CHAPTER- I

INTRODUCTION

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1.1: Introduction.

Anthropology is the sciences that studies, their biology, adaptations, behavior and variation within the context of a specialized adaptation of learned social behavior called culture. Anthropologist study such broad-ranging phenomena as physical and cultural differences among human groups, the structure of the many human languages, the adaptability of human groups to different environmental conditions, the pattern of growth and the changing pattern of culture over time. This broad scientific agenda makes anthropology a discipline with many specialists and many sub-disciplines. For this reason, anthropological research is frequently described as “multidisciplinary”. One characteristic of all anthropologists is a common to understanding humanity in its entirety, as a functioning whole. For this reason anthropology is also termed “holistic”.

Contemporary anthropology is generally divided into four broad categories viz;

Physical anthropology is also known as biological anthropology, study the physical makeup, evolution and variations of human populations, the relationship of humanity with the natural world, and the biological base of human behavior.

Cultural anthropologists study living societies of people, their customs, their myths, their kinship systems, their rituals, and all aspects of their social behavior within the uniquely human adaptation of culture.

Archaeology study how human culture has adapted and evolved over time through the artifacts and sites.

Linguistic anthropology study language its many varieties, the forces governing how language change, the relationship between language and the brain, and the interactions between language and cultural concepts.

1.1.1: Biological anthropologists strive to accurately describe human physical structure both in the present and in the past. They seek to understand how human structure functions in real life and how human individuals with that structure behave. In addition, biologists investigate how function and behavior are integrated into the environment in which human beings live. Because they want to understand the origins of structures, biological anthropologists also explore human genetics, growth, nutritional and development, and evolutionary history.

There are some strong connections between biological anthropology and other anthropological sub-disciplines. Biological anthropologists may come into close contact with archaeologists in the cross-disciplinary area of paleoanthropology, the study of human evolution through fossils and artifacts. Archaeologists may find a fossilized human skull, but the job of describing and studying the specimen falls to the biological anthropologists. Or biological anthropologists may find it essential to put together their knowledge of skeletal biology with that of the cultural and living contexts that the archaeologist has discovered in order to better understand the adaptations of a past human population. Biological anthropologists who study the behavior of the nonhuman primates may have close intellectual ties to psychologists. Specialists in human growth and adaptation may feel particularly at home among a group of biologists who specialize in human biology. And biological anthropologists who investigate molecular biology and the genetics of human populations may work closely with geneticists and molecular biologists.

1.1.2: 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 foodstuffs, the determinants of their production 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 anthropologist 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 community level requires nutritional assessment of them. "Nutritional assessment" the original term was used by a sub-committee of the League of Nation (1932) referring to a set of medical tasks to determine the nutritional status of a population (Gibson, 2005). After (Bistrain and Blackburn et al, 1976), it becomes a standardized, hospital based set of tools to predict nutrition and health outcome 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 status of an individual or population as influenced by their intake and utilization of nutrients".

1.1.3: Health: The word 'health' was derived from the English word 'hoelth', which meant a state of being sound, and was generally used to infer a soundness of the body (Dolfman, 2009). According to WHO (1984) "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 behavior of the community (Gopalan, 2008).

1.1.4: 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 components required for the proper growth, development and maintenance of the body. Nutrition also improves their ability to learn, communicate, think analytical, socialize effectively and adapt to new environments and people. Nutrition success stories are replaced with individuals, groups, and organizations that have been a critical part of the process at every stage. Good nutrition signals the realization of people's rights to food and health. It reflects a narrowing of the inequalities in our world. Without good nutrition, human beings cannot achieve their full potential. When people's nutrition status improves, it helps break the intergenerational cycle of poverty, generates broad- based economic growth, and leads to a host of benefits for individuals, families, communities, and countries. Good nutrition provides both a foundation for human development and the scaffolding needed to ensure it reaches its full potential. Good nutrition, in short, is an essential driver of sustainable development.

The opposite of good nutrition—"bad" nutrition—takes many forms: children and adults who are skin and bone, children who do not grow properly, people who suffer because their diets lack nutrients or are unhealthy, people who are obese or suffer from diet-related non communicable disease such as diabetes, heart disease, and some cancers. These multiple forms of malnutrition have common causes: poor-quality diets, weak care of mother and child, insufficient access to health services, and unsanitary, unhealthy environments.

1.1.5: Relationship between nutrition and health: Individual can be broadly categorized into having optimal nutritional status, or being undernourished. The major causes and consequences of these nutritional statuses are indicated. It is important to realize that many other lifestyle and environmental factors, in addition to nutrition, influence health and wellbeing, but nutrition is a major, modification and powerful factors on promoting health, preventing and treating disease and improving quality of life.

Nutritional situation	**Health consequences, outcomes**
Optimum nutrition Food secure individuals with adequate**,** → balanced and prudent diets.	Health, well-being, normal development, high quality of life.
Undernutrion: Hunger Food insecure individuals living in poverty, → ignorance, political unstable environments, disrupted socities, war.	• Decreased physical and mental development; • Compromised immune systems; • Increased infectious diseases; • Vicious circle of undernutrition, underdevelopment, poverty.
Overnutrition Overconsumption of food, especially → macronutrients, plus: • Low physical activity • Smoking, stress, etc.	Obesity, metabolic syndrome, cardiovascular disease, type 2 diabetes mellitus, certain cancers: chronic noncommunicable diseases (NCDs), often characterized by overnutrition of macronutrients and micronutrient undernutrition.
Malnutrition Nutrition transition: individuals and → communities previously food insecure → confronted with abundance of palatable food → some undernourished other too much macronutrients and too little micronutrients.	Double burden of infectious plus NCDs, often characterized by overnutrition of macronutrients and micronutrient undernutrition.

1.1.6: Nutritional epidemiology: Nutritional epidemiology is the application of epidemiological techniques to the understanding of disease causation in populations where exposure to one or more nutritional factors is believed to be important. Epidemiology deals with associations, analyzing strengths and seeing how specific they are. Nutritional epidemiology does not establish factual cause, but it can provide powerful circumstantial evidence of association. One of the nutritional epidemiology is to disentangle the complex relationship between diet and disease to establish a relationship between the two. Much of the focus of nutritional epidemiology has been on the elucidation of the chronic disease, especially heart disease and cancer. Another important function of nutritional epidemiology is to evaluate the quality of the measure of exposure or outcome that is made. A key purpose of nutritional epidemiology must be to inform public health nutrition, a population approach to the prevention of illness and the promotion of health through nutrition. Public health nutrition puts nutritional epidemiological finding into a wider social and ecological context to promote "wellness" through a healthy lifestyle, including good diet.

1.1.7: Balanced diet is required for better growth, development, survival and reproduction. It is 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.

1.1.8: Nutritional status: nutritional status is the present body status of an individual 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 and external factors. Internal factors like: age, sex, nutrition, behavior, physical activity and disease. External or environmental factors like: food safety, cultural, social and economic circumferences. According to WHO (1978), nutritional status is the condition of the body as a result of 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 disease 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 individual or population group "at risk" or in greatest need of assistance.

1.1.9: 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 segment of the population. It is an important cause of low birth weight, brain damage and other birth defects, and contributes to developmental (physical and cognitive) retardation, increased risk of infection and death and other problems in infants and children (WHO, 1995). Malnutrition, though, is a problem of staggering size—large enough to threaten the world's sustainable development ambitions. Malnutrition takes many forms: children and adults who are skin and bone, children who do not grow properly, people who suffer because their diets are imbalanced, and people who are obese or suffer from nutrition-related non communicable diseases. Malnutrition affects all countries and one in three people on the planet. Nearly half of all countries face multiple serious burdens of malnutrition such as poor child growth, micronutrient deficiency, and adult overweight.

1.1.10: Global malnutrition: It is a major tragedy that millions of people currently live with hunger and fear starvation. Malnutrition is a problem of staggering size world-wide—large enough to threaten the world's sustainable development ambitions for the post-2015 period. Malnutrition affects all countries and almost one in three people on the planet (GNR 2014). Nearly half of all countries are dealing with more than one type of malnutrition at the same time (IFPRI 2014a) and the threat is growing. Al- though some forms of malnutrition, such as stunting, are showing slow and uneven declines, other forms, such as anemia in women of reproductive age, are stagnant. And still others, such as overweight and obesity, are increasing. The resolve to act to reduce malnutrition is high. The causes of malnutrition have never been clearer. Our understanding of how to lower the number of malnourished people—albeit not perfect has never been greater. We know that combating malnutrition in all of its complexity will require a combination of actions designed to (1) strengthen the political environment in ways that enable malnutrition reduction, (2) ensure that all sectors that affect nutrition con- tribute as much as they can to improving people's nutrition status, and (3) expand targeted nutrition interventions to cover all the people who need them. These actions, of course, will take different forms in different countries. Momentum for improving nutrition is growing stronger, both globally and in individual countries (GNR-2014). The challenge now is not only to lock in existing commitments to reducing mal- nutrition in all its forms, but also to multiply them exponentially and convert them into faster progress. The time is right to rise to this challenge.

World malnutrition report; While the numbers of people affected by different types of malnutrition cannot simply be summed (because a single person can suffer from more than one type of malnutrition), the scale of mal- nutrition is staggering:

- 2 billion people experience micronutrient malnutrition (WHO 2015m).
- 1.9 billion Adults are overweight or obese (WHO 2015n).
- 161 million children under age 5 are too short for their age (stunted), 51 million don't weigh enough for their height (wasted), and 42 million are overweight; none of these children are growing healthily (UNICEF/WHO/World Bank 2015).
- 794 million people are estimated to be calorie deficient (FAO 2015f); and
- 1 in 12 adults worldwide has Type 2 diabetes (WHO 2015c). In many countries, only a minority of children are growing healthily. In Bangladesh, Democratic Republic of the Congo, Ethiopia, Nigeria, and Pakistan, for example, the percentage of children under 5 who are not stunted or wasted ranges between 43 and 48 percent.

