dwellers of present study **(Fig 8.32)** have higher mean value than Kolkata college students (Sengupta et al. 2013) and Fisher women of Araku of Andra Pradesh (Sengupta et al. 2014). Analysis of variance in conicity index of females among these studies were statistically significant ($p<0.01$).

A comparative study of body composition measurements of adult male slum dwellers of present study with other studies are presented in **Table 8.7**. Percent body fat and fat mass of adult male slum dwellers of present study **(Fig 8.33, Fig 8.34)** have lower mean values than Kolkata slum dwellers (Chakraborty R. 2011), College students of Kolkata (Sengupta et al. 2014) and Rural communities of West Bengal (Nag et al. 2015). However, the mean values of percent body fat and fat mass of present study is higher than Mundas and Oraons of Paschim Medinipur, West Bengal reported by Das et al. 2013. Analysis of variance in percent body fat and fat mass of males among these studies were statistically significant ($p<0.01$).

The mean value of fat free mass of adult male slum dwellers of present study **(Fig 8.35)** have lower mean value than rural communities of West Bengal (Nag et al. 2015). However, the mean value of fat free mass of present study is higher than Kolkata slum dwellers (Chakraborty R. 2011) and College students of Kolkata (Sengupta et al. 2014). Analysis of variance in fat free mass of males among these studies were statistically significant ($p<0.01$).

The mean value of fat mass index of adult male slum dwellers of present study **(Fig 8.36)** have lower mean value than Kolkata slum dwellers (Chakraborty R. 2011) and College students of Kolkata (Sengupta et al. 2014). However, the mean value of fat mass index of present study is higher than Mundas and Oraons of Paschim Medinipur, West Bengal reported by Das et al. 2013. Analysis of variance in fat mass index of males among these studies were statistically significant ($p<0.01$).

The mean value of fat free mass index of adult male slum dwellers of present study **(Fig 8.37)** have higher mean value than Kolkata slum dwellers (Chakraborty R. 2011) and College students of Kolkata (Sengupta et al. 2014). Analysis of variance in fat free mass index of males among these studies were statistically significant ($p<0.01$).

A comparative study of body composition measurements of adult female slum dwellers of present study with other studies are presented in **Table 8.8**. Percent body fat and fat mass of adult female slum dwellers of present study **(Fig 8.38, Fig 8.39)** have lower mean values than College students of Kolkata (Sengupta et al. 2013), fisher women of Araku, Andra Predesh (Sengupta et al. 2014) and Rural communities of West Bengal (Nag et al. 2015). However, the mean values of percent body fat and fat mass of present study is higher than Mongolian origin of Santiniketan, West Bengal reported by Biswas et al. 2016. Analysis of variance in percent body fat and fat mass of females among these studies were statistically significant ($p<0.01$).

The mean value of fat free mass of adult female slum dwellers of present study **(Fig 8.40)** have lower mean values than College students of Kolkata (Sengupta et al. 2013) and Mongolian origin of Santiniketan, West Bengal (Biswas et al. 2016). However, the mean values of fat free mass of present study is higher than fisher women of Araku, Andra Predesh (Sengupta et al. 2014) and rural communities of West Bengal (Nag et al. 2015). Analysis of variance in fat free mass of females among these studies were statistically significant ($p<0.01$).

The mean value of fat mass index of adult female slum dwellers of present study **(Fig 8.41)** have lower mean values than College students of Kolkata (Sengupta et al. 2014) and fisher women of Araku, Andra Predesh (Sengupta et al. 2014). Analysis of variance in fat mass index of females among these studies were statistically significant ($p<0.01$).

The mean value of fat free mass index of adult female slum dwellers of present study **(Fig 8.42)** have lower mean value than College students of Kolkata (Sengupta et al. 2014). The mean value of fat free mass index of present study is higher than fisher women of Araku, Andra Predesh (Sengupta et al. 2014). Analysis of variance in fat free mass index of females among these studies were statistically significant ($p<0.01$).

8.3: NUTRITIONAL STATUS:

The nutritional status of a community is the sum of the nutritional status of the individual who form that community. CED is caused by inadequate intake of energy and accompanied by high level of physical activities and infections (Shetty and James 1994, Shetty et al 1994). It is also associated with reduced work capacity (Pryer 1993, Durnin 1994), performance and productivity (Garcia and Kennedy 1994, Shetty and James 1994, Strickland and Ulijaszek 1994) and also behavioural changes (Kusin et al 1994).

Nutritional categories of the present study (sample) are agrees, in general, with the earlier studies (Bose et al. 2006, Bose et al. 2007, Chakraborty et al. 2008, Chakraborty et al. 2010, Chakraborty R. 2011, Devgun et al. 2014, Ninama et al. 2016). Mean differences of different anthropometric characteristics between present samples and other studies are statistically significant ($P<0.01$).

The prevalence of nutritional categories of adult male slum dwellers of present study and other studies are presented in **Table 8.9 (Fig 8.43)**. The prevalence of CED III , CED II and CED I of present sample have lower than slum dwellers of Midnapore town, Paschim Medinipur (Bose et al. 2006), Savaras of Orissa (Chakraborty et al. 2008), Shabar tribe in Orissa (Chakraborty et al. 2010) and Slum dwellers of Kolkata (Chakraborty R. 2011).

The prevalence of Normal and Overweight of present samples have higher than slum dwellers of Midnapore town, Paschim Medinipur (Bose et al. 2006), Savaras of Orissa (Chakraborty et al. 2008), Shabar tribe in Orissa (Chakraborty et al. 2010) and Slum dwellers of Kolkata (Chakraborty R. 2011).

The prevalence of nutritional categories of adult female slum dwellers of present study and other studies are presented in **Table 8.10 (Fig 8.44)**. The prevalence of CED III of present sample have lower than tribes of Banswara District of Rajasthan reported by Ninama et al. 2016 but the prevalence of CED III of present sample have higher than slums of Midnapore town, Paschim Medinipur (Bose et al. 2007), Shabar tribe in Orissa (Chakraborty et al. 2010) and Slum areas of Amritsar City (Devgun et al. 2014).

The prevalence of CED II and CED I of present sample have lower than Slum areas of Amritsar City (Devgun et al. 2014) but the prevalence of CED II and CED I of present sample have higher than slums of Midnapore town, Paschim Medinipur (Bose et al. 2007), Shabar tribe in Orissa (Chakraborty et al. 2010) and tribes of Banswara District of Rajasthan reported by Ninama et al. 2016

The prevalence of Normal of present sample have lower than Slum areas of Amritsar City (Devgun et al. 2014) but the prevalence of Normal of present sample have higher than slums of Midnapore town, Paschim Medinipur (Bose et al. 2007), Shabar tribe in Orissa (Chakraborty et al. 2010) and tribes of Banswara District of Rajasthan reported by Ninama et al. 2016.

The prevalence of Overweight of present sample have lower than Slum dwellers of Midnapore town, Paschim Medinipur (Bose et al. 2007), Shabar tribe in Orissa (Chakraborty et al. 2010), Amritsar City (Devgun et al. 2014), and tribes of Banswara District of Rajasthan (Ninama et al. 2016).

Table 8.1: Comparison of different anthropometric variables of male slum dwellers of present study with other studies

Variables	Present Study	Bose et al. 2005	Chakra-borty et al. 2008	Dewangan et al. 2010	Chakra-borty R. 2011	Das et al. 2013	F- ratio
HT(cm)	160.7 (7.9)	159.4 (6.4)	158.7 (5.5)	162.0 (6.0)	161.5 (6.2)	159.9 (6.4)	12.87*
WT (kg)	55.4 (10.2)	46.9 (6.3)	46.5 (4.7)	56.1 (5.7)	53.0 (9.5)	50.5 (6.8)	92.48*
SHT (cm)	81.2 (4.7)	79.7 (4.8)	81.0 (3.22)	-	-	-	9.12*
MUAC(cm)	23.9 (2.9)	23.4 (3.1)	-	-	25.0 (2.92)	23.4 (2.0)	22.57*
CC(cm)	83.1 (7.6)	67.6 (6.3)	-	-	-	79.3 (3.9)	394.15*
WC(cm)	76.6 (9.9)	78.8 (6.6)	-	74.9 (5.7)	73.9 (9.3)	72.4 (5.63)	22.63*
HC(cm)	84.2 (7.5)	-	-	-	84.1 (7.8)	79.7 (5.1)	16.82*

Standard deviations are presented in parentheses
* - significant at the 0.01 level

Table 8.2: Comparison of different anthropometric variables of female slum dwellers of present study with other studies

Variables	Present Study	Bose et al. 2005	Karakas et al. 2012	Roy et al. 2013	Nag et al.2015	Dutta Banik S. 2016	F- ratio
HT(cm)	148.6 (6.4)	149.2 (6.7)	164.9 (4.8)	149.5 (5.8)	151.3 (5.5)	147.4 (6.5)	1005.28*
WT (kg)	48.5 (10.0)	39.8 (6.2)	56.8 (5.0)	40.8 (4.7)	59.8 (11.2)	-	315.91*
SHT (cm)	75.0 (4.00)	74.1 (4.9)	-	-	-	74.7 (3.4)	3.170*
MUAC(cm)	22.9 (3.1)	22.2 (2.4)	-	20.8 (1.9)	28.2 (3.6)	-	307.43*
WC(cm)	77.2 (12.4)	63.9 (6.8)	73.2 (5.1)	-	79.6 (9.0)	-	148.31*
HC(cm)	86.1 (9.3)	78.5 (5.7)	95.4 (4.8)	-	94.4 (9.0)	-	347.66*

Standard deviations are presented in parentheses
* - significant at the 0.01 level

Table 8.3: Comparison of different skinfold variables (mm) of male slum dwellers of present study with other studies

Variables	Present Study	Bose et al. 2005	Chakra-borty et al. 2010	Chakra-borty.R 2011	Das et al.2013	Roy et al.2013	F- ratio
TSF(mm)	7.4 (3.6)	5.7 (2.2)	6.2 (2.6)	7.2 (3.6)	3.9 (1.4)	4.6 (1.6)	44.17*
BSF(mm)	5.0 (2.8)	3.6 (1.6)	3.3 (1.0)	4.4 (2.4)	2.33 (0.8)	2.8 (0.9)	63.73*
SUBSF(mm)	12.1 (5.3)	7.9 (2.6)	9.9 (3.7)	13.5 (7.6)	7.4 (2.2)	7.8 (3.1)	66.68*
SUPSF(mm)	10.6 (5.2)	7.2 (3.0)	6.8 (3.5)	13.0 (8.7)	5.1 (1.9)	5.2 (2.5)	98.76*
MCSF(mm)	9.4 (4.6)	6.1 (2.4)	4.6 (2.1)	7.0 (3.9)	5.0 (2.2)	4.7 (1.9)	111.95*
ATSF(mm)	11.4 (6.0)	7.7 (2.9)	-	11.5 (6.9)	6.40 (2.1)	-	44.71*

Standard deviations are presented in parentheses
* - significant at the 0.01 level

Table 8.4: Comparison of different skinfold variables (mm) of female slum dwellers of present study with other studies

Variables	Present Study	Bose et al. 2005	Chakraborty et al. 2010	Roy et al.2013	Ninama et al.2016	F- ratio
TSF(mm)	12.6 (5.2)	9.1 (2.4)	9.1 (3.7)	8.3 (1.6)	10.7 (1.6)	70.56*
BSF(mm)	7.1 (3.6)	4.6 (2.9)	4.1 (1.8)	4.0 (1.9)	-	47.94*
SUBSF(mm)	14.9 (6.9)	9.0 (2.3)	10.7 (4.6)	9.5 (3.3)	8.7 (1.9)	98.52*
SUPSF(mm)	14.0 (6.6)	9.8 (3.1)	8.4 (4.7)	6.6 (3.7)	-	121.06*
MCSF(mm)	14.1 (5.7)	7.8 (2.5)	7.5 (3.5)	7.6 (3.0)	-	229.26*

Standard deviations are presented in parentheses
* - significant at the 0.01 level

Table 8.5: Comparison of adiposity characteristics of male slum dwellers of present study with other studies

Variables	Present Study	Chakraborty R. 2011	Das et al. 2013	Das et al.2013	Sengupta et al. 2014	Nag et al.2015	F- ratio
BMI (kg/m^2)	21.5 (3.7)	20.3 (3.3)	18.5 (2.4)	18.6 (2.8)	21.9 (2.5)	24.5 (3.7)	135.01*
WHR	0.91 (0.07)	0.89 (0.17)	0.91 (0.05)	0.90 (0.05)	0.92 (0.02)	0.89 (0.04)	4.48*
WHTR	0.48 (0.06)	0.46 (0.06)	0.45 (0.04)	0.44 (0.05)	0.46 (0.02)	-	17.29*
CI	1.20 (0.10)	1.19 (0.09)	1.18 (0.07)	1.18 (0.09)	1.16 (0.09)	-	4.68

Standard deviations are presented in parentheses
* - significant at the 0.01 level

Table 8.6: Comparison of adiposity characteristics of female slum dwellers of present study with other studies

Variables	Present Study	Bose et al. 2005	Sengupta et al. 2013	Sengupta et al.2014	Nag et al.2015	Verma et al. 2016	F- ratio
BMI (kg/m^2)	21.9 (4.4)	17.9 (2.5)	23.1 (3.1)	19.6 (2.6)	26.1 (4.3)	23.2 (4.5)	108.93*
WHR	0.89 (0.08)	0.81 (0.06)	0.87 (0.03)	0.84 (0.03)	0.83 (0.05)	0.95 (0.46)	13.25*
WHTR	0.52 (0.08)	-	0.45 (0.01)	0.42 (0.02)	-	0.54 (0.08)	71.33*
CI	1.24 (0.18)	-	1.11 (0.03)	1.02 (0.06)	-	-	63.46*

Standard deviations are presented in parentheses
* - significant at the 0.01 level

Table 8.7: Comparison of body composition characteristics of male slum dwellers of present Study with other studies

Variables	Present Study	Chakraborty R. 2011	Das et al. 2013	Das et al. 2013	Sengupta et al. 2014	Nag et al. 2015	F- ratio
PBF (%)	13.4 (5.6)	15.9 (7.0)	7.08 (3.6)	7.5 (3.8)	20.5 (1.7)	27.3 (4.9)	621.53*
FM (kg)	7.8 (4.6)	9.0 (5.4)	3.7 (2.2)	3.8 (2.4)	12.1 (3.9)	18.5 (5.4)	555.05*
FFM (kg)	47.6 (7.2)	44.2 (5.5)	-	-	47.1 (4.3)	48.5 (7.6)	38.59*
FMI (kg/m2)	2.99 (1.71)	3.41 (2.02)	1.44 (0.83)	1.51 (0.92)	4.48 (1.76)	-	65.30*
FFMI (kg/m2)	18.46 (2.64)	16.92 (1.69)	-	-	17.40 (1.84)	-	60.52*

Standard deviations are presented in parentheses
* - significant at the 0.01 level

Table 8.8: Comparison of body composition characteristics of female slum dwellers of present study with other studies