Key Factor Global Nutrition:

- Nearly every country has a serious health problem owing to malnutrition in one of its forms.
- Forty-five percent of all mortality of children under age 5 is linked to malnutrition (Black et al. 2013).

- Scaling up nutrition-specific undernutrition interventions to 90 percent coverage will generate a median benefit-cost ratio of 16:1.

- The cost of obesity in the United States is equivalent to 10 percent of median income. The cost of adult undernutrition in Africa and Asia is equivalent to 8–11 percent of GDP (GNR 2014a).

- Sixty-nine countries out of the 99 with data are on course to meet at least one of four global nutrition targets stunting, wasting, and overweight in children under age 5 and anemia in women age 15–49—adopted by World Health Assembly (WHA).

- Forty-nine percent of countries do not have enough nutrition data to deter- mine if they are on or off course for meeting the global WHA targets.

1.1.11. Molecular aspect of nutrition: Nutrients have the ability to interact with the genome and to alter gene expression, which in turn can affect normal growth, health and disease. To understand how nutrients interact with the genome; this aspect of nutritional science is known as molecular nutrition or nutrigenomics. Some important research to investigate molecular aspect of nutrition, examine how the genome influences the response to nutrients. The human genome project has provided an enormous amount of genetic information and thus a greater understanding of our genetic background. Molecular nutrition looks at the relationship between the human genome and nutrition from two perspectives. First, the genome determines every individuals genotype (or genetic background), which in turn can determine their nutrient state, metabolic response and/or genetic predisposition to disease. Secondly, nutrients have ability to interact with genome and alter gene expression. But gene expression is only the first stage of the whole body or metabolic response to a nutrient and a number of post translational events (e.g. enzyme activity, protein half-life, co-activators, co-repressors) can also modify the ability of nutrients to alter an individual’s phenotype. The principle aim of molecular nutrition is to understand how the genome interacts with nutrition and nutrition related disease, it attempts to determine nutrients that enhance the expression of the genes, proteins and metabolic pathways that are associated with health and suppress those that predispose to disease. It is unrealistic to assume that nutrition can overcome our genetic fate; good nutrition can improve health and quality of life. It is essential that extend our understanding of the molecular interaction between the genome and nutrition and therefore have a great understanding of molecular relationship between diet, health and disease.

1.1.12: 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. Anthropometry is an essential component of child health supervision and the epidemiological assessment of the nutritional status of a defined population. Anthropometry, as a scientific discipline, however, began with Johann Friedrich Blumenbanch (1752-1852) (Sihgh and Bhasin, 2004). Anthropometric measurements, such as weight, height, circumferences and skinfolds are commonly used to assess the nutritional status of both child and adults.

World Health Organization (1995) has recommended that anthropometry could be used to assess nutritional and health status of both children and adults. It is the single most portable, universally acceptable method to assess the size, proportions and composition of the human body (WHO, 1995). It has been recognized as one of the most fundamental practical 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). These are the measurements of variations of physical dimensions and gross composition of the human body at different age levels and degrees of nutrition (Jelliffe, 1996).

1.1.13: Anthropometric Studies in India:

Earliest available record of anthropometric study in India is of Shortt, who measure the several Indian population of south India. The result published jointly by J. Shortt and Col. Ouchterlony (1868) in “an account of the tribes of Neilgirries (Madras)”. W. Elliot (1869) is one of the pioneers of anthropometric investigations in India. Anthropometric studies in India were initiated by Von Ujfalvy (1879-1884), the distinguished human geneticists and anthropologist in the late nineteen century, who for the first time carried out the investigation in Kashmir and West Himalayan region. The result of the investigation published in two well-known works, Aus-den West Himalaya and les Aryens-Hind old- Kouch in 1884 and 1886 respectively.

Major anthropometric investigation in India was, however, mostly confined to non-tribal population. The tribal elements which constitute the sub-stratum of the Indian populations has been subject of very few such survey. Scientific anthropometry was introduced at large scale in India in the 1890 in connection with Ethnographic Survey of Bengal. Sir H.H. Risely (1891) published the anthropometric materials entitled 'The study of Ethnography in India' a summary report of the measurements of few characters of tribes and castes of Bengal, United province, Agra, Oudh and Punjab. The investigation had been carried out in accordance with the scheme approved by Late William Flower of British Museum and prof. Topinad of Paris. Topinad's instruments and techniques were consideration for this investigation. Analysis of these data rendered it possible to distinguish three main types which named provisionally Aryan, Dravidian and Mongolian. E. Thurston during 1896 to 1909, Von E. Eickstedt from 1920 to 1936, R. Biasutti 1925 contributed valuable anthropometric data on different Indian communities.

After independence the Anthropological Survey of India initiated an All India Anthropometric Survey in the year 1961. This survey covered several thousand people from the various states and union territories. So far anthropometric data on Andhra Pradesh, Andaman Island, Assam, Bihar, Gujrat, Himachal Pradesh, Jammu and Kashmir, Maharashtra, Madhya Pradesh, Orissa, Karnataka, Tamil Nadu, Uttar Pradesh and of South zone and North zone have been published.

1.1.14: Body Mass index (BMI):

Body Mass Index (BMI) is also widespread as Quetelet's index, which is body weight (in kg) divided by height (in m^2) (Keys et al, 1972). Better known as body mass index (BMI), this measure was an attempt by the 19^{th} 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 nutritional status of a population in both developed and developing countries. Cole et al (2007) has recommended that anthropometry could be used to assess the nutritional and health status of the children age and sex specific. 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). Although there are several methods available to assess nutritional status, only a few of them are suitable in large-scale epidemiological survey. 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 bothdevoloped and developing countries (Bharati, 1989; Osmani, 1992; Naidu and Rao, 1994; Cornu et al., 1995, Reddy, 1998; Martikainen and Marmot, 1999). BMI is generally considered a good indicator of not only the nutritional status but also the socio-economic condition of a population, especially adult population of developing countries (Ferro-Luzzi et at, 1992; Shetty and Jmaes, 1994; Nube et al 1998; Mosha, 2003).

1.1.15. 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 define 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).

1.1.16. Body Composition: Body composition is the “makeup of the body in terms of the absolute and relative amount of adipose tissue, muscle mass, skeletal mass internal organ and other tissues” (Bogin, 1999). According to Misra and Ganda (2007) body composition is an important factor in identifying population at risk of metabolic disease including type-2 diabetes in South Asian children. 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, lung, liver, spleen, kidneys, intestines, muscles and lipid-rich tissue throughout the central nervous system is called essential fat, whereas fat that accumulates in adipose tissue is called storage fat. Essential fat 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 pratical methods of measuring body composition include skinfolds, circumference (girth) measures, hydrostatic weighing, bioelectrical impedance and near-infrared interactance (Kravitz& Heyward, 1992). Most pratical 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 (subscutaneous fat) thickness at specific sites of the body (Kravitz& Heyward, 1992). There is considerable biological variation in the distribution of subscutaneous, intermascular, 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. Currently it is the most widely adopted field method for measurement of body fat in children (Heyward &Stolarczyk, 1996; Heyward, 2006). 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).

1.1.17: Percent body fat the obesity epidemic, at one time confined to adults, has now penetrated the pediatric age range and shows every sign of a rapid escalation (Lobstein et al., 2004, Royal College of physicians, 2004). 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). Measurement of body composition in South Asian children is therefore likely to be important in identifying groups and individuals at risk of metabolic disease including type-2 diabetes. 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 group 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.

1.2. Background: Occupational safety and health (OSH) is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goal of all occupational safety and health programs is directed toward fostering a safe work environment (Joshi 2011). OSH is a science of anticipation recognition, evaluation and control of hazards arising in or from the workplace which could impair the health and wellbeing workers or which impacts the surrounding communities and the environment (Pun 2011).

Brick industry is one of the oldest industries in India. Architectural masterpieces had been built in the past with bricks and stones. Almost all type of construction work requires bricks in it. Brick is used in the construction of building, infrastructure, dams and houses. The word ‘brick’ was originated from late middle English from middle low German, Middle Dutch ‘bricke’, probably reinforced by Old French ‘brique’, of unknown origin or ‘briquette’, which means a block of compressed coal dust or pest used as fuel (Kahkoen and Lintukangas, 2012). Brick kiln workers perform several types of strenuous activities such as cutting the mud with a sped, carrying the mud, preparation of clay, carrying the clay, molding, stacking (loading and unloading the bricks), carrying the bricks (green and burn bricks), and burning the bricks in kiln. During this process, brick kiln workers have to face a lot of problems. For instance, molders are directly exposed to dust which contains a mixture of inorganic compounds including free silica, iron oxide etc. On the other hand, brick kiln workers (firemen) have to face very high temperatures along with more proximal exposure to smoke and toxic gases like sulfur dioxide, hydrogen sulfide, carbon dioxide and carbon monoxide, as well as particulate air pollutants while burning biomass fuels (Shaikh et al, 2012). In India, occupational health problems are gaining momentum. Assessment of occupational health problem is one of the common fields of study in ergonomics (Das, 2014). Adverse environmental and physical conditions affect the health status of brick field workers who perform other types of activities, e.g. they have to walk on a hot surface (top of the furnace) while monitoring and regulating the fire. Physiological responses to such activities mainly involve the musculoskeletal and cardiovascular systems. Since, the environment is unfriendly; it hinders excess heat elimination by the circulatory system, making the heart work harder to transport energy to the muscles for a successful completion of the job. An increase in age concurrently deteriorates the functional capacity (Garg, 1997).