Variables	Present Study	Sengupta et al. 2013	Sengupta et al. 2014	Nag et al.2015	Biswas et al. 2016	Biswas et al.2016	F- ratio
PBF (%)	20.67 (7.45)	26.40 (2.73)	23.52 (3.66)	37.34 (4.56)	17.15 (4.01)	16.27 (2.82)	587.62*
FM (kg)	10.5 (5.7)	14.4 (4.1)	13.5 (3.9)	22.6 (6.0)	9.3 (3.9)	8.6 (2.5)	304.74*
FFM (kg)	37.9 (5.8)	40.2 (4.1)	33.1 (4.3)	37.22 (6.1)	43.2 (6.2)	43.6 (6.1)	25.89*
FMI (kg/m2)	4.75 (2.48)	6.12 (1.74)	5.70 (1.77)	-	-	-	16.60*
FFMI (kg/m2)	17.18 (2.62)	17.22 (1.62)	15.30 (1.86)	-	-	-	13.79*

Standard deviations are presented in parentheses
* - significant at the 0.01 level

Table 8.9: Comparative prevalence of nutritional categories of male slum dwellers of present study with other studies

Variables	Prevalence (%)				
	Present Study	Bose et al 2006	Chakraborty et al. 2008	Chakraborty et al. 2010	Chakraborty R. 2011
CED III	1.8	7.1	4.0	4.4	6.5
CED II	4.9	9.4	13.0	12.8	4.9
CED I	14.2	21.7	36.0	28.4	20.9
NORMAL	64.0	55.7	47.0	52.0	59.5
OVERWEIGHT	15.2	6.1	0.0	2.5	8.3

Table 8.10: Comparative prevalence of nutritional categories of female slum dwellers of present study with other studies

Variables	Prevalence (%)				
	Present Study	**Bose et al. 2007**	**Chakraborty et al. 2010**	**Devgun et al. 2014**	**Ninama et al. 2016**
CED III	4.6	13.8	15.3	13.8	4.2
CED II	5.3	11.7	11.3	4.7	11.3
CED I	14.2	21.3	23.7	2.8	19.6
NORMAL	52.2	45.3	46.3	67.6	53.3
OVERWEIGHT	23.5	7.8	3.5	11.1	11.7

Figure 8.1: Comparison of Height (cm) of male slum dwellers of present study with other studies

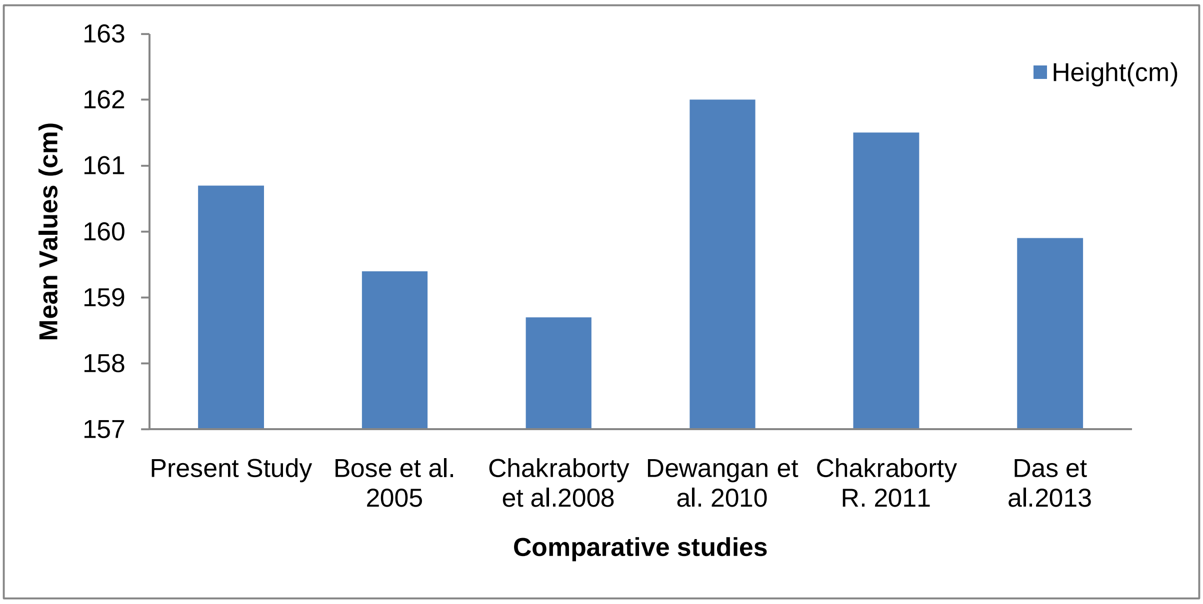


Figure 8.2: Comparison of Weight (Kg) of male slum dwellers of present study with other studies

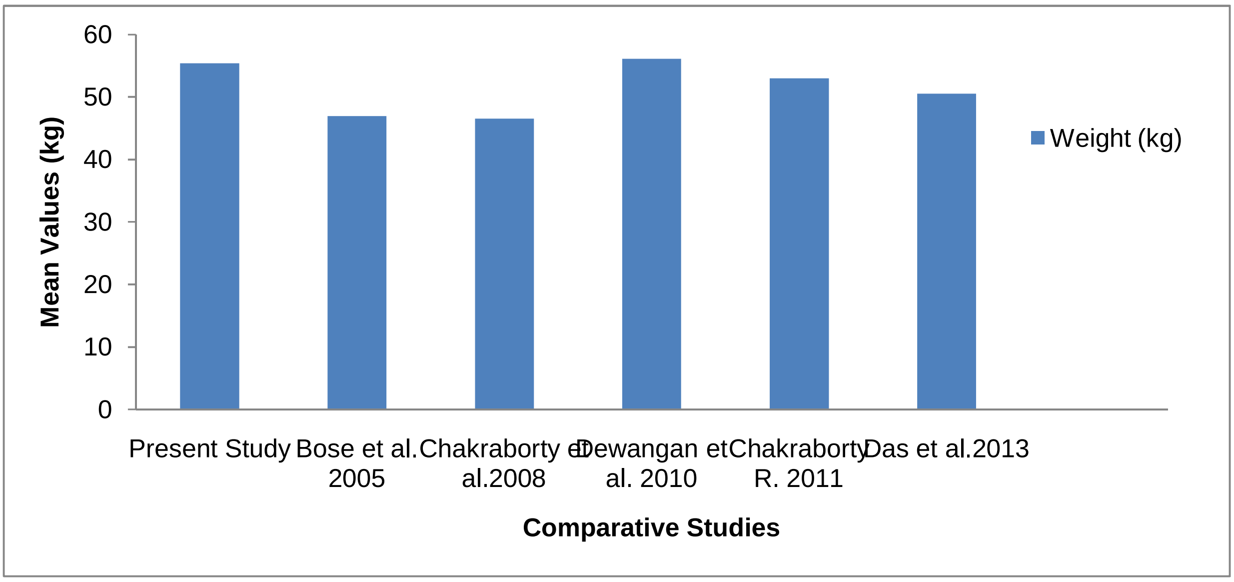


Figure 8.3: Comparison of Sitting Height (cm) of male slum dwellers of present study with other studies

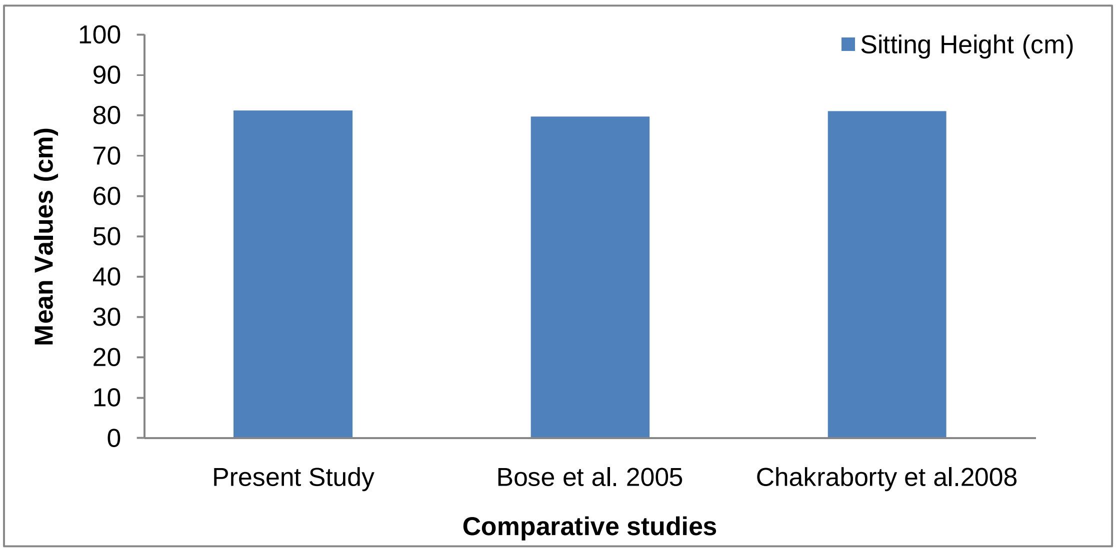


Figure 8.4: Comparison of mid-upper arm circumference (cm) of male slum dwellers of present study with other studies

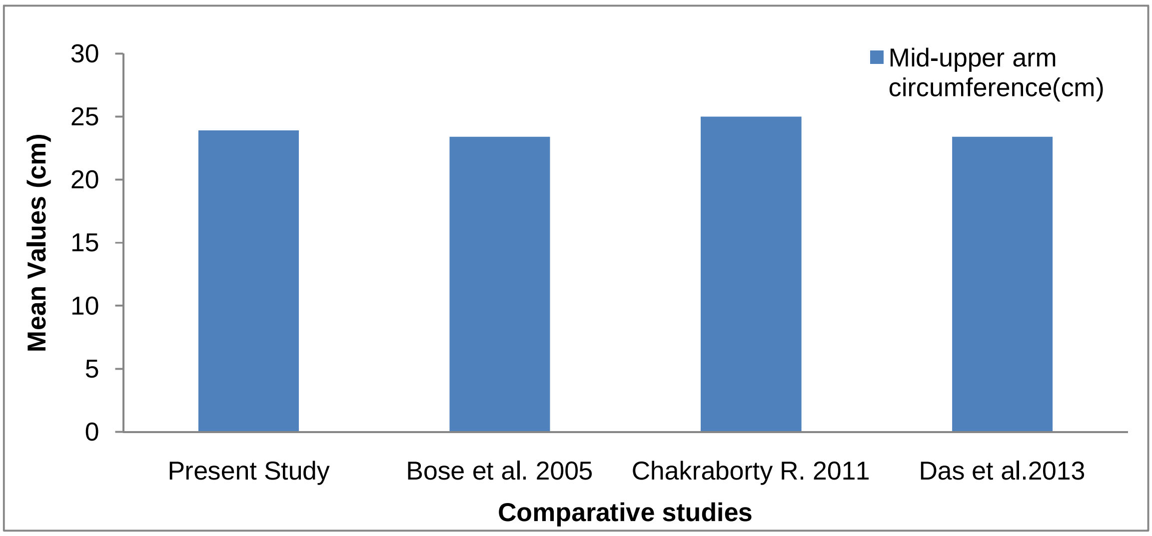


Figure 8.5: Comparison of Chest Circumference (cm) of male slum dwellers of present study with other studies

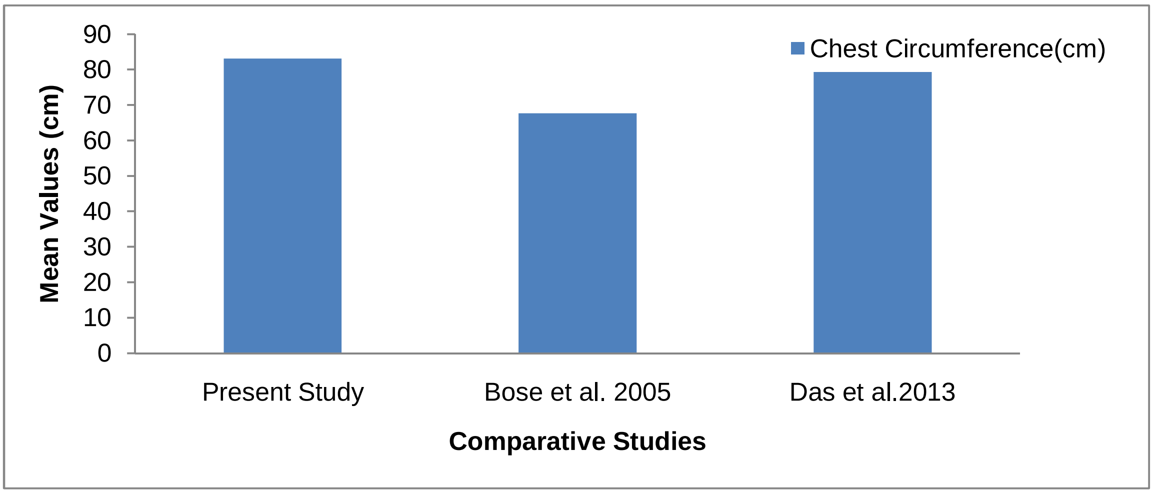


Figure 8.6: Comparison of waist circumference (cm) of male slum dwellers of present study with other studies

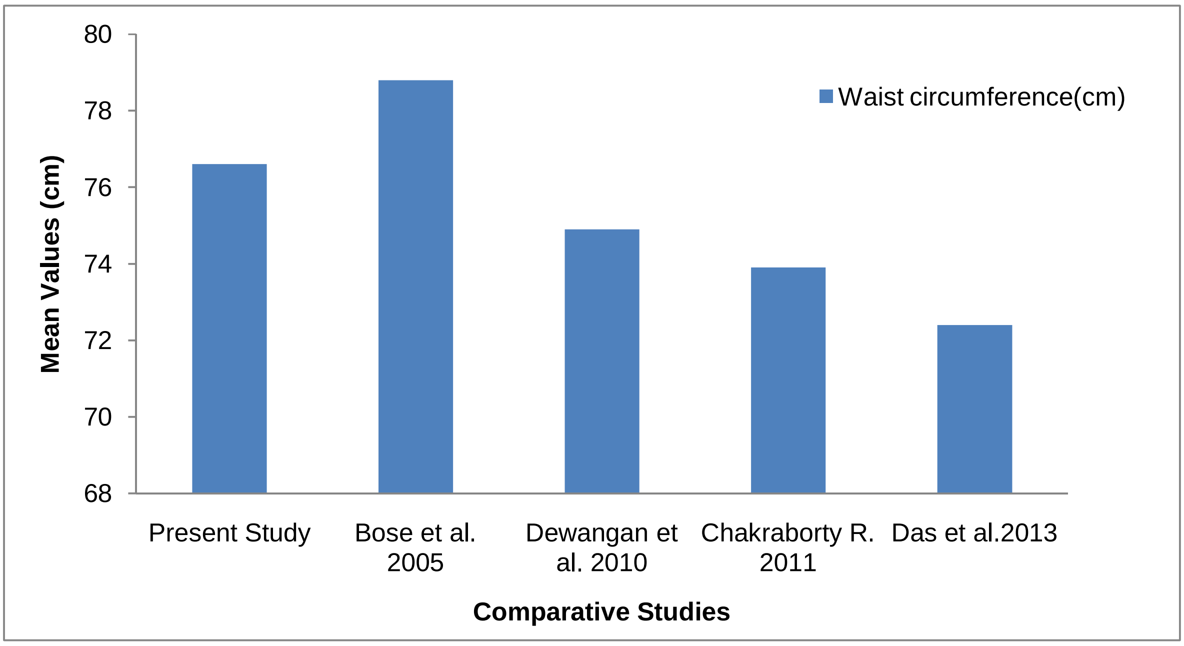


Figure 8.7: Comparison of Hip circumference (cm) of male slum dwellers of present study with other studies

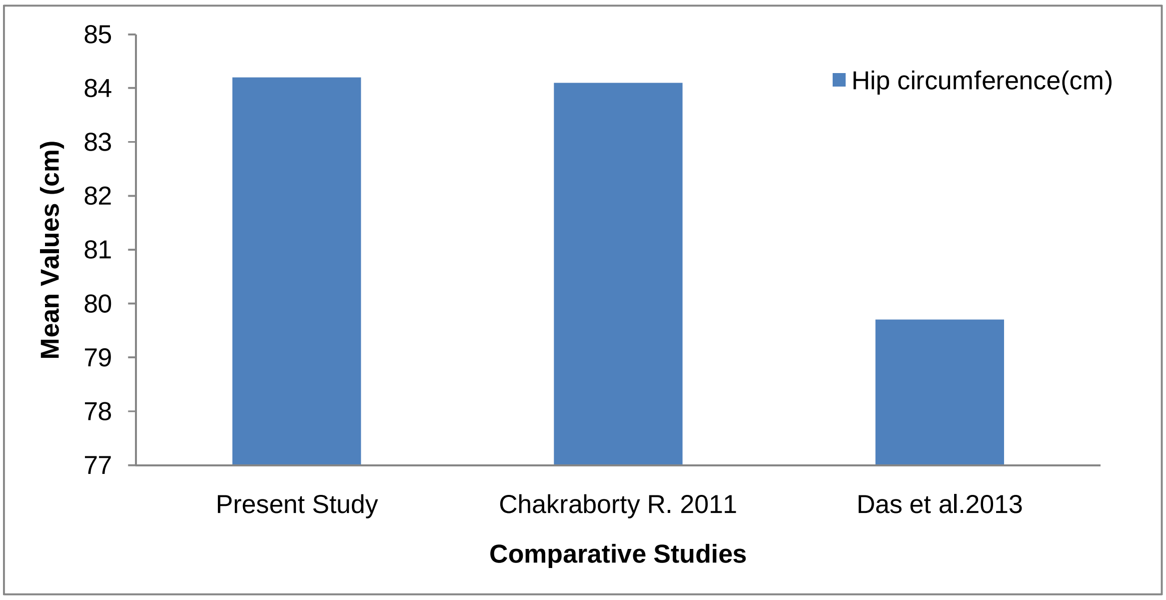


Figure 8.8: Comparison of Height (cm) of female slum dwellers of present study with other studies

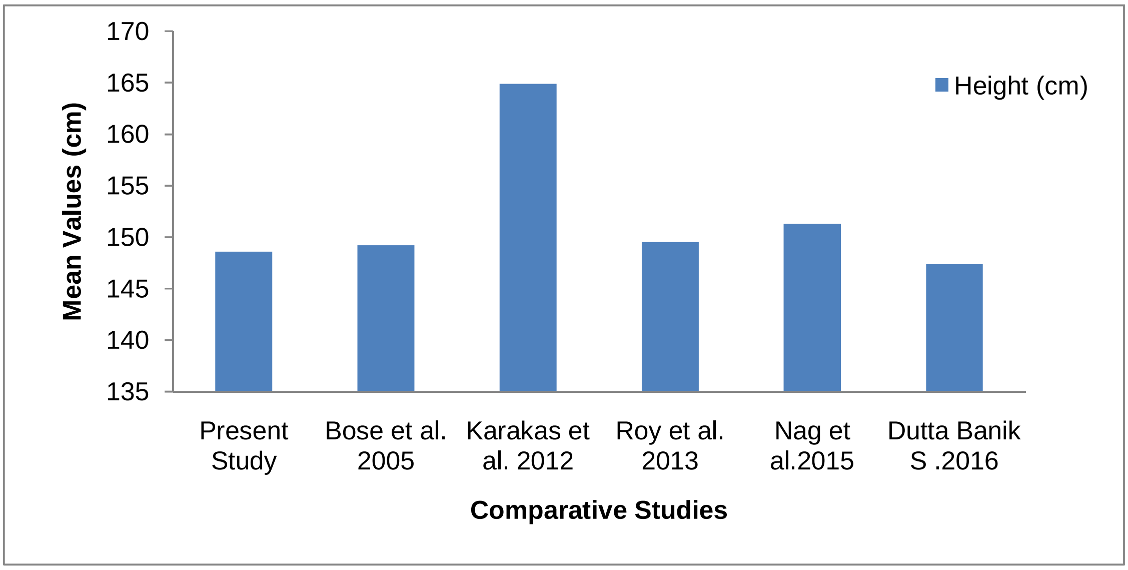


Figure 8.9: Comparison of Weight (kg) of female slum dwellers of present study with other studies

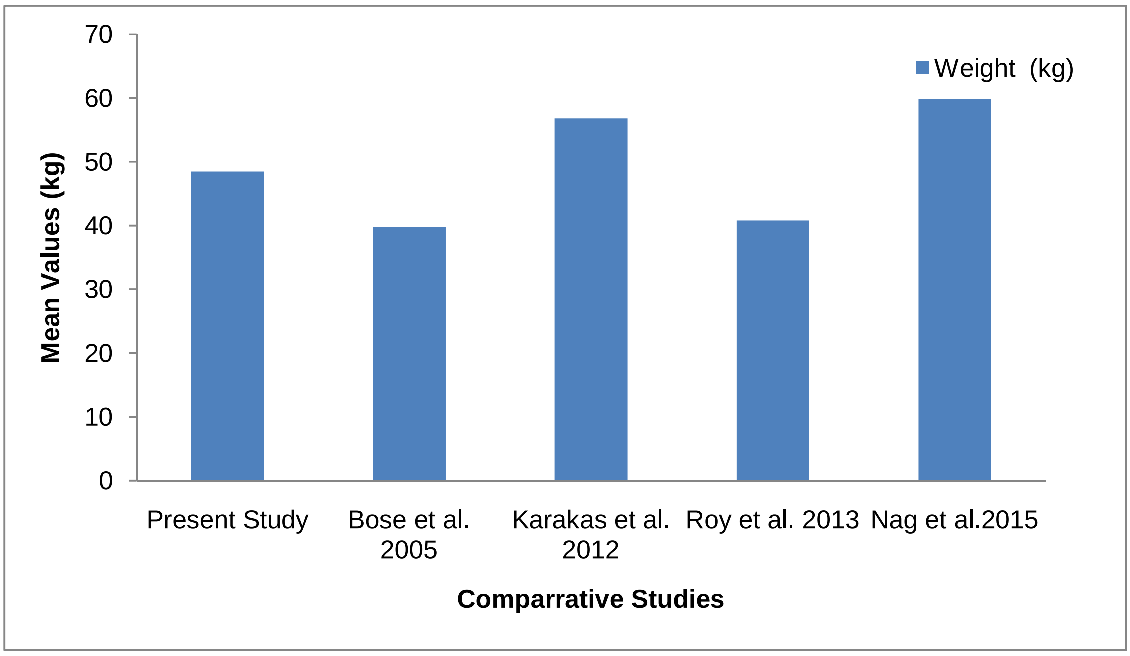


Figure 8.10: Comparison of Sitting Height (cm) of female slum dwellers of present study with other studies

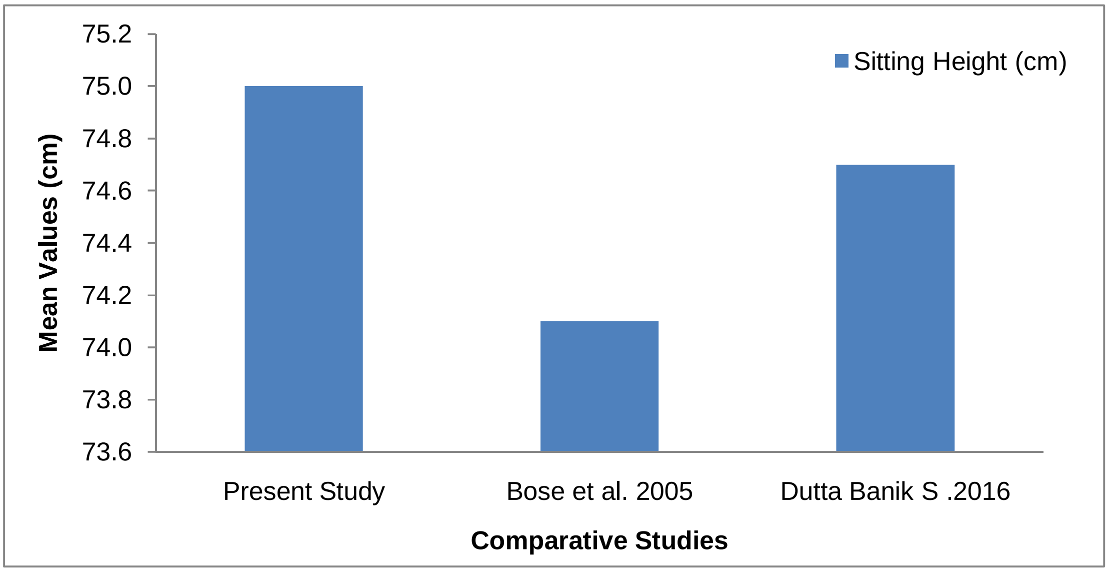


Figure 8.11: Comparison of Mid-Upper arm circumference (cm) of female slum dwellers of present study with other studies

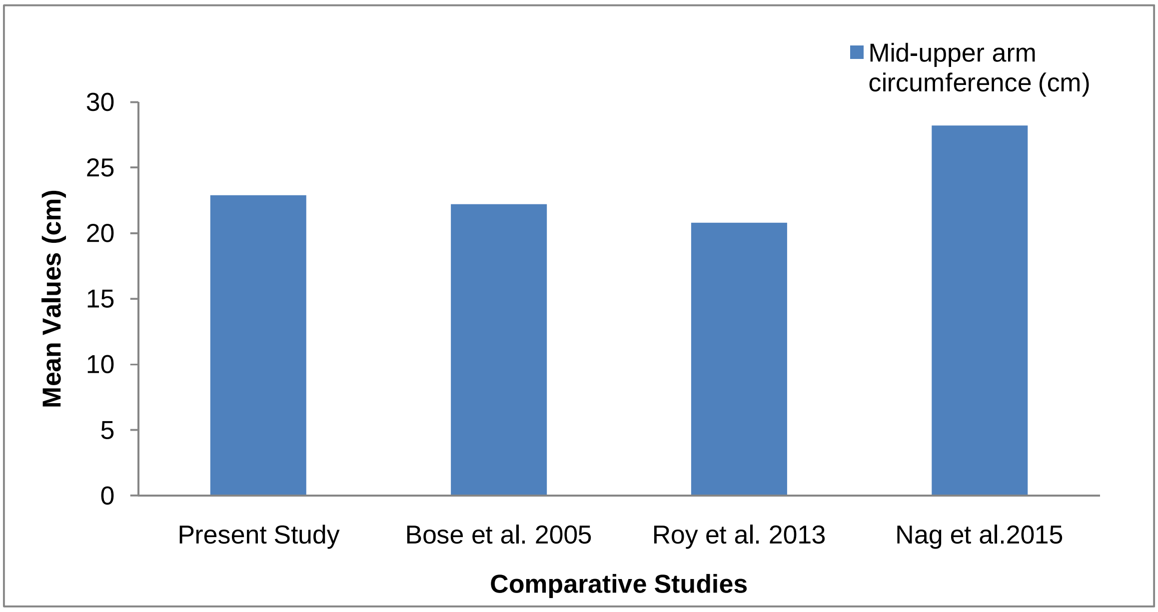


Figure 8.12: Comparison of Waist Circumference (cm) of female slum dwellers of present study with other studies

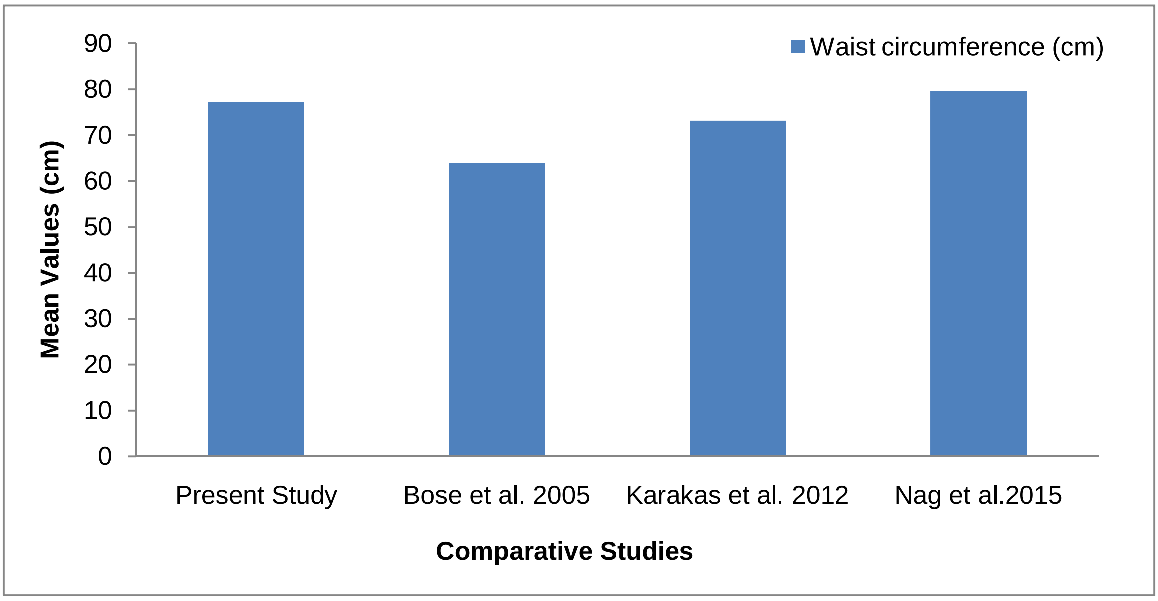


Figure 8.13: Comparison of Hip Circumference (cm) of female slum dwellers of present study with other studies

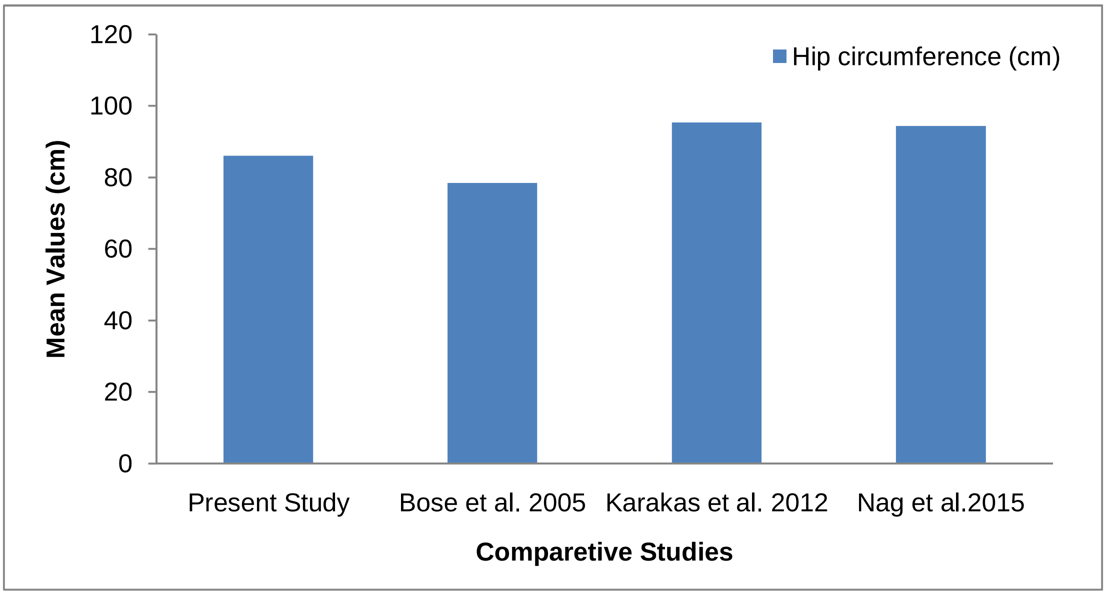


Figure 8.14: Comparison of Triceps Skinfold (mm) of male slum dwellers of present study with other studies