The brick kiln sector is particularly vulnerable to forced and bonded labour due to the employment of a workforce that has predominantly migrated internally, the majority whom are from socially excluded and economically marginalized communities, the widespread use of large advances and loans to secure and control workers, exploitative recruitment practices, and a piece rate wage system which treats the entire family as the wage unit rather than each individual worker therefore resulting in extremely low wages. This is combined with a failure by the Government to implement relevant laws and prosecute offenders, a lack of sustained action targeting the root causes of bonded labour, proposed changes to laws which would heighten vulnerability and an environment in which workers experience threats and violence when seeking to organize and act collectively. It is estimated that there at least 100,000 functioning brick kilns in India. The National Sample Survey Organization (NSSO) estimated that in 2009-2010, brick kilns employed more than 5 per cent of India’s 460 million workers; which would equate to more than 23 million brick kiln workers. Several sources believe the actual number employed in brick kilns to be significantly higher. Many of India’s brick kiln workers have migrated internally from the poorer states in India, and are predominantly from groups that are commonly discriminated against such as Dalits, other low castes and indigenous groups, making them easier to exploit.

Each year, labour contractors (or brokers) secure the employment of workers through the use of the payment of an advance or loan. In the brick kiln, the worker will labour against the advance that he has taken. The verbal agreement is made with the male worker. The remuneration for most activities in a brick kiln is on a piece rate basis (paid per brick). Brick kiln workers do not receive a regular wage, since their earnings service the debt. Instead, they receive a weekly or fortnightly payment for food and other necessities which is added to their debt. At the end of the brick making season, their earnings are calculated and adjusted against the amount of advance taken and total received for expenses. Workers usually have no idea until the end of the season how much they are entitled to receive, or if they still owe the brick kiln owner. Although required under the law, there is often no employment records maintained and there is no transparent and verifiable process of wage determination and wage settlement against advances. If the advance payment is not considered by the employer to have been cleared, the worker will be tied to return to the same brick kiln the following season. As they often take new loans to clear past debts, many workers remain in perpetual bondage. The working and living conditions in brick kilns can be extremely harsh. The average working day consists of 15-16 hours. As workers usually live within the kiln, there are high levels of hazardous substances such as arsenic, burnt plastic and dust. Workers, including children, are frequently injured at work.

The history of brick industry in the district is very older in nature. During the Nawab era several structure like Hazarduri, Imanbari, Mitimasjid and a number of Raj palace are made by the thermal brick in 17th century. The king use to deep pond or large pond to protect their kingdom from outside attacks and on the other hand it was source of large amount of fish and water for boating. Now the size and width of the bricks are changed but, the pattern of bricking still remain same. So, the people of the district very much familiar with the brick making industry but the only differences is that during that period the industry or brick making was only concern with the domestic use but, in present time the major shift in the brick industry as commercial sectors has come into existence after 1980-90s. At 1980-90 there few industrial units functioning across the district. After 1990 the steady growth of brick industry are observed in various part of the district. The statistics has shown that the real growth of brick industry in the district is taken place during the period of 200 to 2010. There are four hundred and twenty-six (426) brick kilns all over the district (Govt W.B, DL&LRO, 2010-12). In India the brick-kiln is one of the important sectors of informal economy and plays a major role in development activity. Now, there 50,000 brick kilns all over India, employing on an average 100 workers (Prayas, 2004). The district's economy is primarily dependent on agriculture and 80% of the population is directly involved in agriculture. But brick making industry as an informal sector of economy has experience tremendous growth in recent past. This has radically changed the socio-economic environment and occupation structure. Most of the workers of brick industry constitute one of the poorest and weaker sections of the rural society. They are fall in the category of landless to small farmers who combined self-cultivation with income from wage labour and seasonal migrant labourers. Both of the categories are net buyers of food and dependent on wages labour for the major share of their yearly income.

The latest report of national sample survey organization (NSSO May 2011) about the casual workers in India between 2004-2005 and 2009-2010 compared to that of the period between 1999-2000 and 2005-2005 very clearly shows that there is significant increase in the number of casual workers and decline in the number of regular workers. Social security was first officially recognized in 1919 by the International Labor Organization (ILO) which stressed on the need and protection of the workers against sickness, disease and injury. At that time the General Assembly of the United Nation adopting the Universal Declaration of Human Right (UDHR), which states that every members of the society has right to social security.

In India, the unorganized workers social security Act was passed in 2008. The social security board for unorganized workers constituted in August 2009, but limited to an advisory role and does not have sufficient powers to implement, monitor or enforced social security. Though some of the labor laws are applicable but, they are violated in the brick field area and the workers remain unprotected, insecure and unorganized.

The Present study: In view if this, present investigation studied the prevalence of undernutrition and body composition among the adult male brick kiln workers of

Murshidabad District of West Bengal. Present study also reviews available paper to determine the comparative prevalence of undernutrition widespread among the brick kiln workers of India and abroad. The anthropometric assessment of nutritional status and body composition was also undertaken. The well-established anthropometric measures of nutritional status among adult (viz, MUAC, BMI and PBF) and their recognized cut off values were also assessed. The relationship of house type, education, monthly family income (MFI), type of work, duration of work, food habit, drink alcohol, tobacco chewing, and smoking habit with anthropometry and nutritional status were also studied. In this study BMI, MUAC, WHR, CI AND PBF were considered to be key anthropometric measures (outcomes variables) to be studied in relation with the others. Anthropometric measures of adult malnutrition rely on height, weight, circumferences and skinfold thickness.

Assessment of occupational health problems is one of the common fields of ergonomics. Health of the brick kiln workers was highly affected due to working in unhealthy working conditions for a long period of time (Das; 2014). Brick kiln workers perform several types of strenuous activities such as cutting the mud with a sped, carrying the mud, preparation of clay, carrying the clay, molding, stacking (loading and unloading the bricks), carrying the bricks (green and burn bricks), and burning the bricks in kiln. During this process, brick kiln workers have to face a lot of problems. For instance, molders are directly exposed to dust which contains a mixture of inorganic compounds including free silica, iron oxide etc. On the other hand, brick kiln workers (firemen) have to face very high temperatures along with more proximal exposure to smoke and toxic gases like sulfur dioxide, hydrogen sulfide, carbon dioxide and carbon monoxide, as well as particulate air pollutants while burning biomass fuels (Shaik et al; 2012). Brick kilns employment to nearly 12 million people in different sub-occupations (Budhwar et al; 2003). The combustion of coal leads to serious environmental pollution and health problems. Several studies, shown that brick industries causes air pollution and land degradation besides decreasing herb density and causing nutrient disorders in plants/animals in immediate vicinity (Bhanarkar et al, 2002, Pangety et al; 2004, Dwivedi&Tripathi; 2004). Several studies has been pointed out that brick industries workers are prone to respiratory disease such as silicosis, pneumonocosis and musculoskeletal disorders (Hai et al; 2001, Zuskin et al; 1998, Trevelyan &Haslam; 2001). Brick kilns have been shown to affect ground water quality due to leaching of substances (Datta et al; 1996).

Assessment of occupational health problems is one of the common fields in study of ergonomics. The industry has an annual turnover of more than 10000 corers and it is one of the largest employment generating industries (Khan & Vyas, 2008). In many developed countries some mechanization has been introduced but in India the conditions have not improved and human drudgery still prevails. Several studies showed that the workers working in the brick manufacturing units suffered from musculoskeletal problems due to awkward working postures (Heuer et al, 1996; Chung &kee, 2000; Trevelyan &Haslani, 2001). Brick workers are known for poor health and poor access to health care. The brick-kiln workers are living in poor environment adjoining brick making units. They have poor access to health care. They are at risk of various types of illnesses. Work related illnesses are very common among the brick-kiln workers (Mehta, 2010) leading to loss of job and earning.

Emission from brick kilns comprises of fine dust particles, hydrocarbons, Sulphur Dioxide (SO2), Oxides of Nitrogen (NOx), Fluoride compounds, Carbon Monoxide (CO) and small amount of carcinogenic dioxins if rubber tyres were used as fuel. Clay dust contains a mixture of inorganic compounds including free silica, iron oxide, lime, magnesium carbonate, alkalis, calcium carbonate, calcium sulfate, and sodium chloride and varying amounts of organic materials (Joshi et al., 2008). Generally speaking, Myer et al., (1989) found that work conditions in brick kilns were rather dusty with much pollution from coal fires in the kilns and from clay used for bricks making. In addition, they are exposed to high concentration of dust during manual breaking of coal. There is also the risk of exposure to dust (from bottom ash spread on the kiln) .They are also exposed to high concentrations of repairable suspended particulate matters (RSPM), during monitoring and regulating the fire, as the furnace chamber is covered with ash (Monga et al., 2012), also, during the kiln unloading and shipping process (Spies and Naicker, 2006). Inhalation of even relatively low concentrations of fine particles could affect lung function and lead to increases in cardiovascular and respiratory diseases.