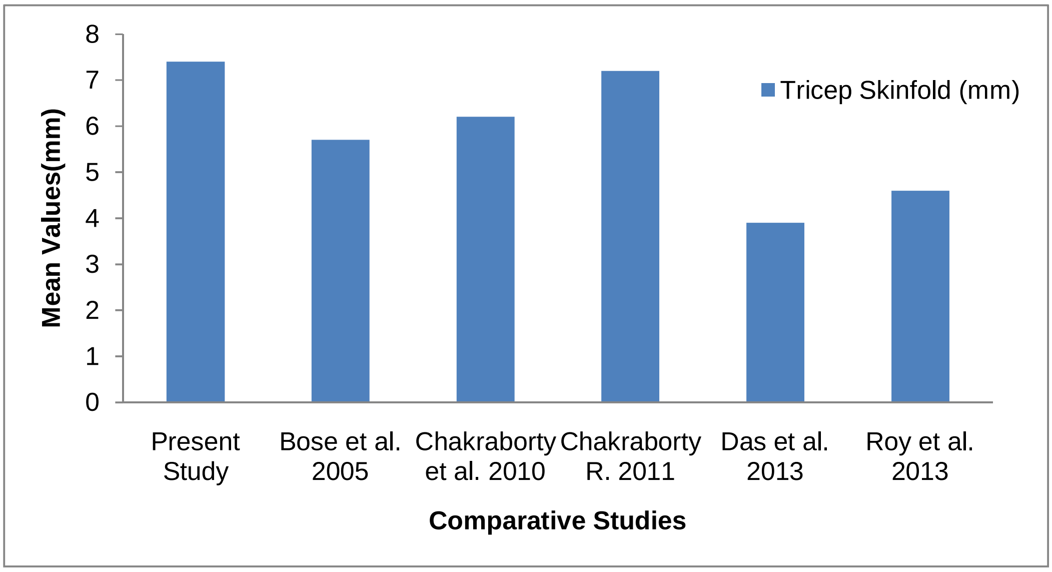


Figure 8.15: Comparison of Biceps Skinfold (mm) of male slum dwellers of present study with other studies

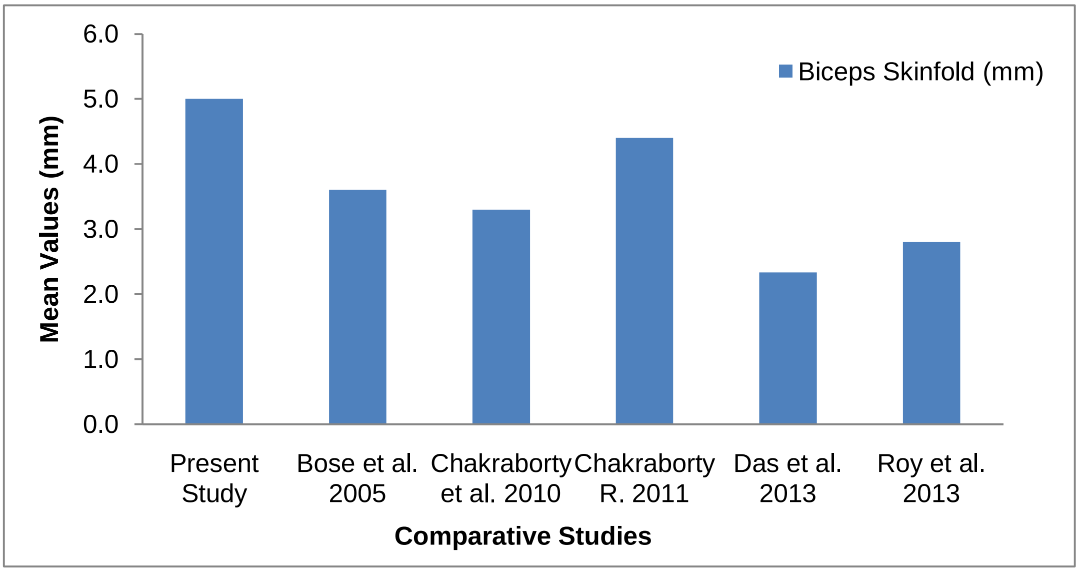


Figure 8.16: Comparison of Subscapular Skinfold (mm) of male slum dwellers of present study with other studies

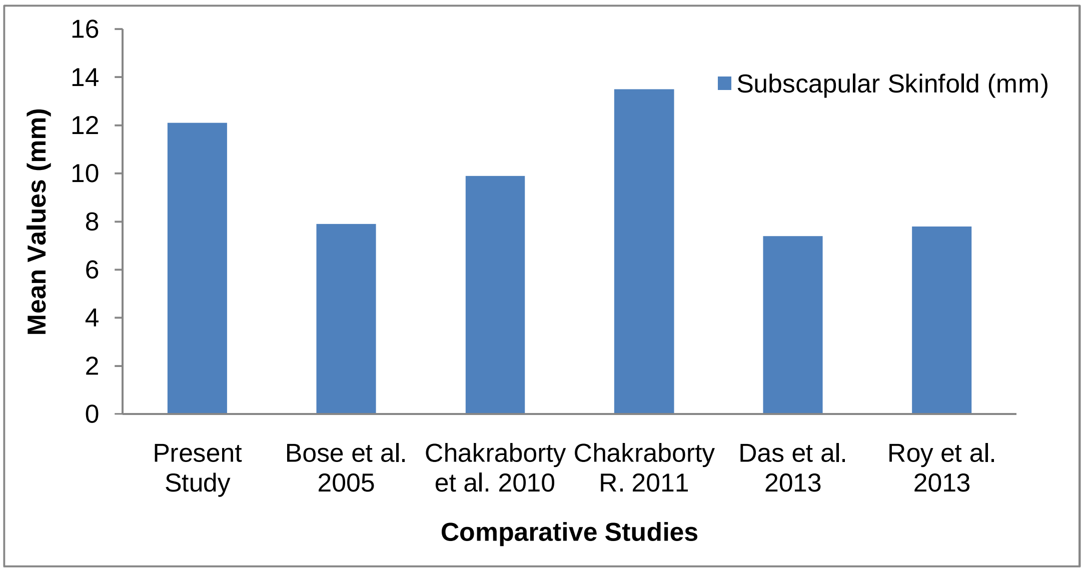


Figure 8.17: Comparison of Suprailiac Skinfold (mm) of male slum dwellers of present study with other studies

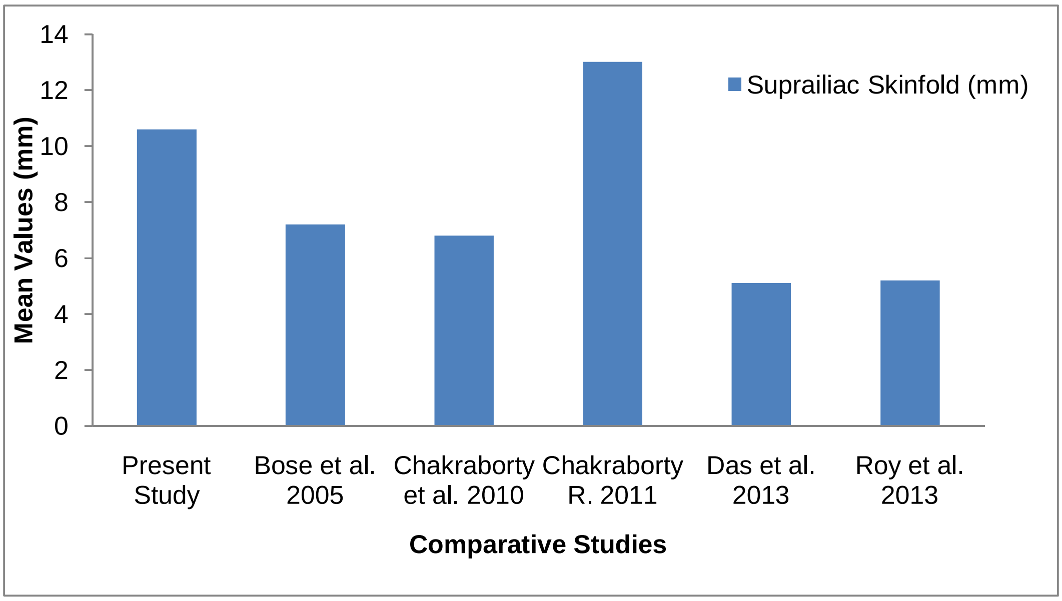


Figure 8.18: Comparison of Medial Calf Skinfold (mm) of male slum dwellers of present study with other studies

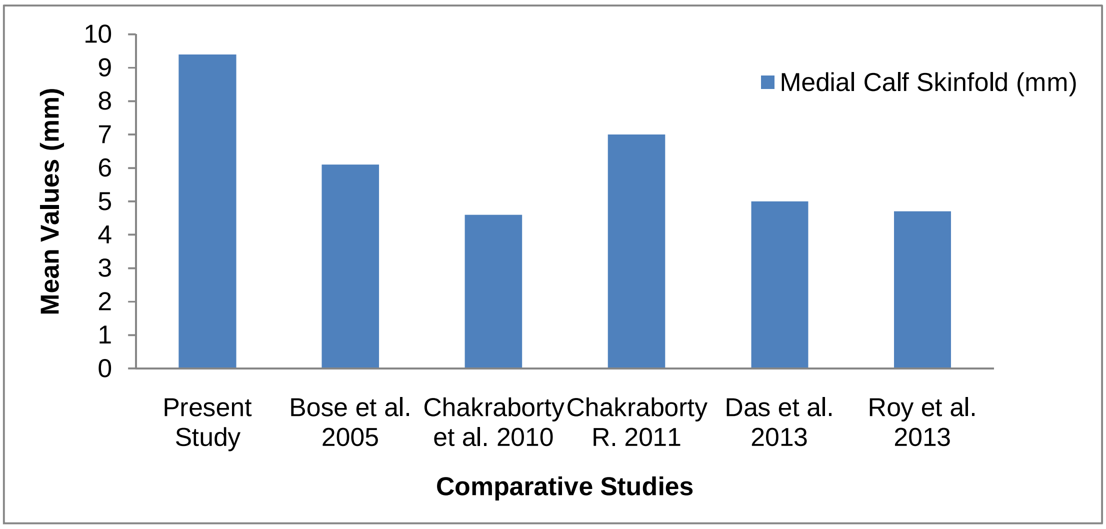


Figure 8.19: Comparison of Anterior Thigh Skinfold (mm) of male slum dwellers of present study with other studies

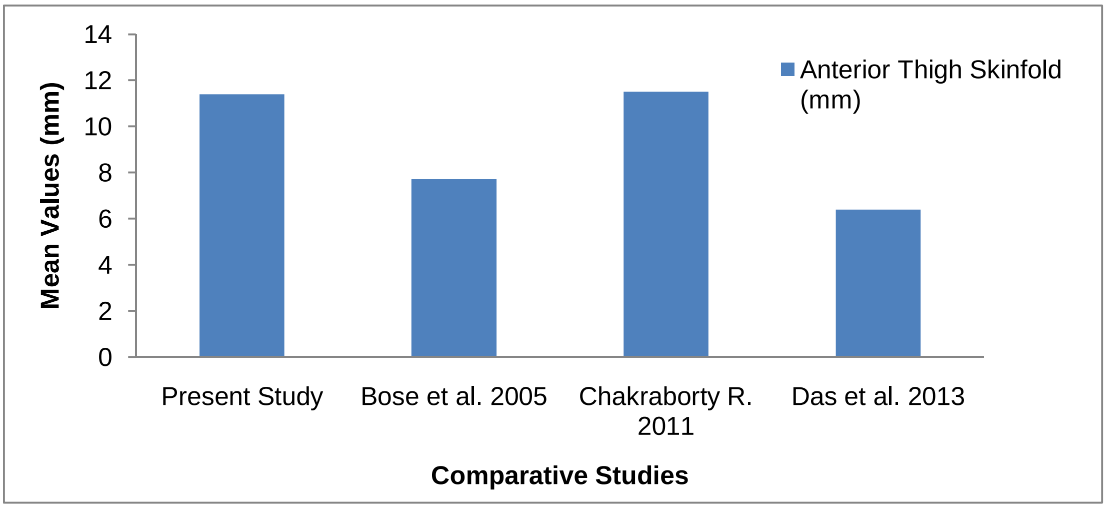


Figure 8.20: Comparison of Triceps Skinfold (mm) of female slum dwellers of present study with other studies

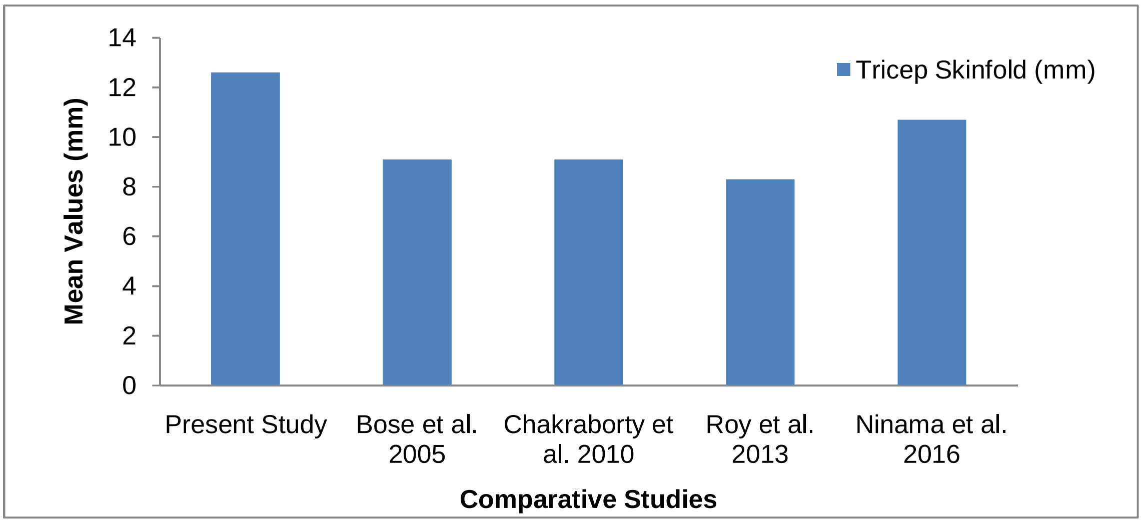


Figure 8.21: Comparison of Biceps Skinfold (mm) of female slum dwellers of present study with other studies