Higher amount of CO, which is produced in these kilns due to poor kiln design that results in incomplete combustion of coal, could also increase incidence of heart disease. Epidemiological studies done in different places around the world have found the evidence that increase in rate of bronchitis, asthma, decreased lung function, pharyngitis, cough, eye irritation, fibrosis, emphysema, allergic rhinitis, low birth weight are linked with deteriorating ambient air quality in brick kilns (Joshi et al., 2008). The household living around the brick kiln reported the respiratory problems, pulmonary disorder, tuberculosis, asthma, malaria, diarrhea and jaundice during rainy season (Singh 2002). The fine particulates and dust enter into the human body through the respiratory system and long run it is cause of lung cancer and skin cancer (Mohan, 2008; Ramaswamy, 2010 &Sapkale, 2011).

Poor nutritional status, in turn contributes to an array of morbidities and mortality (Pollitt et al 1996) offer a similar formulation. In addition, they present evidence that poor nutritional status affects brain growth both pre and post natal. Socio-economic status (SES) is one of the most commonly studied creates in the bio-social sciences. Several ways of determining SES have been proposed, but most comprise in biological anthropological study are some quantification of family income, family members, education and occupational status. Research shows that SES is associated with a wide array of health, cognitive and socio-emotional outcomes of both children and adult, with effects beginning prior to birth and continuing into adulthood. So, information on house type, education, food habit, smoking, family income, family member, duration of work, type of work in brick kiln area and other occupation are also taken for the better understanding of the impact of overall biological and socioeconomic variables on the nutritional status of the brick kiln workers from Murshidabad district.

1.3: Objectives of the study:

1. To study anthropometric variation and body composition characteristics of the brick-kiln workers.

2. To understand the heath scenario with the help of nutritional status and morbidity pattern among the brick-kiln workers.

3. To study the socio-economic and lifestyle patterns of the brick-kiln workers.

4. Whether nutritional status of the worker depends on their socio-economic status.

5. Comparison the nutritional status within different work groups in brick-kiln area.

CHAPTER- II

REVIEW OF LITERATURE

CHAPTER- II

Review of Literature

2.1: International study.

Undernutrition is a nutritional anomaly just opposite to over-nutrition, and it is more relevant and a major public health concern in developing countries (Launer and Harris 1996, Chilima et al. 1998). Although, under-nourishment in children, especially in rural and socio-economically marginalized areas, is a very important issue, the need to assess this in adults is considered to be of particular importance, because it is this age group which is primarily responsible for the economic support of the rest of the population (WHO 1995).

Under-nutrition affects mostly the body weight in adults. The term 'under-weight' in adults refers to low body weight relative to height and generally expressed in terms of BMI (WHO 1995). In 1988, the International Dietary Energy Consultative Group defined the degrees of under-weight in adults as 'Chronic Energy Deficiency' (CED), categorized on the basis of BMI (James et al. 1988, Ferro-Luzzi et al.1992). Excepting BMI, another measurement i.e., MUAC has also been proved to be a good assessor of CED (James et al. 1994).

World Health Organization (WHO 1995), published a technical report of an expert committee involving more than 100 experts worldwide on the use and interpretations of anthropometry. It provided 'a framework and context for the present and future uses and interpretation of anthropometry' as the 'single most universally applicable, inexpensive and non-invasive method available to assess size, proportion and composition of human body'. It recognized and recommended the use of anthropometry to predict performance, health and survival. The report covered applications of anthropometry from infancy to old age. The report also recommended standard international cut off values of body mass index for identifying various nutritional status, viz., CED, overweight and different grades of obesity.

A cross sectional study was conducted among the adult male (173) brick-kiln workers in MitGhamar district in Dakahlia Governorate Egypt (Sheta&Laithy 2013). This study showed that brick kilns workers have significant increase of chronic respiratory problems in the brick kiln workers ≥ 10 years' work duration was detected compared to the workers 5-10 years, common chronic respiratory symptoms among them were chronic cough followed by dyspnea, chest wheeze, chronic bronchitis and asthma. Moreover 39.91% of brick kilns workers were complaining of more than one respiratory symptom.

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).

Body mass index and different grades of it (NS) were studied among the adult male in the Riyadh Region-Saudi Arabia. The urban and rural subjects were compared with reference to their dietary intake. Strikingly, the mean BMI and the prevalence of obesity were higher in the rural group than in the urban! However, the sample size was small, 85 in each residential group (Al-Assaf and Al-Numair 2007).

Studies have shown that the prevalence of low BMI is higher in the low SES groups (Ferro-Luzzi et al 1992). Some studies in India also have found association of low SES with smaller body size, and poor nutrition (Bharati 1989) and fatness (Sanjeev 1991). Studies in the developed World showed inverse relationship between BMI values and social status (class) (Seidell et al 1995, Bielicki et al 2000, 2001). But it is very interesting to also find co-existence of both under-nutrition and obesity in the low SES group of the developing World (Sawaya et al 1995, Mishra et al 2001). Thus, it is specially interesting and essential to study the etiology of this co- existence of both the ends of malnutrition in the low SES groups of the developing countries like India.

The relationship between BMI and SES has been studied in both developed and developing countries, including the Latin America. In a review work, Sobal and Stunkard

(1989) established a negative association between BMI and SES in developed countries. This was reaffirmed by McLaren (2007). BMI and SES were inversely related in Mexico, a relatively wealthy Latin American nation (Barquera et al 2003). In developing countries, however, a positive relationship was observed in various studies (Sobal and Stunkard 1989, Nagata et al 2009). 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). In developing countries experiencing economic transition in terms of increasing per capita gross national product (GNP), for example, the positive association between SES and BMI becomes less clear. In a review, Monteiro et al (2004) found the differences between the association between obesity and SES was due to 'gender' and the per capita GNP. Although a positive relationship between obesity and SES was found among men, an inverse relationship among the woman was reported in the same population (Monteiro et al 2004). In addition this study identified a general trend of shift of the burden of overweight and obesity towards the lower SES populations within a country as per capita GNP increased. 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. For example, in Mexico, low-income sub-populations demonstrate a positive association between BMI and SES, which is different from the national Mexican trend (Fernald 2007). These findings warrant more study in the sub-sections of the general populations in a country like India, in particular, in the urban areas where socio-economic disparities are more profound.

Delpeuch et al (1994) presented a study based on representative samples from various urban and rural situations of Congo. They concluded that the prevalence of low BMI was clearly linked with the low SES and was particularly sensitive to economic changes over time.

Ge et al (1994) studied the BMI of the Chinese adults with data from 1982 China Nationwide Nutrition Survey (CNS – 82) and the 1989 China Health and Nutrition Survey (CHNS – 89). Increased income was associated with reduced prevalence of low

BMI in the urban sample while, for the rural and overall samples, the opposite was found for obesity.

Nube et al (1998), based on their study on adults in Ghana, found that at the individual level, BMI showed a significantly positive relation with the variables of standard of living. The correlation between BMI and the mean per capita income was as high as 0.86. They concluded that information on adult BMI (mean and distribution) could be used for assessing differences in standard of living between population groups.

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.

There is a vast ocean of publications based on studies with regard to high BMI, overweight and obesity related morbidity and mortality. In most of these studies, diagnosed illness was considered to be as morbidity. But there are also very few studies which also addressed mortality and morbidity related to the lower end of BMI values (including CED) (Lew 1979, Waller 1984, Harres et al 1984, Henry 1990, Khongsdier 2002). Again, a very few of them has utilized data on self reported morbidity (SRM) (Khongsdier 2002).

Relationship between morbidity and malnourishment, though less studied, also found interest in some studies. James et al (1988), in a study in Bangladesh, suggested that morbidity rates among adult males increased when BMI values were < 17.0 kg/m^2.

Garcia and Kennedy (1994), using probit analysis of data collected by IFFRI and the World Bank from four developing countries, viz., Philippines, Kenya, Pakistan and Ghana, observed that there were small but significant effect of low BMI on proneness to morbidity in Pakistan and Kenya, but not in the other two countries. The threshold at which morbidity begins to rise is not consistent with the suggested BMI cut of 18.5 kg/m^2. The cut off was meaningful only in the case of Pakistan.

Strickland and Ulijaszek (1993), in a cross sectional study of 447 men and 564 women aged > 18 years of the Iban tribe of rural Sarawak, showed that the symptoms of self-reported illness had a negative association with BMI.

A study from Brazil (De Vasconcellos 1994) indicated that there was amarked increase in morbidity among adult individuals with BMI <18.5 kg/m^2. The study demonstrated a U-shaped morbidity curve similar to that of the mortality curve of BMI in Western populations. The thin as well as the obese people had a greater probability of being in bed due to illness than the individuals with normal BMI.

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.

Although, BMI is a very dependable and established indicator of NS in population, some studies also indicate that it is more important to use more precise indicators of fatness (e.g., PBF) because it is the actual storage of excess energy (van Itallie 1990). Studies have found that prevalence of obesity according to PBF was more than twice that estimated by BMI in Indians (Dudeja et al 2001). It has been observed a higher PBF at a comparatively low BMI among Indians and other Asian population (Wang et al 1994). It has been also noticed that the relationship between BMI and PBF differs between ethnic groups (Wang et al 1994, Norgan 1994, Swinberg 1996, Gallagher et al 2000) and even within an ethnic group (Deurenberg-Yap et al 1998).

Recent evidences also show that underweight and overweight co-exist in close proximity (Doak et al 2000, Delpeuch and Maire 1997). The relationships between BMI and other measures of regional adiposity were studied mostly in higher socio-economic groups (SG) (Wardle et al 1996, Wellens et al 1996, Lear et al 2003). Thus, it is not clearly evident whether the relationship between BMI and other adiposity measures remains identical or not in lower SGs. Thus, it seems to be of great interest to study the relationship between BMI and other measures of fatness or fat distribution in various nutritional states, especially in low SES groups. It is also essential to examine the validity of BMI to assess NS and finding out new variables and their cut-off values in different populations in different situations (Deurenberg 2001, Dudeja et al 2001).