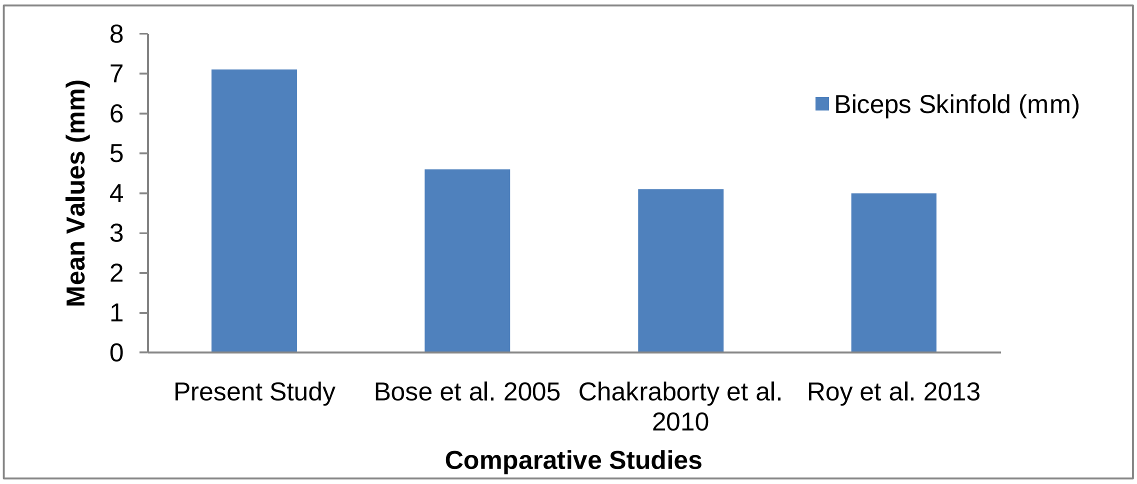


Figure 8.22: Comparison of Subscapular Skinfold (mm) of female slum dwellers of present study with other studies

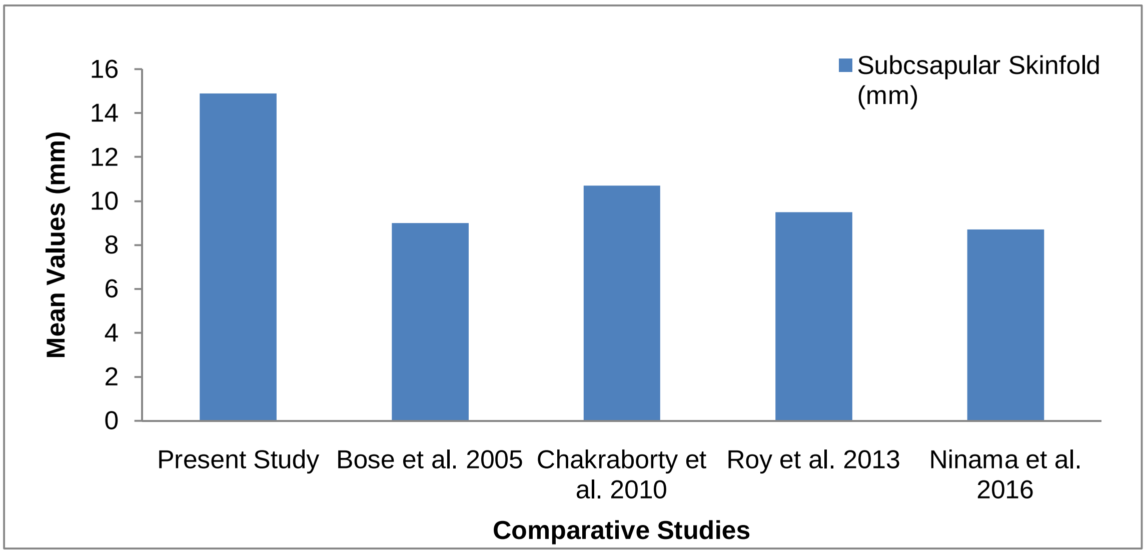


Figure 8.23: Comparison of Suprailiac Skinfold (mm) of female slum dwellers of present study with other studies

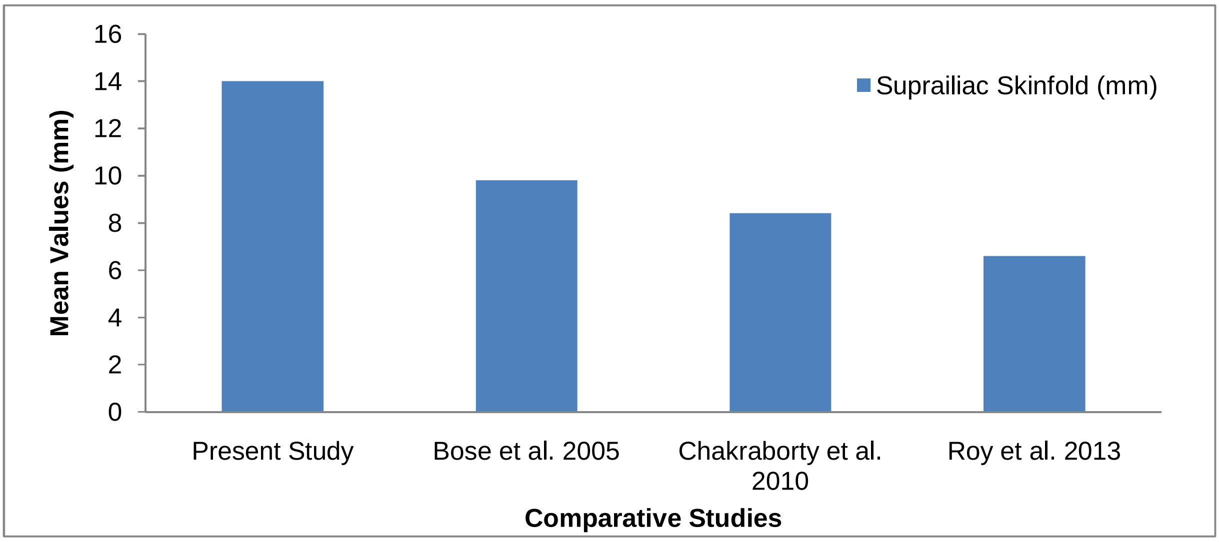


Figure 8.24: Comparison of Medial Calf Skinfold (mm) of female slum dwellers of present study with other studies

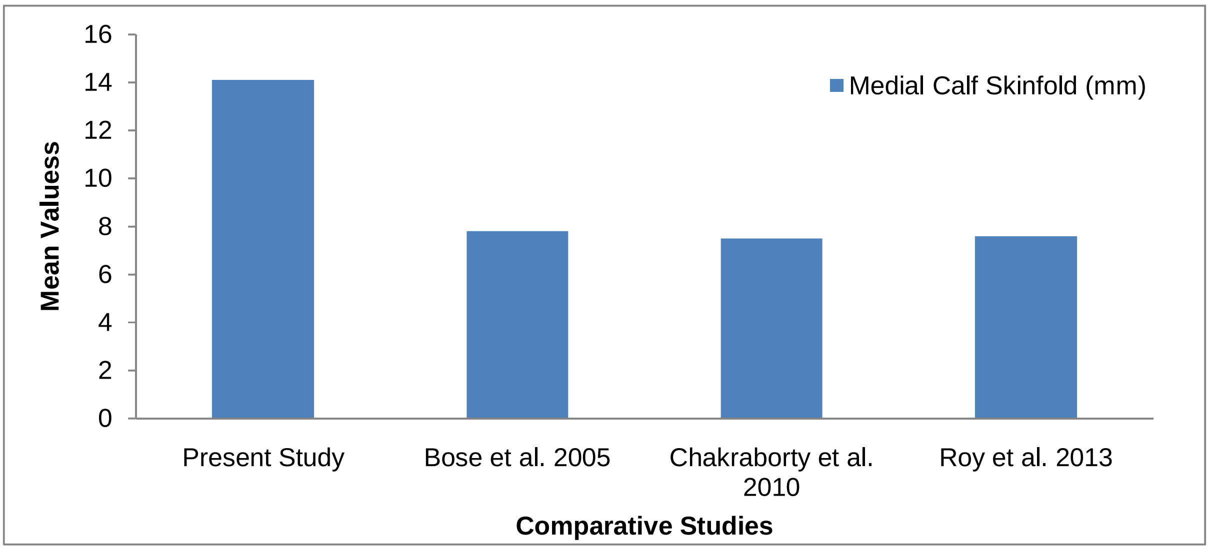


Figure 8.25: Comparison of Body Mass Index (kg/m^2) of male slum dwellers of present study with other studies

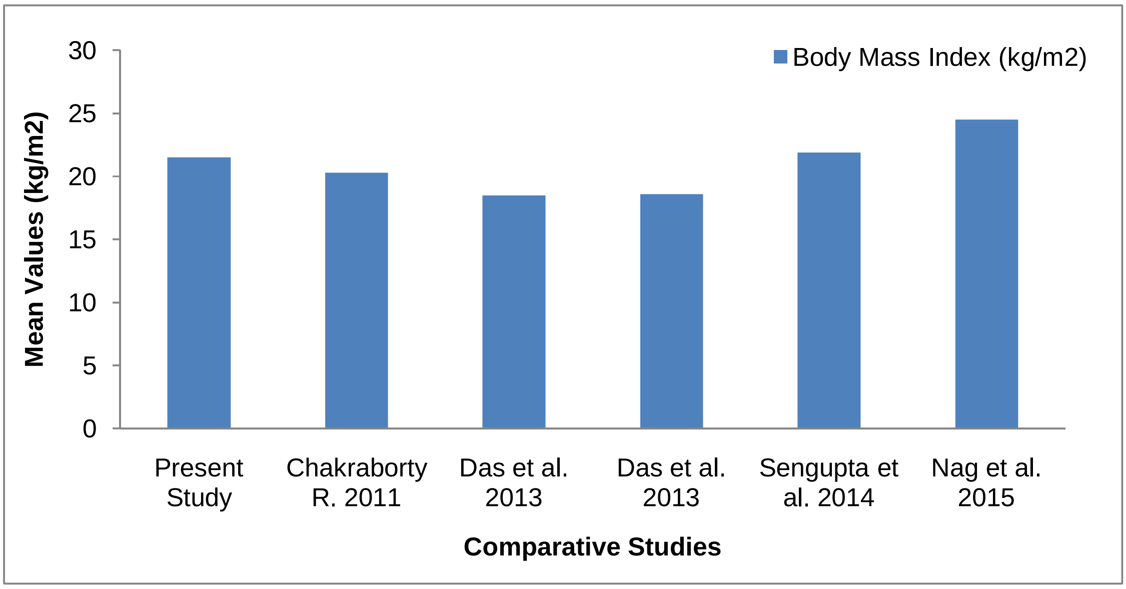


Figure 8.26: Comparison of Waist Hip Ratio of male slum dwellers of present study with other studies

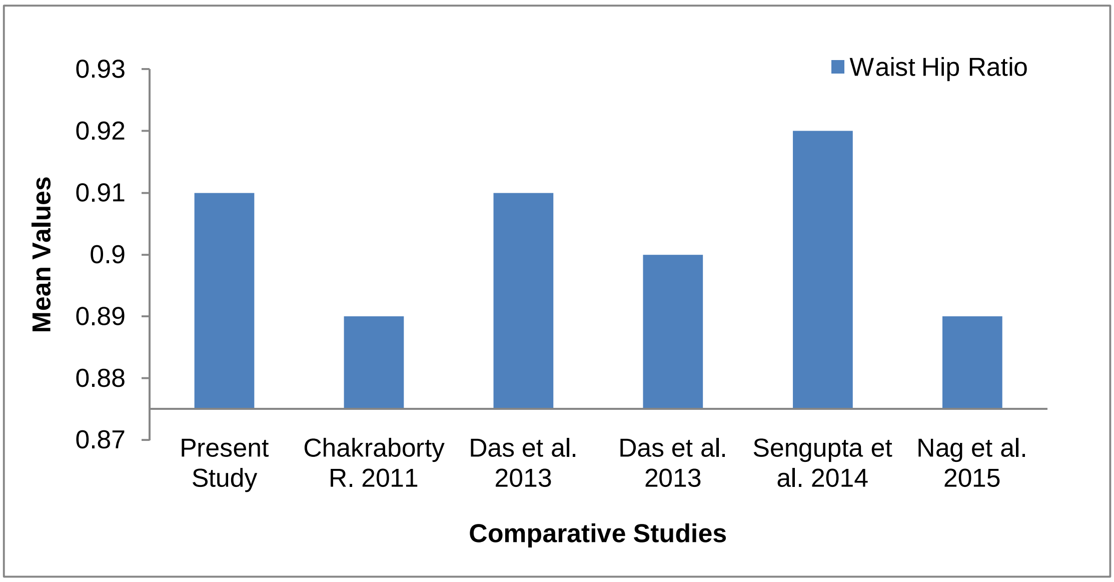


Figure 8.27: Comparison of Waist Height Ratio of male slum dwellers of present study with other studies

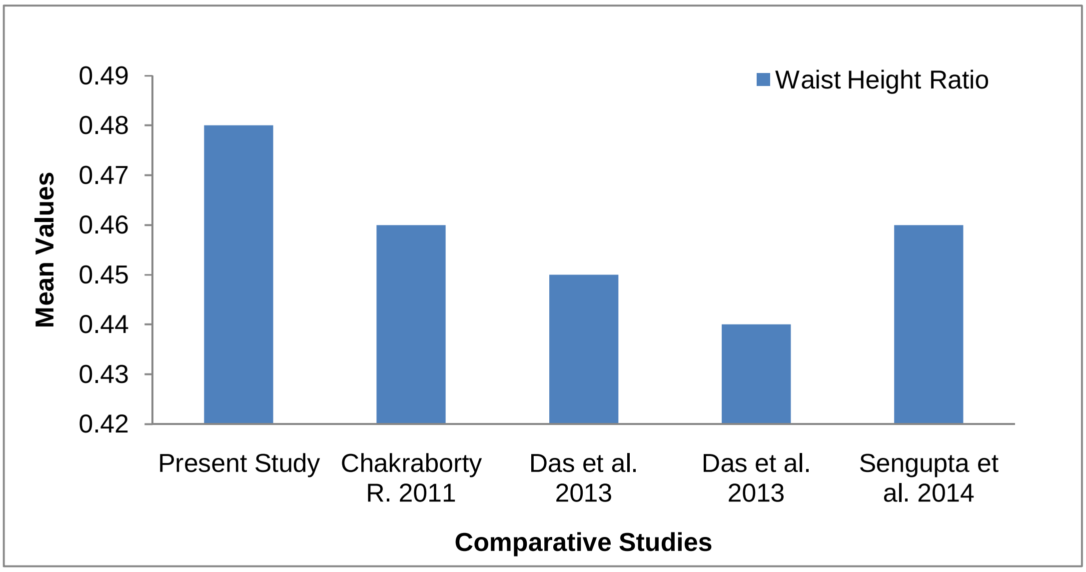


Figure 8.28: Comparison of Conicity Index of male slum dwellers of present study with other studies