2.2: National level study:

In India also, there are many recent studies addressing adult nutritional status in terms of BMI. In an excellent study (Shukla et al 2002), the descriptive epidemiology of BMI was presented for an urban adult (aged ≥ 35 years) population in western India. In this cross sectional study, 40071 men and 59527 women were studied with reference to their age, Height (HT), weight (WT), BMI, educational status and tobacco use pattern. Age and sex specific values of anthropometric measure and grades of thinness and overweight were presented. The relative risks of thinness as well as overweight for different educational and smoking categories were also evaluated. The study revealed an equal prevalence of thinness and overweight in the urban area and their association with age, education and tobacco use.

A study was carried out by Prasad et al in 2016, among the brick industries workers, to assess the health status in selected area in Wardha district, Maharastra, India. From this study, we know that musculoskeletal problem, respiratory problem and weakness were the common problems among the brick-kiln workers.

Manoharan et al (2012) was conducted a research among the brick kiln workers of Jharkhand to estimate the risk factors in ergonomic processes in brick kilns workers using Fuzzy Logic. This paper present ergonomic approach for modeling the risk factors for better productivity without compromising or minimize the risk for transforming measured body data between various working postures in brick kiln.

I the year 2007 a survey was conducted by Khan and Vyas in Ujjian city to understand brick making process and impacts of bricks industries on river water, soil, vegetation and human health. This paper discusses the effect of the industries on the environment and human health and also suggests alternative sustainable strategies for the kiln process.

In the pubra block of Faizabad district in Uttar Pradesh in 2012 a study was done by Pandey and Vats among the brick kiln workers. This study discusses that majority of the workers were felling pain and discomfort in different body parts, specifically in neck, back, knee and elbow region. It was also observed that those workers worked continuously in awkward postured during certain raw brick making activities. Consequently they may suffer from discomfort in different part of the body. The same type of study was also conducted by Qutubuddin et al in 2013, among the brick kiln workers of North Karnataka, India.

A research was carried out during February to March 2011, among the brick kiln workers of sakwar village, Thane district , to asses socio-demographic, nutritional status, morbidity profile and working conditions and safety measures practiced at brick kiln (Shewate et al 2011). Majority of the workers were undernourished (44.6%) and 58.7% of workers complained of musculoskeletal problems. Maximum workers were not aware about safety measures and none was practicing such measures.

In a large multi-population study in the central India (Adak et al 2006), data on HT, WT, sitting height, BMI, cormic index, and NS (based on BMI) were presented of 11498 adult males aged 18-62 years, belonging to 38 populations. They also represented five major social groups, viz., scheduled castes (SC), scheduled tribes (ST), other backward castes (OBC), general castes (GC) and Muslims. The level of malnutrition was the lowest among the GCs followed by the SC and STs. The SCs were the worst sufferer.

Another study involving adult couples from 90 families from rural Maharashtra found that both men and women from farming households were thinner than who carried out other type of work. Women but not men were found to be significantly thinner in farming households which owned more land and milking animals, lived further from the main village and had a traditional joint family system (Barker et al 2006).

In a community-based study (Chhabra and Chhabra 2007) on 3428 healthy adult non-smoking subjects, the distribution of BMI and its determinants were investigated in the rural and urban areas of Delhi, India. BMI was found to be higher among the female, urban residents, and the higher income group.

Gautam, (2007), had carried out a study to investigate the type and extent of correlation between adult male BMI and socio-economic, cultural and bio-demographical variables using data from 11496 individuals from 38 districts of central India. From the study it was concluded that life expectancy was increased when adult male BMI increased.

In another study (Gautam 2008), the relationship between BMI and traditional occupation and adaptation process among adult males of Central India. The study involved 6663 adult males belonging to 22 caste groups. The prevalence of CED was found to be the highest among the wage labourers. The people within the same occupational group are more homogeneous than those from different occupational groups.

Bhasin and Jain (2007) attempted to study the nutritional status of scheduled tribes of Rajasthan, India, using BMI. It was a cross-sectional study of 2928 samples belonging to both adolescents and adult age groups (aged 8 years and above). The study indicated a high prevalence of undernutrition in both adolescents and adults.

Another extensive study in South India (Kusuma et al 2008) reported the prevalence of CED and its relationship to other central adiposity measures in low SES populations. Two ethnic groups from each area type of tribal, rural and urban areas were included involving 646 men and 640 women. Out of the clusters selected for the study, five were urban slums. A considerable portion of the population was found to be CED. The study concluded that adult undernutrition, as indicated by BMI, is spread to a considerable extent in populations belonging to low SES. Among males, the highest prevalence of CED was recorded in the Valmiki tribal group (72 %). Rural males, The CED prevalence in the urban slum males were 38% and 32.7%.

In another cross-sectional study (Bose et al 2006b) of 226 male Bathudis, a tribal population of Keonjhar District, Orissa, India, the age variations in anthropometric and body composition characteristics and the frequency of underweight were investigated. Significant negative age effect on most of the anthropometric and body composition variables and indices were recorded. It was also observed that with increasing age, there was an increase in the frequency of underweight individuals.

Bose et al (2006c) studied the adult Savar tribals of Keonjhar district, Orissa, India, to see the sexual dimorphism in mean BMI and the effect of age on BMI and nutritional status. A total of 600 (300 for each sex), aged 18 years and above, were included in the study. The prevalence of CED was found to be 38% and 49%, respectively, in men and women. Age was significantly negatively correlated with BMI in both sexes and the prevalence of CED increased significantly with age.

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 addition to the above-mentioned publications, mention may be made here of 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.

Sanjeev et al (1991) studied 651 adults (331 males and 330 females) aged 18-49 years, and of high and low SES from Chandigarh zone of North West India. The relationship between subcutaneous fatness, measures of body circumferences and SES were considered. The upper SES males had higher means for height, weight, all skinfolds, all circumferences, BMI, upper arm muscle circumference, WHR and sums of skinfolds. The difference in WHR was small.

In their study, Naidu and Rao (1994), showed that the mean BMI values were lower in landless agricultural labourers and also in households with low per capita income (PCI) compared with artisans and higher income groups, respectively. In these populations the occupation and PCI of the households were considered to be measures of poverty level by the authors.

Shukla et al (2002), in their study 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 in Delhi (Chhabra and Chhabra 2007), India, involvingd 3428 non-smoking adults, described the nutritional profile and quantifid the risk associated with the economic and demographic factors for both underweight and overweight. Three housing colonies, one each from the lower, middle and higher SES categories were selected from non-urban areas. The mean BMI was significantly higher in the higher income group than in the lowest one. The low and the middle income groups were 4.0 and 2.07

times more likely, respectively, to be underweight as compared with the high income group. The high and the middle-income groups, on the other hand were 5.61 and 3.73 times more likely to develop overweight and/or obesity, respectively, than the low-income group.

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).

Naidu and Rao (1994), based on rural data of the National Institute of Nutrition, India (NIN Report 1989-90), showed that the rate of mortality increased steadily from 12 per 1000 population in BMI class of >18.5 kg/m^2 to 33 per 1000 in grade III CED (BMI < 16.0 kg/m^2). They had also argued that a BMI of 18.0 rather than 18.5 would be more appropriate to distinguish CED. BMI <13.0 kg/m^2 in adult males and 11.0 kg/m^2 in adult females might be considered as the lowest threshold of mortality risk.

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. The present researcher, also investigated and tested the usefulness of another anthropometric parameter, MUAC, in identification of CED and related morbidity. This has not been attempted by any researchers till date.

As mentioned above, there were reported evidence of a ‘U’ shaped relationship between NS and morbidity in Indian populations as has been stated above. But there were also some strong evidence from a recent prospective study (Sauvaget et al 2008) that the upper categories of BMI did not show relationship with mortality. This finding was striking to scholars. It was suspected that the interaction of BMI and central obesity might have made the relationship different in the analysis of data by Sauvaget et al., 2008 (Adams and Subramanian 2008). Therefore, these contradictions in findings made the ways for more investigations in these directions involving body composition and central obesity.

Higher BMI is associated with central adiposity and higher WHR along with the non-communicable diseases that appear at lower BMI ranges in Indian population (Yajnik 2001).

2.3: State level study:

In 2014 a study was conducted at Alta village of Adisaptogram in Hooghly district, West Bengal, among the female brick kiln workers (Bagchi et al, 2014). This study was hypothesized that early emergence of PMS (pre-menopausal syndrome) among these worker who suffer from silent pain and muscle-skeletal disorders probably due to their work posture, working environment and related lifestyles.

Bharati et al (2007) investigated the nutritional status (BMI-based) of adult women in India (aged 15-49 years) with special emphasis on the prevalence of CED and obesity. 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.

Chakrabarty et al (2008) published an article based on database of the Anthropological Survey of India of adult males of major social groups in Orissa and Bihar states in India. The study included 11 scheduled castes (SC), 13 scheduled tribes (ST), 15 general (GC) and other castes and also the Muslims. The authors found that the SC and STs of Bihar have the highest percentage of CED (64.7 and 57.4%, respectively). The overall prevalence is lower in Orissa (49.1%) than in Bihar (54.6%).

A community base cross sectional and observational study was conducted in the brick kilns of periurban Kolkata along the eastern banks of the river Hooghly (Biswas et al, 2011). This study indicated that acute respiratory infections, improper immunization, socio-economic status and not practicing exclusive breast feeding, were significantly associated with under-nutrition.

A cross sectional study was conducted on 220 male brick field workers from 12 brick field, working in a selected brick field unit of Bhadrakali in Hooghly district, to determine the prevalence of musculoskeletal disorders, respiratory disorder and physiological stress (Das, 2014). Brick field workers suffered from pain especially in the lower back (98%), hands (93%), knee (86%), wrist (85%), shoulders (76%) and neck (65%). This study concludes that health of the brick field workers was highly affected due to working in unhealthy working conditions for a long period of time.

Another 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.

Ghosh and Bharati (2006) carried out one cross sectional study on 387 Munda (tribe) and 317 Pod (lower caste) adult males and females living in a peri urban area of Kolkata city, India, and belonging to low SES, to assess their nutritional status. Significantly higher CED rates were observed in Munda males and females. BMI decreased significantly with the increase of age among Munda males and females as well as Pod females but not in Pod males.

Datta Banik et al (2007) studied 305 (159 men and 146 women) adult Dhimals, a tribal population of Naxalbari, West Bengal, India to determine the anthropometric characteristics and prevalence of CED and compared the results with those from four other tribes of Eastern India: the Bathudis, Kora Mudis, Santals, and Savars. The overall prevalence of CED was very high (36.4%). The prevalence was significantly higher in women (46.4%) than in men (27.0%). However, in general, compared with other tribal people of eastern India except the Santals, adult Dhimals had better anthropometric and nutritional profiles.

Bose et al (2008) reported the anthropometric characteristics and nutritional status of adult male Lodha and Bhumij, two tribes of the Paschim Medinipur District, West Bengal. A total of 157 Lodha and 161 Bhumij adult (>18 years) men was investigated. Both Lodha (45.2%) as well as Bhumij (48.4%) males had similar high rates of chronic energy deficiency CED. According to the WHO classification of the public health problem of low BMI, the prevalence of CED was very high (≥40%) in both these groups, indicating a serious situation.

Bisai and Bose (2008) reviwed the existing published and unpublished work on the nutritional status (assessed by BMI) of adult tribal populations of West Bengal. This review provided strong evidence that, in general, tribal populations of West Bengal were experiencing serious or critical nutritional stress. Immediate appropriate nutritional intervention programs are needed for implementation among these ethnic groups.

Bisai et al (2008) investigated 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.

Datta Banik (2008) undertook a cross sectional study among 290 Oraon tribal men of Ranchi district in Jharkhand state of India. The author recorded a low mean BMI (18.9 kg/m^2) and a high frequency of CED (53.1%). Moreover, on the basis of MUAC cut off point (<23 cm), the rate of undernutrition was as high as 38.3%. Age had a significant negative association with both BMI and MUAC.

Bharati et al (2007), in their above-mentioned publication on 81,712 women (aged 15-49) from 26 states of India (NFHS-II data), took into consideration of the socio-economic variables. The educational status and standard of living had significant positive effects on the nutritional status of women. The prevalence of CED reduced and of overweight and obesity increased, respectively, with the increase in educational attainment, irrespective of their urban or rural residence. Even the increase in their husbands' education had the similar effects. The occupation had also a significant effect on the nutritional status. The rural manual labourers had the highest prevalence of CED, followed by agriculture, non-working and the professional, sales and services group. In the urban sector, however, the agriculture group had the highest frequency of CED. The prevalence also decreased as the standard of living index increased, in both urban and rural sectors. The prevalence of overweight and obesity also increased with the standard of living.

Gautam (2008), in his earlier mentioned study 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 study by Kusuma et al (2008) on the CED in some low SES populations of South India, also included 5 urban slums where the sample comprised of the Wadabalija (WB) and Settibalija (SB) castes, both of which had been declared by the Government of India as socially and economically backward. Among males, the rural Valmiki had the highest percentage of CED (73%). The urban WB and SB had 37.9% and 32.7% of CED, respectively. It is worth mentioning in the present context that the urban slum residents had higher CED prevalence than their respective rural counterparts. Among the females the highest CED was again observed in the Valmikis. But the rural urban difference was not evident in the WB women and the prevalence was higher in the rural SB women than in their urban counterpart.

A cross sectional 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. 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. The frequency of morbidity (24·6%) and hospitalization (11·9%) was lowest among normal BMI individuals. Morbidity was significantly higher among CED (48·2%) subjects compared with normal BMI individuals. Similarly, compared with normal BMI subjects, morbidity was higher (38·5%) among overweight subjects. Hospitalization was more common among CED subjects (16·1%) compared with normal BMI subjects. Similarly, the frequency of hospitalization was more among overweight individuals (15·4%). In conclusion, this study provided evidence that there were strong inter-relationships between BMI, CED, MFI and morbidity.

A cross sectional study was done by (Banarjee et al 1999), from the study, it has been observed a higher PBF at a comparatively low BMI among Indians and other Asian population (Dasgupta and Hazra 1999), also observed higher WC/WHR in relatively low BMI values in Bengalee population of Kolkata, W.B.. From various study we also noticed that the relationship between BMI and PBF differs between ethnic groups. There is only ono study (Ghosh and Bandyopadhyay 2007), till date, to find out the appropriate cut off point of BMI to determine obesity based on PBF in Bengalee 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.

CHAPTER – III

MATERIALS AND METHODS

CHAPTER – III

MATERIALS AND METHODS

3.1. The study area, population and boundary.

Murshidabad district is a district of West Bengal, in eastern India. Situated on the left bank of the river Ganges, the district is very fertile. Baharampur town is the headquarters of the district. It borders West Bengal's Malda district to the north, Jharkhand's Sahebganj district and Pakur district to the north-west, Birbhum to the west, Bardhaman to the south-west and Nadia district due south. The international border with Bangladesh Rajshahi Division is on the east.

According to the 2011 censusMurshidabad district has a population of 7,102,430, (District Census 2011) roughly equal to the nation of Bulgaria (Country Comparison Population 2011) or the US state of Washington (U.S Census Bureau 2011). This gives it a ranking of 9th in India out of a total of 640 (District Census 2011). The district has a population density of 1,334 inhabitants per square kilometre (3,460/sq mi) (District Census 2011). Its population growth rate over the decade 2001-2011 was 21.07%. Murshidabad has a sex ratio of 957 females for 1000 every male, and a literacy rate of 67.53% (District Census 2011).

The language of the district is Bengali. The dialect is more or less the same as spoken in south Bengal, with occasional local accents. Beside this Khotta language (A dialect of Hindi language mixed with Bengali words, largely spoken in Malda, Murshidabad and some parts of Birbhum) speaking people can be seen in the northern part of Murshidabad district. Especially from Farakka to Jangipur area such Khotta speaking people resides. They are from Muslim community and have got them into West Bengal OBC list because of their language distinction.

The district comprises two distinct regions separated by the Bhagirathi River. To the west lies the Rarh, a high, undulating continuation of the Chota Nagpur plateau. The eastern portion, the Bagri, is a fertile, low-lying alluvial tract, part of the Ganges Delta. The district is drained by the Bhagirathi and Jalangi rivers and their tributaries. Bhagirathi is a branch of the Ganges, and flows southwards from Farakka barrage where it originates from the Ganges. It flows southwards through the district and divides it into more or less equal halves. Most of the land is arable, and used as agricultural land. Commonly seen trees are Neem, Mango, and Jackfruit. Jowbona is a popular village near nowdathana and also called green village in West Bangal.

Murshidabad has a tropical wet-and-dry climate (Köppen climate classification). The annual mean temperature is approximately 27 °C; monthly mean temperatures range from 17 °C to 35 °C (approximate figures). Summers are hot and humid with temperatures in the low 30's and during dry spells the maximum temperatures often exceed 40 °C during May and June. Winter tends to last for only about two and a half months, with seasonal lows dipping to 9 °C – 11 °C between December and January. On an average, May is the hottest month with daily average temperatures ranging from a low of 27 °C to a maximum of 40 °C, while January the coldest month has temperatures varying from a low of 12 °C to a maximum of 23 °C. Often during early summer, dusty squalls followed by spells of thunderstorm or hailstorms and heavy rains cum ice sleets lash the district, bringing relief from the humid heat. These thunderstorms are convective in nature, and are locally known as Kalbaisakhi (AMS 2006). Rains brought by the Bay of Bengal branch of South-West monsoon lash the city between June and September and supplies the district with most of its annual rainfall of approx. 1,600 mm (62 in). The highest rainfall occurs during the monsoon in August approx. 300 mm (12 in). Floods are common during Monsoon, causing loss of life, destruction of property, and loss of crops.

Most of the people depend on agriculture for their livelihood. There are some silk farms and some weaving machines, but they are losing out fast against the modern industries. Murshidabad is famous for the high quality silk produced here Beedi industry is also there. Many of the India's major beedi companies are from this district. Trade and business are conducted primarily with Asansol, Burdwan and Kolkata. There were some discussions between India and Bangladesh to open an internal water transport link between Dhulian and Rajshahi but it has not materialized yet.In 2006 the Ministry of Panchayati Raj named Murshidabad one of the country's 250 most backward districts (out of a total of 640) (MPR 2009). It is one of the eleven districts in West Bengal currently receiving funds from the Backward Regions Grant Fund Programme (BRGF) (MPR 2009).

The district comprises five subdivisions: Barhampur, Domkol, Lalbag, Kandi and Jangipur. Other than municipality area, each subdivision contains community development blocks which in turn are divided into rural areas and census towns (WBDCO 2008). In total there are 29 urban units: 7 municipalities and 22 census towns. Baharampur and Kasim Bazar together form an urban agglomeration.