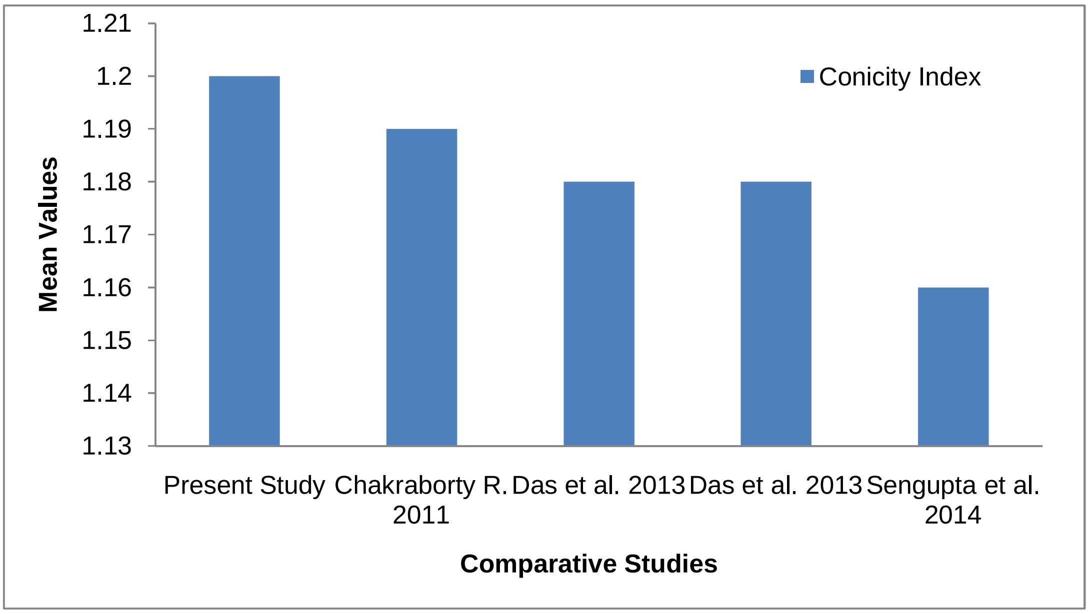


Figure 8.29: Comparison Body Mass Index (kg/m^2) of female slum dwellers of present study with other studies

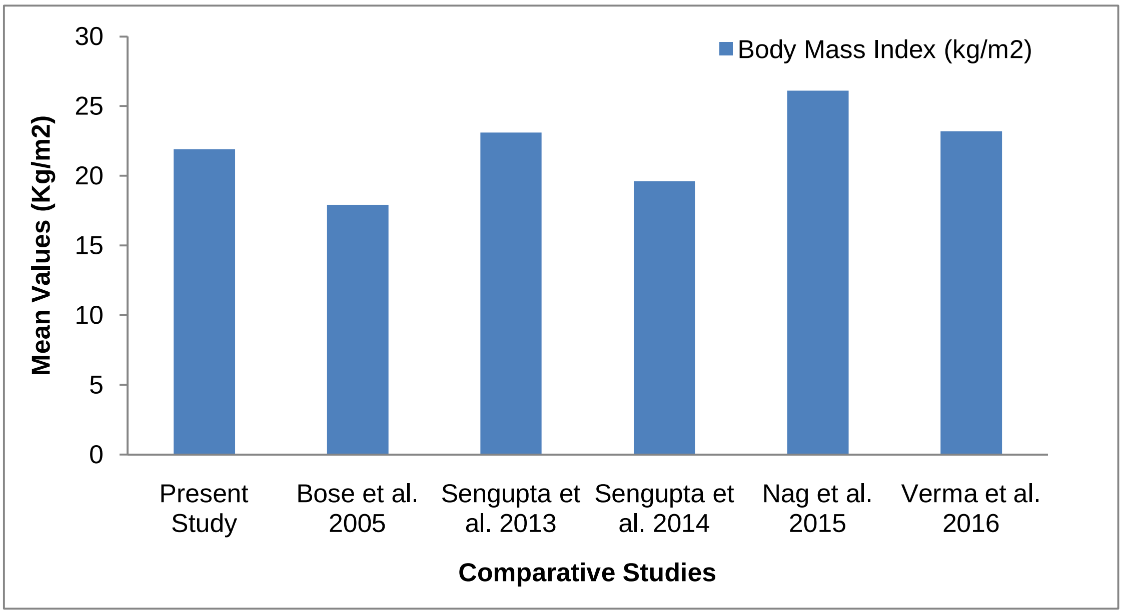


Figure 8.30: Comparison of Waist Hip Ratio of female slum dwellers of present study with other studies

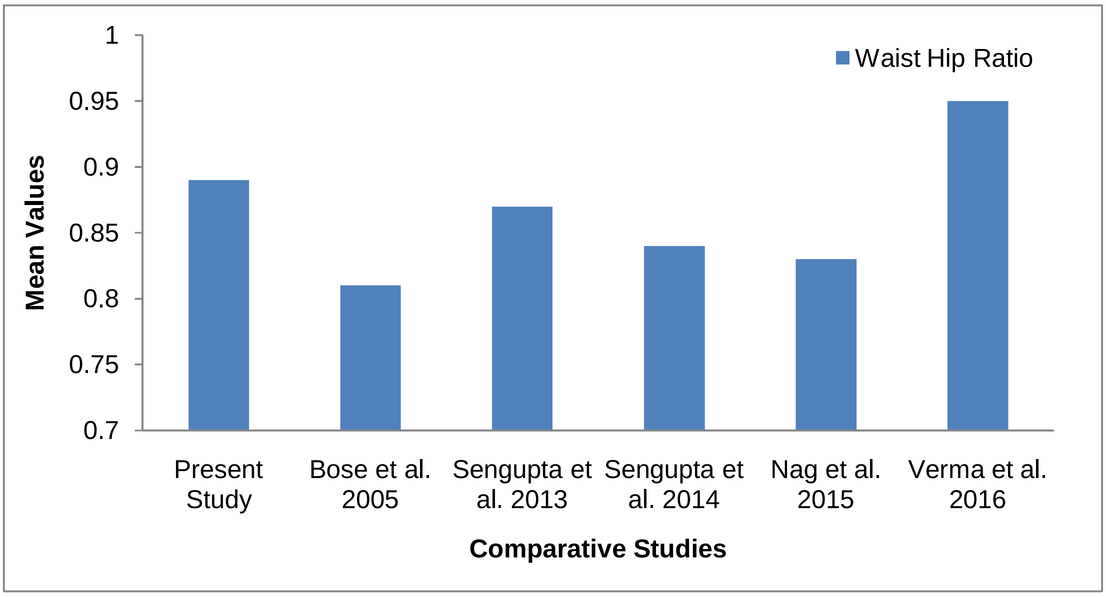


Figure 8.31: Comparison of Waist Height Ratio of female slum dwellers of present study with other studies

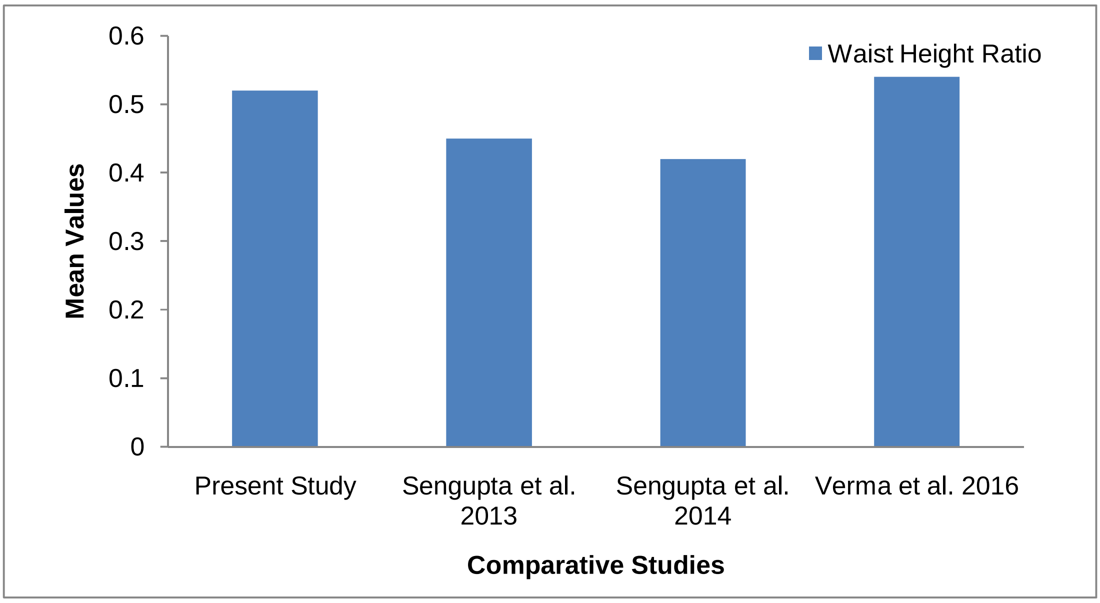


Figure 8.32: Comparison of Conicity Index of female slum dwellers of present study with other studies

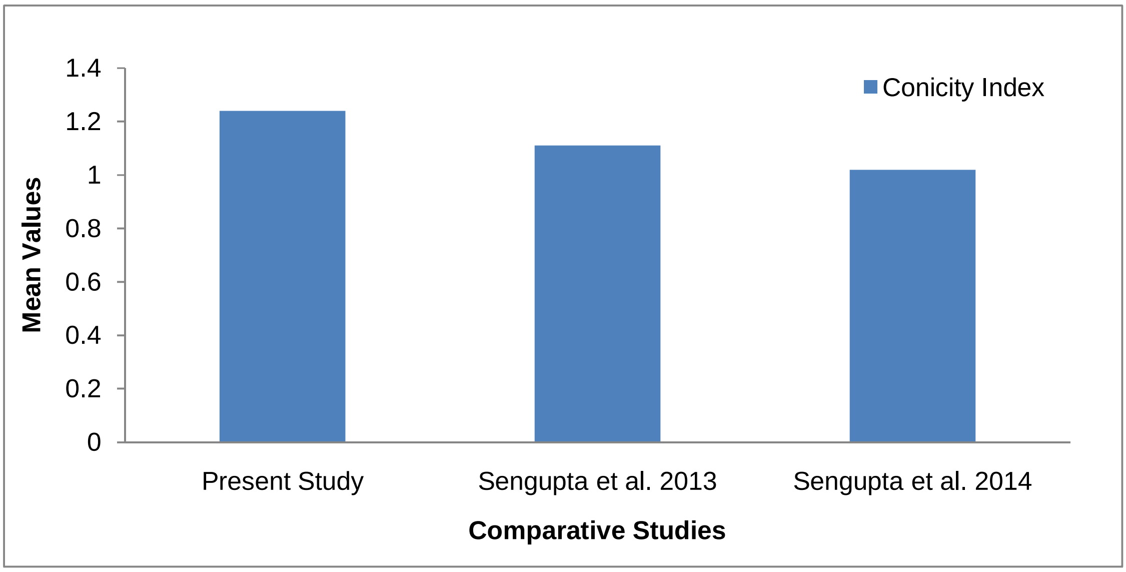


Figure 8.33: Comparison Percent Body Fat (%) of male slum dwellers of present Study with other studies

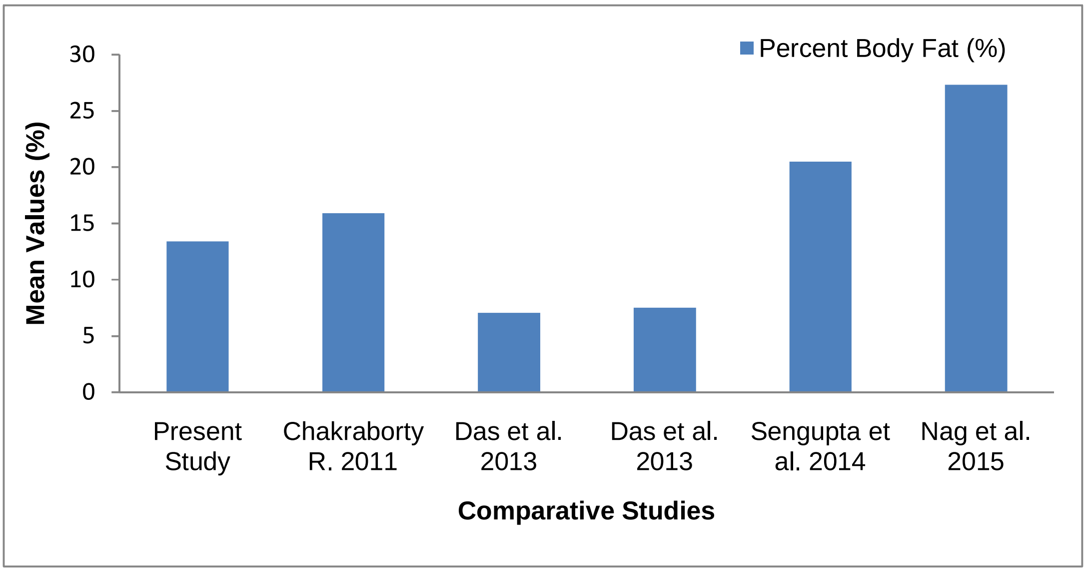


Figure 8.34: Comparison of Fat Mass (kg) of male slum dwellers of present Study with other studies

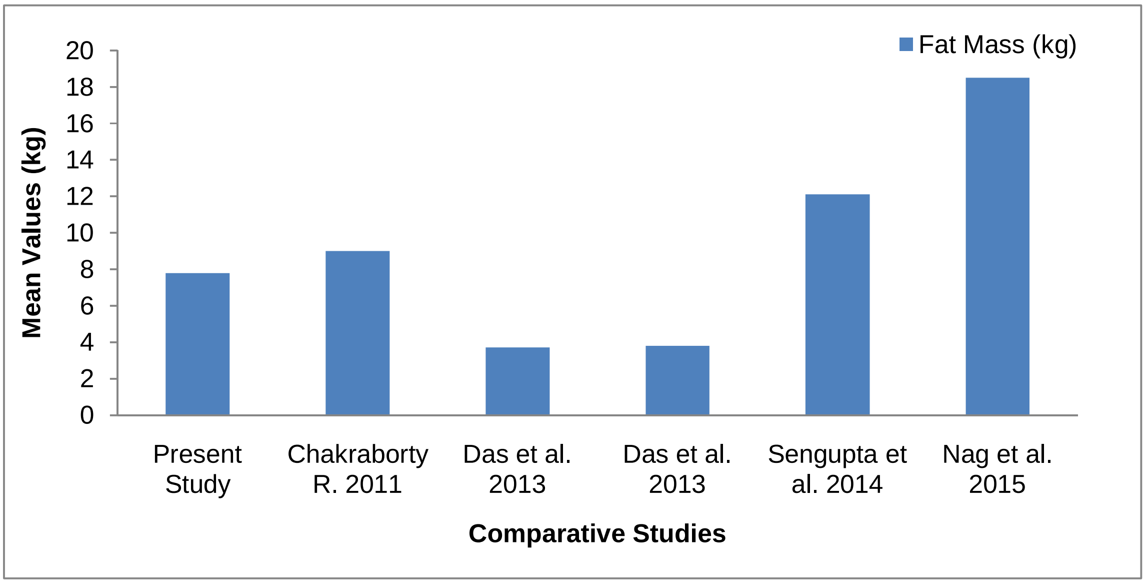


Figure 8.35: Comparison of Fat Free Mass (kg) of male slum dwellers of present Study with other studies