Barhampur consists of Baharampur municipality, Beldanga municipality, and five community development blocks: Berhampore, Beldanga I, Beldanga II, Hariharpara and Naoda. Domkol subdivision consists of four community development blocks: Domkal, Raninagar I, Raninagar II and Jalangi. Lalbag subdivision consists of Murshidabad municipality, Jiaganj-Azimganj municipality and five community development blocks: Murshidabad-Jiaganj, Bhagawangola I, Bhagawangola II, Lalgola and Nabagram. Kandi subdivision consists of Kandi municipality and five community development blocks: Kandi, Khargram, Burwan, Bharatpur I and Bharatpur II. Jangipur subdivision consists of Jangipur municipality, Dhulian municipality and seven community development blocks: Raghunathganj I, Raghunathganj II, Suti I, Suti II, Samserganj, Sagardighi and Farakka (Block & Gram Panchyat of W.B 2008). There are 26 police stations, 26 development blocks, 7 municipalities, 254 gram panchayats and 1937 villages in this district (Census of India 2001, Block & Gram Panchyat of W.B 2008), Murshidabad Govt Site 2008) .

For the present study, I have selected two community development blocks, Beldanga-I and Beldanga-II, under Beharampursubdivisioin.

Beldanga-I is a community development block that forms an administrative division in Barhampur subdivision of Murshidabad district in the Indianstate of West Bengal. Beldanga police station serves this block. Headquarters of this block is at Beldanga. It is located 16 km from Baharampur, the district headquarters.Beldanga is located at 23°56′N 88°15′E. Beldanga-I CD Block is bounded by Berhampore CD Block in the north, Hariharpara CD Block in the east, Beldanga II CD Block in the south and Nabagram CD Block, in the west (Murshidabad District Census 2011). Beldanga I CD Block has an area of 165.77 km^2 (Murshidabad Govt Statistical page).

As per 2011 Census of India Beldanga-I CD Block had a total population of 319,322, of which 310,470 were rural and 8,852 were urban. There were 164,147 (51%) males and 155,175 (49%) females. The population of those below 6 years was 50,070. Scheduled Castes numbered 12,621 and Scheduled Tribes numbered 252 (Murshidabad Govt website). As per 2001 census, Beldanga I block has a total population of 259,139, out of which 134,602 were males and 124,537 were females. Beldanga I block registered a population growth of 23.35 per cent during the 1991-2001 decade. Decadal growth for the district was 23.70 per cent (Murshidabad Govt Statistical page). Decadal growth in West Bengal was 17.84 per cent (W.B. Govt websie on Murshidabad District).

As per 2011 census the total number of literates in Beldanga I CD Block was 188,635 (70.06% of the population above 6 years) out of which 99,823 (53%) were males and 88,812 (47%) were females (Murshidabad Govt website). Bengali is the local language in these areas (Murshidabad District Census 2011). Beldanga I block is one of the areas where ground water is affected by arsenic contamination (MPR 2009).

Beldanga - II is a community development block that forms an administrative division in Barhampur subdivision of Murshidabad district in the state of West Bengal. Rejinagar police station serves this block. Headquarters of this block is at Shaktipur. It is located 31 km from Baharampur, the district headquarters.Rejinagar is located at 23°50′53″N 88°15′35″E. Beldanga - II CD Block is bounded by Beldanga I CD Block in the north, Naoda CD Block in the east, Kaliganj CD Block in Nadia district and Ketugram - II CD Block in Bardhaman district in the south and Bharatpur I and Bharatpur - II CD Blocks in the west (Murshidabad District Census 2011) . Beldanga - II CD Block has an area of 204.01 km^2(Murshidabad Govt Statistical page) . As per 2011 Census of India Beldanga - II CD Block had a total population of 250,458, all of which were rural. There were

129,144 (52%) males and 121,314 (48%) females. Population below 6 years was 34,837. Scheduled Castes numbered 20,863 and Scheduled Tribes numbered 541 (Murshidabad Govt website).

As per 2001 census, Beldanga - II block has a total population of 210,195, out of which 109,107 were males and 101,088 were females. Beldanga - II block registered a population growth of 19.21 per cent during the 1991-2001 decade. Decadal growth for the district was 23.70 per cent.[2]Decadal growth in West Bengal was 17.84 per cent (W.B. Govt websie on Murshidabad District).

As per 2011 census the total number of literates in Beldanga - II CD Block was 146,321 (67.86% of the population above 6 years) out of which 79,229 (54%) were males and 67,092 (46%) were females (Murshidabad Govt website).

Bengali is the local language in these areas (Murshidabad District Census 2011). Beldanga - II block is one of the areas where ground water is affected by arsenic contamination (Ministry of Panchayati Raj 2009).

3.2 The Subjects and the Sampling

On principle, ten brick-kilns 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 brick kiln association of Murshidabad district, manager and owner of the brick kilns were informed and convinced about the objective of the research. And, then the adult members of the brick kiln workers were informed and convinced about the objective of the research. An attempt was made to include in the sample all those adult males, 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 aged 18 years and above, were included to carry out the work. The brick fields were situated in a linear fashion one after another from one end to the other in the bank of Bhagirathi River and remote area of the blocks, mainly inside the villages. Each brick kiln was approached during field visits from one direction to another and the available adult male 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. Some brick kilns were visited twice or more for new enrollment of subjects. 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 boundary of brick kiln area 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 male members of each brick kilns unit were thus, sampled randomly.

In the above mentioned procedure, data were collected on 501 men belonging to the Bengalee ethnic group aged 18 and above.

3.3 Age groups

Subjects were classified into four age groups, each with a width of 10 years (except first group, width 12 years). The groups were 18-30, 31-40, 41-50, and >50 years.

Age in years	**Category**
18-30	I
31-40	II
41-50	III
>50	IV

3.4 Anthropometry and body composition

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 International – 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 circumferential anthropometric measures, millimeter unit was used for skinfold thickness. In the result section of this thesis it was followed strictly. But in the introduction, literature review and discussion chapters (including tables) of this thesis, the unit were kept in centimeter for an easy comparison with the results in the traditional unit of centimeter published by other workers. As those results are already published documents, the present author did not prefer to transform them into other units.

General measurements: Stature or height (cm), sitting height (cm), subischial height (cm) and body weight (kg)

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

Skinfolds (mm): Biceps (BSF), Triceps (TSF), Sub scapular (SSF), Suprailiac (SISF).

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 measurements and Indices: Total Body Water (TBW), Percent of Body Fat (PBF), Fat Mass (FM), Fat Free Mass (FFM), Mid-upper Arm Area (MUAA), Mid-upper Arm Muscle Area (MUAMA), Mid-upper Arm Fat Area (MUAFA) and Body Mass Index

(BMI), Fat Mass Index (FMI), Fat Free Mass Index (FFMI), Body Adiposity Index (BAI), Waist-Hip Ratio (WHR), Waist Height Ratio (WHTR), Conicity Index (CI), Body Mass Abdominal Index (BMAI).

3.4.2 Techniques of taking anthropometric measurements

Height (HT)

Height is a major indicator of general body size. It was measured to the nearest 1 mm using Martin’s anthropometer. The subject stood on a plain surface in bare feet. Keeping the subject on an erect posture the measurement was taken standing at his back. The anthropometer was placed at the back and between the heels of the subject, kept as close to the subject as possible. The position was checked before taking the measurements.

Sitting Height (STH)

The measurement of sitting height requires a table and an anthropometer. The table should be sufficiently high so that the subject’s legs hang freely. The subjects sit on the table with the legs hanging unsupported over the edge of the table. Sitting height is a measure of the distance from the sitting surface to the vertex. The subject sits as erect as possible with the head in the Frankfort horizontal plane. Firm pressure is applied to compress the hair. The measure should observe the level of the anthropometer blade. The measurement is recorded to the nearest 0.1 cm.

Sub-ischial Height (SIH)

Sub-ischial height or lower extremity length is the distance between the hip joint and the floor when the subjects erect. For the measurement of SIH requires an anthropometer. The measurement is recorded to the nearest 0.1 cm. lower extremity length is the useful in studies of proportion, performance and human engineering.

Body Weight (WT)

Weight is essential in calculation of BMI and body fat content. It was taken in kilogram's with minimum clothing and without shoes, by a conventional weighing machine. Body Weight was recorded to nearest 0.5 kg on the weighing scale.

Circumferences

Circumferences were measured in centimeter (cm) with a standard malleable tape with centimeter and millimeter gradations. The measurements were made to the nearest 1 mm. Circumferences are important measurements that record the size of cross-sectional and circumferential dimensions of the body. Four circumference measurements were taken:

Mid-Upper Arm Circumference (MUAC): The subject's arm hangs relaxed, just away his side, and the circumference was taken horizontally at the marked level. It was measured at a right angle to the long axis of the arm, at the same level as the arm skinfold.

Chest circumference (CC):

The measurement of chest circumference requires a highly flexible inelastic tape measure that is no more than 0.7 cm wide. The tape should be in light contact with the skin, without indenting it, but the tape may be away from the skin near the vertebral column. The skin should be free of perspiration, because this may increase friction between the skin and the tape. During the measurement, the subject stands erect in a natural manner, with the feet at shoulder width. The arms are abducted slightly to permit passage of the tape around the chest. The chest should be bare. Chest circumference is measured at the level of the fourth costosternal joints.

Minimum Waist Circumference (WC): Waist circumference is an indicator of the degree of masculine distribution of adipose tissue, when used in a ratio with the hip circumference. The subject was standing erect with arm at the sides and it was measured at the smallest circumference of the torso, which is at the level of the natural waist.