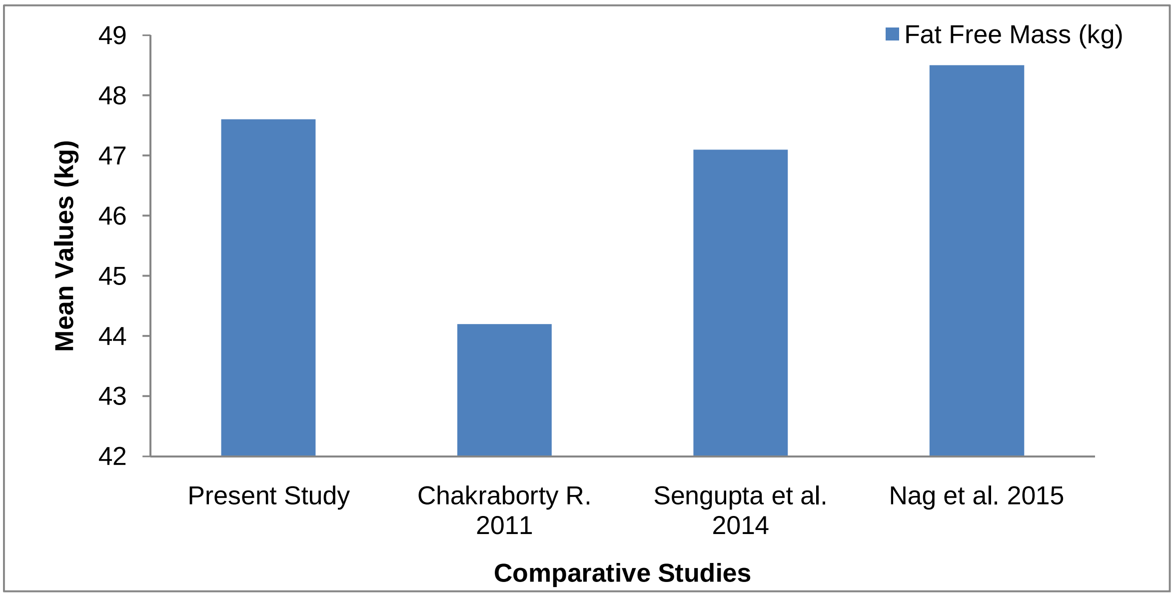


Figure 8.36: Comparison of Fat Mass Index of male slum dwellers of present Study with other studies

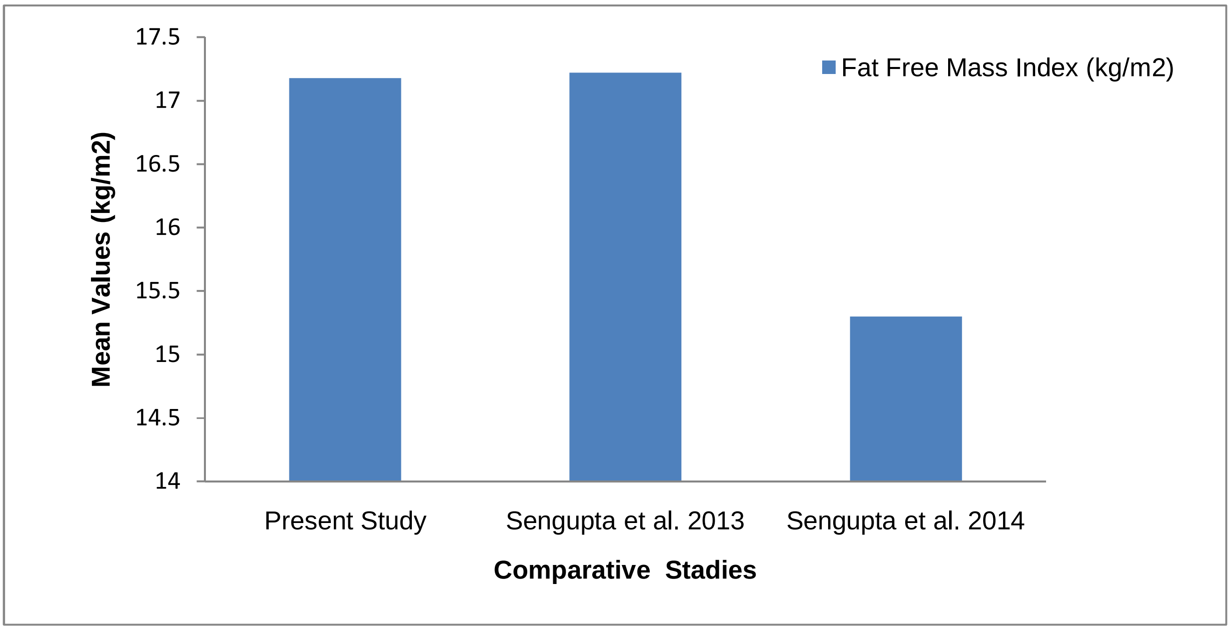


Figure 8.37: Comparison of Fat Free Mass Index of male slum dwellers of present Study with other studies

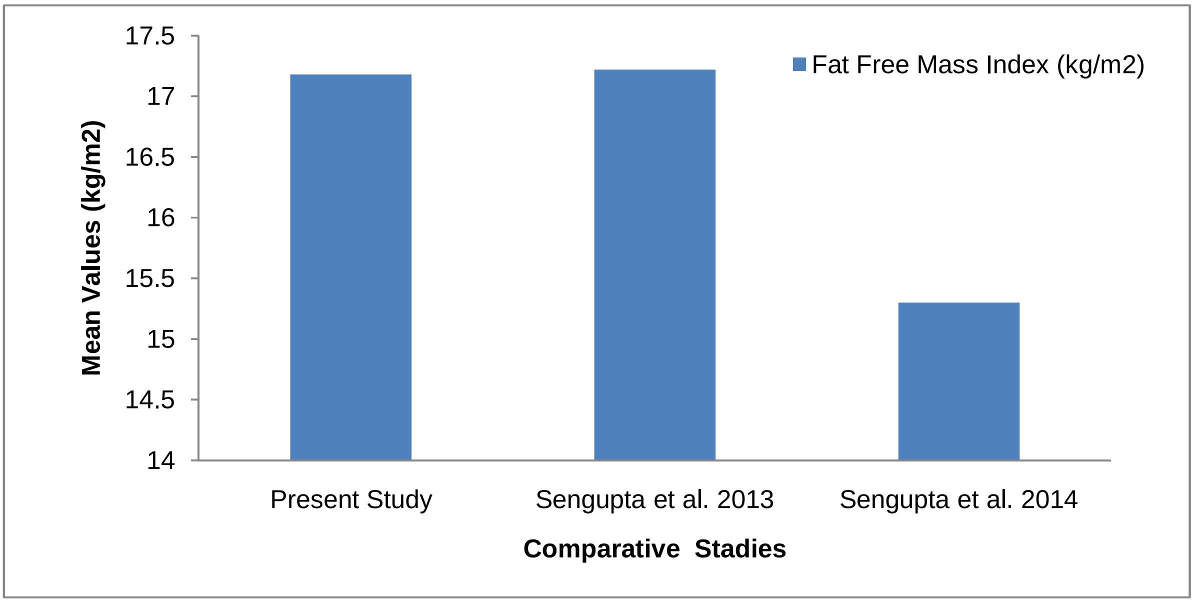


Figure 8.38: Comparison Percent Body Fat (%) of female slum dwellers of present Study with other studies

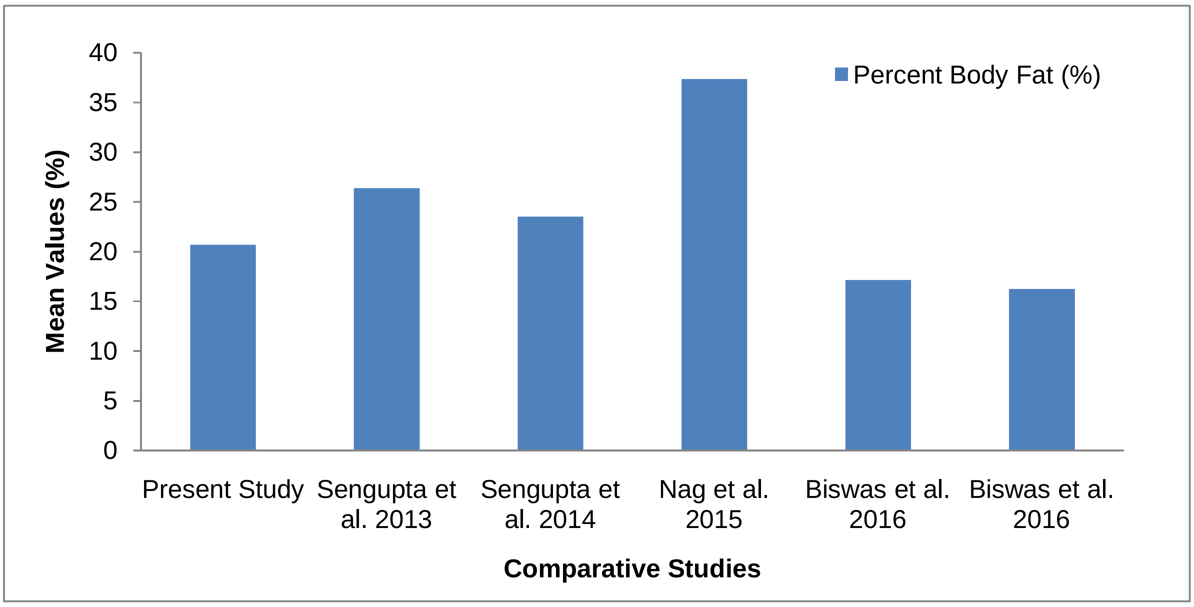


Figure 8.39: Comparison of Fat Mass (kg) of female slum dwellers of present Study with other studies

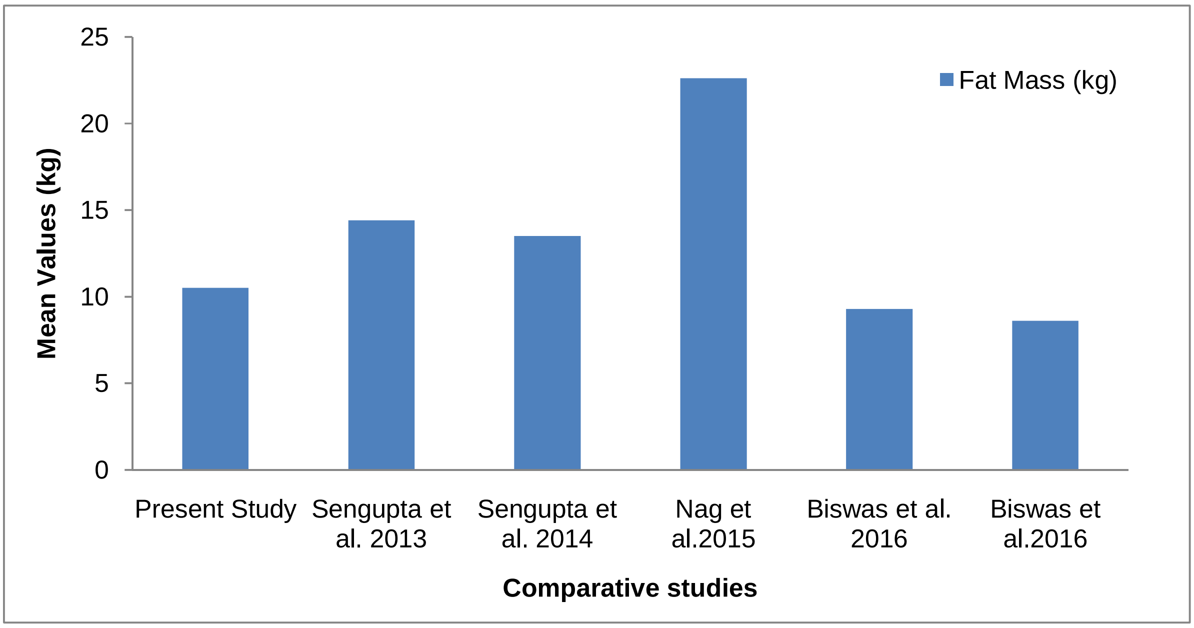


Figure 8.40: Comparison of Fat Free Mass (kg) of female slum dwellers of present Study with other studies

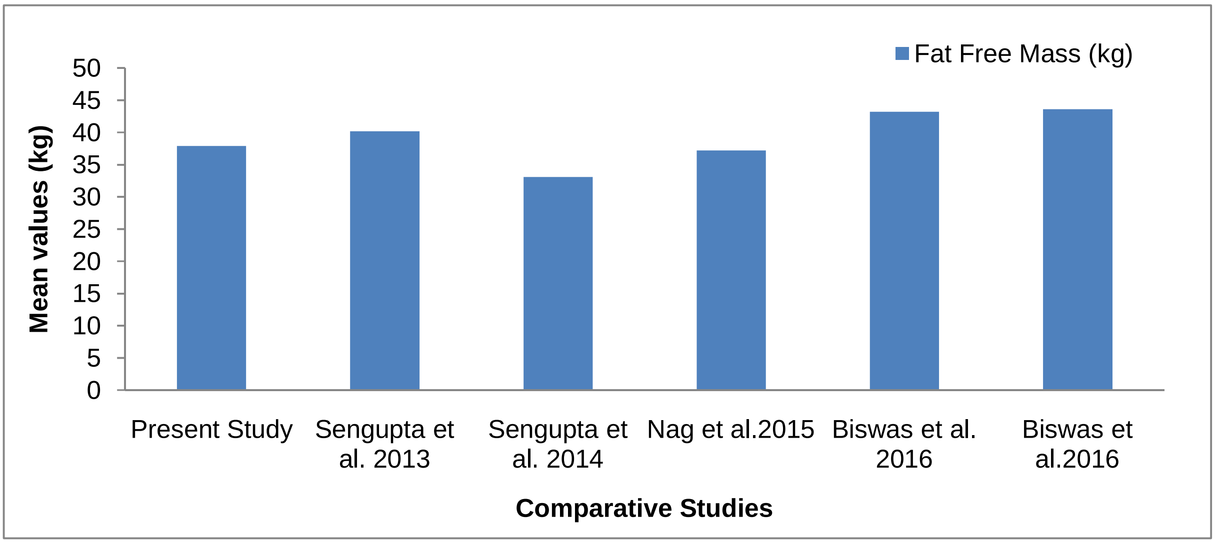


Figure 8.41: Comparison of Fat Mass Index of female (Kg/m2) slum dwellers of present Study with other studies

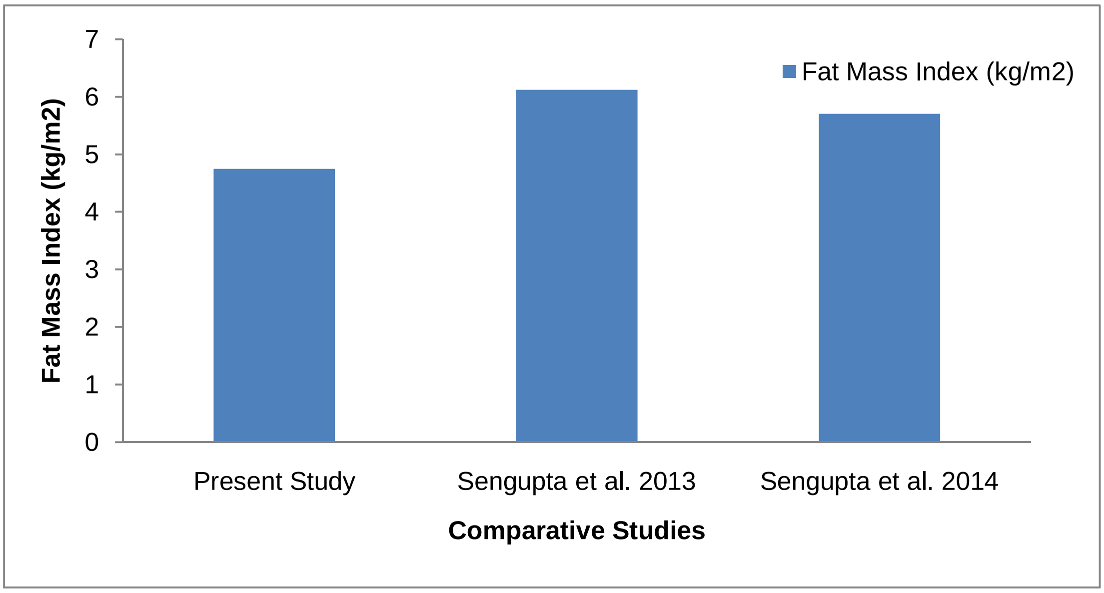


Figure 8.42: Comparison of Fat Free Mass Index of female slum dwellers of present Study with other studies

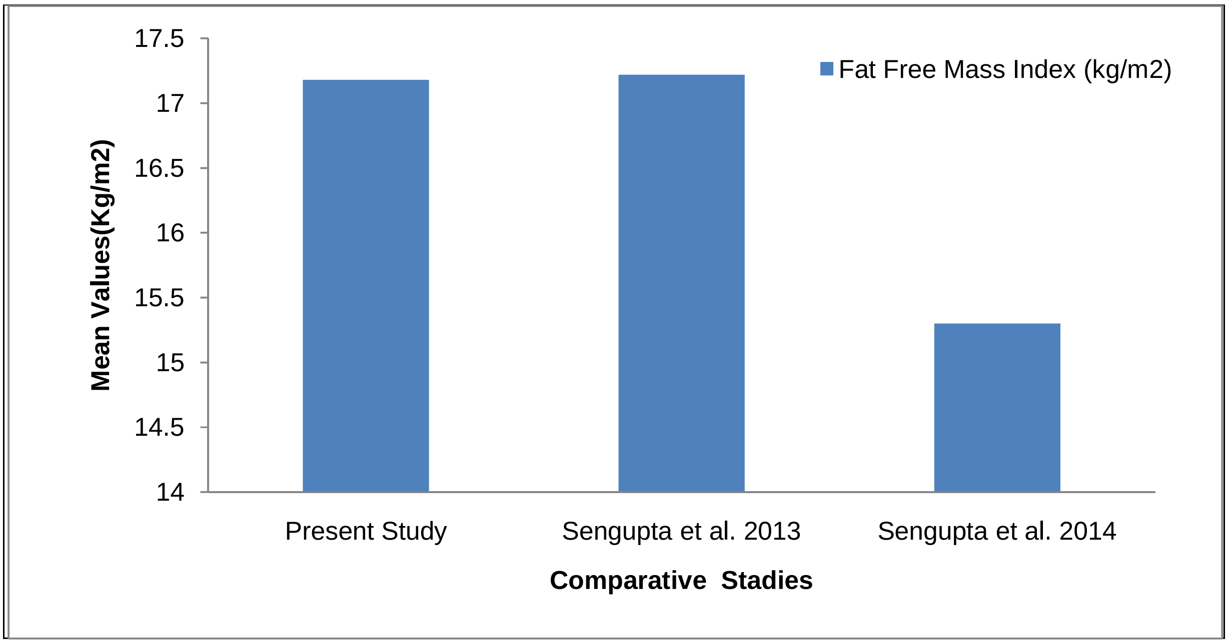


Figure 8.43: Comparative prevalence of nutritional categories of male slum dwellers of present study with other studies

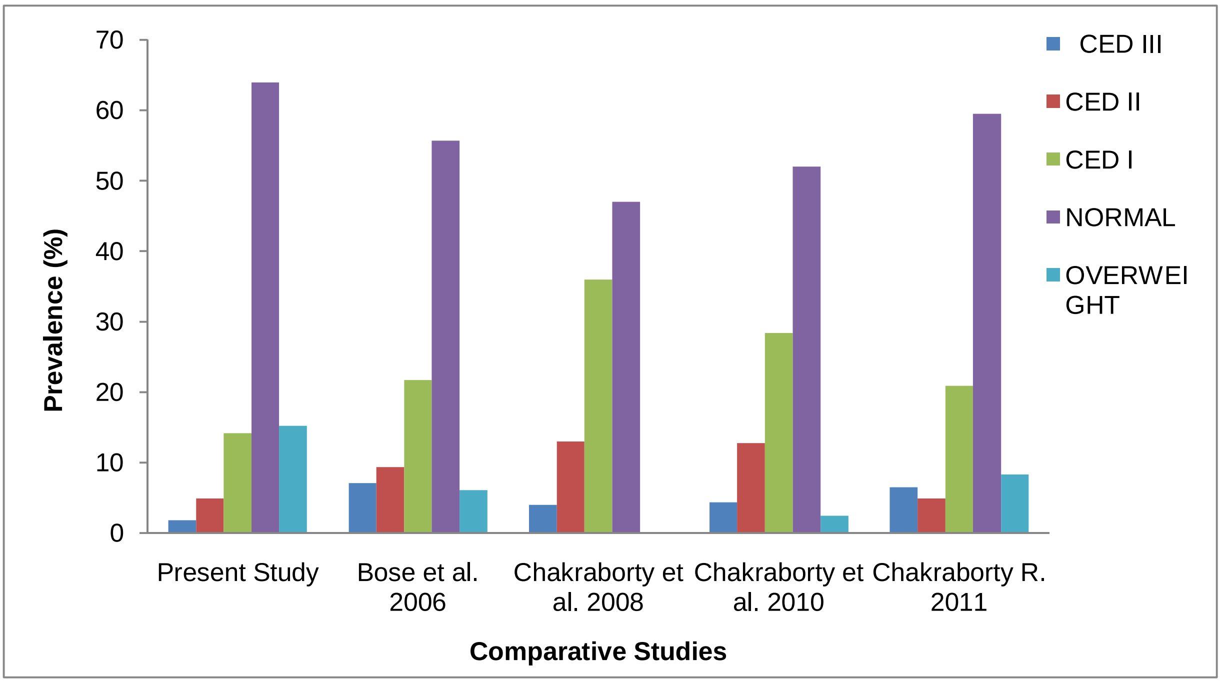
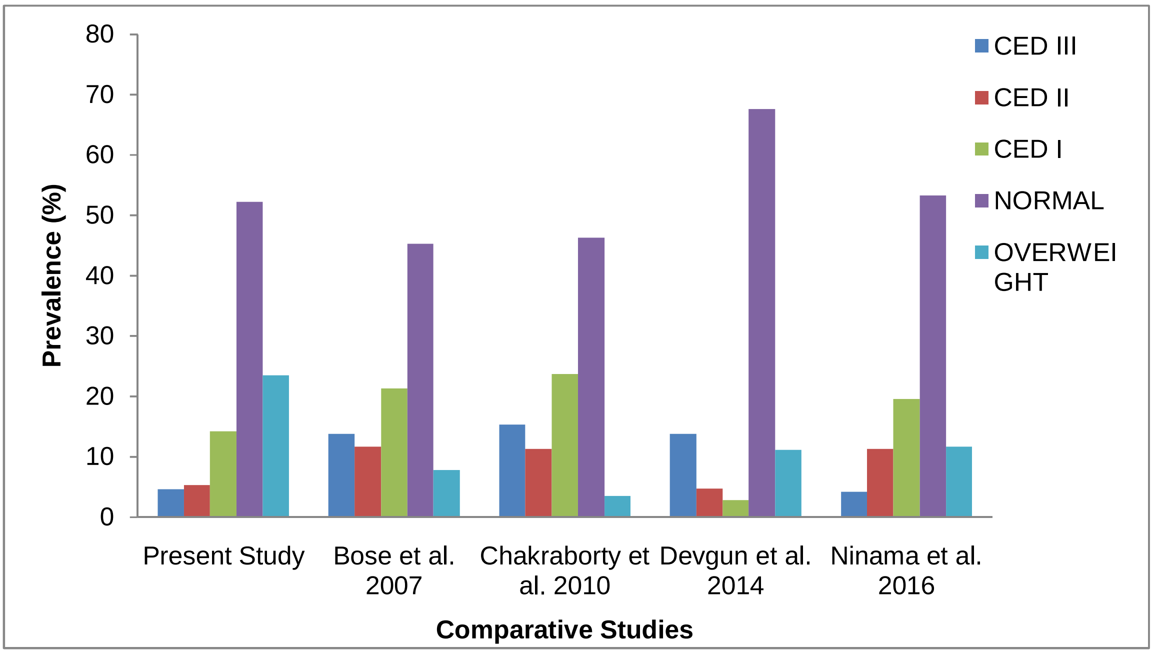


Figure 8.44: Comparative prevalence of nutritional categories of female slum dwellers of present study with other studies



CHAPTER – IX

CONCLUSIONS

IX

CONCLUSIONS

In conclusions, the findings of the present research investigation may be summarized as follows –

1) The Present studied slum dwellers engaged in manual and non manual occupation. The percentages of manual and non manual occupation of males were 55.06% and 44.94%. The percentages of manual and non manual occupation of females were 37.94% and 62.06%.

2) The slum dwellers are high proportion of literate and very lower rate of higher education. 22.87% of males and 48.02% of females were illiterate. Leaving them, the literacy rate of males and females were 77.13% and 51.98%. 7.89% of males and 2.17% of females were higher educated.

3) The males have higher MFI and MPCI than females. The present male slum dwellers MFI and MPCI are higher than recently studied Kolkata male slum dwellers reported by Chakraborty R. 2011.

4) The maximum slum dwellers of the present studies lives in their own house. The percentage of brick walled house of males and females slum dwellers are higher than other wall categories. 34.62% of males and 21.34% of females had separate toilet and 52.22% of males and 68.98%of females had common toilet. 13.16% of males and 9.68% of females had no toilet at all.

5) The prevalence of self-reported morbidity of the subjects reported illness during last four weeks to one year prior to the day of anthropometric measurements, 24.49% of the males and 23.91% of females reported some kind of illness, whereas 75.51% of the males and 76.09% of the females had not any illness.

6) The percentage of male and female slum dwellers who practiced regular physical exercise were 7.09% and 0.79% respectively.

7) There is significant occupation difference in wall type, roof type and sanitation type but there is no significant occupation difference in house type among male and female slum dwellers of present study.

8) There is significant monthly family income group difference in wall type and roof type but there is no significant monthly family income group difference in house type among male and female slum dwellers of present study. However, there is significant MFIG difference in sanitation type of males but there is no significant MFIG difference in sanitation type of females.

9) There is significant monthly per capita income group difference in wall type and roof type but there is no significant monthly per capita income group difference in house type among male and female slum dwellers of present study. However, there is no significant MPCIG difference in sanitation type of males but there is significant MPCIG difference in sanitation type of females.

10) The sex differences of all the anthropometric variables except waist circumference of slum dwellers are statistically significant at the 0.05 level.

11) The mean differences of HT, WT, SHT, HTAC, WC, SUBSF and SUPSF between age groups of males are statistically significant at the level 0.05

but the mean differences of MUAC, CC, HC, TSF, BSF, MCSF and ATSF between age groups of males are not statistically significant at the level 0.05.

12) The mean differences of HT, SHT, WC, HC, MCSF and ATSF between age groups of females are statistically significant at the level 0.05 but the mean differences of WT, HTAC, MUAC, CC, TSF, BSF, SUBSF and SUPSF between age groups of females are not statistically significant at the level 0.05.

13) The sex differences of all the adiposity and body composition measurements except body mass index of slum dwellers are statistically significant at the 0.05 level.

14) The mean differences of WHR, WHTR, CI, SumSFT and SumSFUEX between age groups of males are statistically significant at the level 0.05 but the mean differences of BMI, SumALSF, SumSFEX and SumSFLEX between age groups of males are not statistically significant at the level 0.05.

15) The mean differences of WHTR, CI, SumSFEX and SumSFLEX between age groups of females are statistically significant at the level 0.05 but the mean differences of BMI, WHR, SumALSF, SumSFT and SumSFUEX between age groups of females are not statistically significant at the level 0.05.

16) The mean differences of FFM between age groups of males are statistically significant at the level 0.05 but the mean differences of PBF, FM, FMI and FFMI between age groups of males are not statistically significant at the level 0.05.

17) The mean differences of FFM and FFMI between age groups of females are statistically significant at the level 0.05 but the mean differences of

PBF, FM and FMI between age groups of females are not statistically significant at the level 0.05.

18) The overall percentage of CED (based on BMI) of males and females are 20.85% and 24.31% respectively. The overall percentages of undernutrition (MUAC < 23 cm) of males are 40.49 % and females are 51.78% respectively.

19) There is significant age group differences in nutritional status based on BMI of adult male slum dwellers but there is no significant age group differences in nutritional status based on BMI of adult female slum dwellers.

20) There is no significant occupation and education difference in nutritional status among slum dwellers of Midnapore town.

21) Different anthropometric variables of the present study (sample) are agrees, in general, with the earlier studies (Bose et al. 2005, Chakraborty et al. 2008, Chakraborty R 2011, Dewangan et al. 2010, Das et al. 2013, Dutta Banik S, 2016).

22) Nutritional categories of the present study (sample) are agrees, in general, with the earlier studies (Bose et al. 2006, Bose et al. 2007, Chakraborty et al. 2008, Chakraborty et al. 2010, Chakraborty R. 2011, Devgun et al. 2014, Ninama et al. 2016).

23) Based on WHO classification, the prevalence of CED among this population was high (20-39%) and thus, the situation is serious in both sexes. These rates were, in general, lower than the recently reported studies.

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Annex - 1

HEALTH AND NUTRITIONAL STATUS AMONG ADULT SLUM DWELLERS OF MIDNAPORE TOWN

Name: ____ **ID No.**___________ **Date**_____________________

Date of Birth: ________________; **Age**: _________; **Gender:** Male / Female; **Education**: ___________ (Years)

Religion: Hindu / Muslim / Christian / Others; **Caste**: Gen / OBC / SC / ST; **Ethnicity**_______________________

House Type: Own / rental **Floor pucca**: Yes / No,

Wall: Mud / Bamboo / Bricks, **Roof**: Tile / pucca / straw

Toilet: Common / Separate**,** **Sanitation**: Open / Septic / Semi pucca;

Occupation Own: --

No. of the Employed person in the Household: ___________

Monthly Family Income (Rs) _____________

Expenditure (Rs) ___________ (Including all members of household)

Total Family Members: ---

<u>Health and Behavioral status</u>:

Illness (last 1 / 2 / 3 / 6 / 12 month): Yes / No **Regular physical exercise:** Y / N

Habitual Exercise	Times per week	Duration
CYCLING	**----------------------------**	**----------------**
WALKING	**------------------------------**	**-----------------**

ANTHROPOMETRIC MEASUREMENT

01. HEIGHT (cm) -------------------------------

02. WEIGHT (kg) -------------------------------

03. SITTING HEIGHT (cm) -------------------------------

04. HEIGHT ACROMION (cm) -------------------------------

CIRCUMFERENCES (cm):

05. MID UPPER ARM --------------------------------

06. CHEST --------------------------------

07. MINIMUM WAIST --------------------------------

08. MAXIMUM HIP --------------------------------

SKINFOLDS (mm):

09. TRICEPS -------------------------------

10. BICEPS ------------------------------

11. SUBSCAPULAR ------------------------------

12. SUPRAILLIAC ------------------------------

13. MEDIAL CALF ------------------------------

14. ANTERIOR THIGH -------------------------------

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Signature of the subject **signature of the recorder**