Hip Circumference (HC): Hip circumference is an indicator of lower body fatness and when used in a ratio with the waist circumference it is an indicator of the pattern of subcutaneous adipose tissue distribution. The subject stands erect with arms at the sides and the feet together. The tape was placed around the buttocks without compressing the skin.

Skin fold measurements

The skin fold measurements are very useful for understanding body composition, estimating amount of fat etc. Skin fold thicknesses are actually the thickness of double folds of skin and subcutaneous adipose tissue at particular sites on the body. Skin fold thickness can provide a useful technique for evaluating body fat. It was measured using a Holtain skin fold caliper (Holtain Ltd., UK). The skin fold is picked up between thumb and the caliper jaws applied at exactly the level marked. The measurement was read 2 seconds after the full pressure of the caliper jaws was applied to the skin fold. Skin fold measurements were taken at the following parts of the body: Biceps, Triceps, Sub-scapular and Supra-iliac.

Biceps Skinfold (BSF): The biceps skin fold is a measure of subcutaneous adipose tissue and skin thickness on the anterior aspect of the arm. In combination with other skin fold measurements, it is useful predictor of total body fat.

Triceps Skinfold (TSF): The triceps skinfold was measured in the midline of the posterior aspect of the arm, over the triceps muscle. The triceps skinfold is correlated with percentage of body fat and with total body fat.

Sub-Scapular Skinfold (SSF): The subject stands comfortably erect, with the upper extremities relaxed at the sides of the body. The Subscapular skinfold is picked up on a diagonal, inclined infero-laterally approximately 45 ^{0} to the horizontal plane in the natural cleavage lines of the skin. The site is just inferior-to-inferior angle of the scapula.

Supra-iliac skinfold (SISF): Supra-iliac skinfold thickness is commonly used as indices of body fatness together with other skinfold thickness. The subject stands in an erect position. The suprailiac skinfold was measured in the midaxilliary line immediately superior to the iliac crest.

3.4.3 Derived Measurements and their definition.

Total Body Water (TBW)

Total Body water was calculated using the Watson Formula (1980).

Total Body Water in male = 2.447- (0.09156 x Age in year) + (0.1074 x Height in cm) + (0.3362 x Body Weight in kg).

Percent Body Fat (PBF)

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

Where, Density = 1.1356-0.07 x $\log_{10}$ (BSF+TSF+SSF+SISF).

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)

Mid-upper Arm Area (MUAA)

Mid-upper arm area is an essential of the area of the upper arm. It was derived from the mid-upper arm circumference (MUAC).

MUAA = MUAC (mm)^2/ 4Π.

Mid-upper Arm Muscle Area (MUAMA)

The MUAMA is an estimation of the area of the bone and muscle portion of the upper arm. It is derived from using the following formula.

$$\text{MUAMA} = \frac{\{(\text{MUAC (mm)} - (\Pi \times \text{TSF (mm)} / 10)\}^2 - 10}{4\Pi}.$$

Mid-upper Arm Fat Area (MUAFA)

Mid-upper arm fat area is an estimation of the area of the far portion of the upper arm and is simply the difference between the mid-upper arm area (MUAA) and mid-upper arm muscle area (MUAMA).

MUAFA = (MUAA ------------ MUAMA).

Body Mass Index (BMI)

Body Mass Index is one of the measures of overall adiposity. It is calculated by dividing weight in kg by height (m)^2. The BMI was used to evaluate the nutritional status of the subjects (WHO 1995).

BMI = Weight (kg)/ Height (m)^2.

Body Adiposity Index (BAI)

Body Adiposity Index (BAI) is one among the attempts to identify the obesity of the human body by calculating the percentage of body fat using height and hip circumference.

BAI = Hip Circumference (cm)/ Height (m)$^{1.5}$------------- 18.

Arm Fat Index (AFI)

Arm Fat Index, a percentage of the arm that is fat. It is derived from the following formula.

AFI = 100 x MUAFA (mm^2)/ MUAA (mm^2)

MUAFA = Mid-upper arm fat area.

MUAA = Mid-upper arm area.

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 = Waist Circumference (cm)/ Hip Circumference (cm).

Waist Height Ratio (WHTR)

It is ratio, which indicates the central obesity. The amount of fat accumulated in the central or abdominal region of the body.

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

Conicity Index (CI)

CI = WC (cm) / (0.109) x √ [weight (kg)/height (m). (Flora et al 2009)

Body Mass Abdominal Index (BMAI)

The new index Body Mass Adiposity Index (BMAI) has been derived by combining two separate indices weight for height and waist for height ratio. The BMAI is mostly influenced by waist circumference which will mostly include fat component. Overweight and obese children are likely to stay obese into adulthood and more likely to develop non-communicable disease like diabetes and cardiovascular diseases at a younger age. Overweight and obesity, as well as their related diseases, are largely preventable. “Body Mass Abdominal Index” (BMAI) was proposed in an article (Kumar 2009).

BMAI = Weight/Height X Waist Circumference/Height

= Weight/ $(\text{Height})^2$ X Waist Circumference

= BMI X Waist Circumference

Where Weight is in kg and Height and Waist are in meters.

3.5 Assessment of Nutritional Status

Nutritional status was determined following World Health Organization (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 $\geq$ 25.0
Obese:	BMI $\geq$ 30.0

Nutritional status was also determined following the WHO (2000) guidelines for the Asia-Pacific populations. The following BMI (kg/m^2) cut offs 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 – 22.9
Overweight:	BMI 23.0 – 24.9
Obese:	BMI $\geq$25.0

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

The following internationally accepted cuts off values were used for central obesity for male.

	Value	Category
WHR	**≤0.90**	**Normal**
	>0.90	**Obese**
CI	**≤1.25**	**Normal**
	>1.25	**Obese**
WHTR	**≤0.50**	**Normal**
	>0.50	**Obese**

3.6 Socio-economic Variables:

3.6.1 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. 66 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 crosschecked with the other adult members, mostly with the spouses, where applicable, or with other adult members.

3.6.2 House types

House types were categorized according to the material by which walls were constructed. Two types of materials were found, namely, brick and bamboo fencing. Accordingly, they were classified here as brick-walled (*pucca*) and bamboo-fenced (*kuchha*), respectively. The roofs of all the houses were found covered with tiles, tin and concrete. Therefore, roof of the houses were considered in this study. If, the roof or the floor were found to make by brick or concrete they were classified as (pucca) or otherwise they were classified as (Kachha). 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.

3.6.3 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. One, who could clear the final year under-graduate examination, was recorded as ‘graduate’. Even, the unsuccessful ones were considered as passed ‘higher secondary’ examination. Individuals, who could not pass the masters examination, were classified as graduates.

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 12th up the appearance and being unsuccessful in graduation), graduate and above.

3.7 Type of worker in the brick kiln area.

Work type in the brick-kiln area.

Fireman, who controlled or checked the power system/temperature of the brick-kiln,

Rubbishman, who clean dust of the chamber of the brick kiln area

Beldar, who arranged the mud brick in the chamber before firing,.

Reza, who pick up the brick after firing from the chamber.

Patraman, who prepared the mud brick from soil.

Unskilled worker, who supervise the brick kiln area and others work of the brick kiln area.

3.8 Self-Reported Morbidity.

Information on morbidity was based on 'self-reported illness experience' of each subject as had been used in earlier studies without involvement of any clinical expert or physician (Strickland and Ulijaszek 1993, Garcia and Kennedy 1994, Strickland and Tuffrey 1997, Khongsdier 2002). 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. If an individual reported any illness during the last one month, he was termed as '*recently ill*' and if reported illness at any time during the last one year before the last month, was called '*previously ill*'.

3.9 General dietary practices and lifestyle patterns

A pilot study was undertaken to determine the most commonly eaten food items in the study area for a very short period before commencement of the actual survey. The result of this pilot study revealed that the following food items were eaten most commonly: egg, milk, fish, chicken, beef, mutton, *ghee* (clarified butter), butter, potato (in any form), fresh vegetables (except potato), fruits, Bengali sweets, and fried snacks. Information on the general pattern of consumption of these food items in a week was recorded using a **food frequency** questionnaire (FFQ) to see the dietary habits of the subjects. Although soft drink was not among the most commonly eaten items, it was added to the list to see the pattern of consumption of this non-traditional but popular delicacy among this low socio-economic group. Subjects were asked to mention the **number of times** they usually consumed particular food items **in a week**. The frequencies were recorded as 1 through 7 times, or more than 7 times.

On the basis of the criteria I have categories three groups of smoking habits, alcohol intake and tobacco chew.

Smoking Status	Criteria
Regular smoker	Smoke more than seven times in a week.
Occasional smoker	Smoke one to seven (1-7) times in a week.
Non-smoker	Never smoke.
Alcohol intake status	
Regular	Intake alcohol more than seven times in a week
Occasional	Intake alcohol one to seven (1-7) times in a week.
Never intake	Never intake alcohol
Tobacco-chew status	
Regular	Intake tobacco-chew more than times in a week.
Occasional	Intake tobacco-chew one to seven (1-7) times in a week.
Never intake	Never intake tobacco-chew.

3.10 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. The statistical tests were two-tailed; $p < 0.05$ was considered as statistically significant. Descriptive statistics for continuous variables were computed by mean, standard deviation (SD), and 25, 50 and

75 percentile values. The qualitative variables were described by percentage of their categories. Pearson correlation coefficients were calculated to show association between continuous variables, where necessary. Partial correlation analyses were also performed to see the associations of the central adiposity measures with BMI and PBF, after controlling the effect of age.

One-way analyses of variance (ANOVA) were performed to show differences in age, income, anthropometric, and body composition variables between more than one category of other variables, e.g., educational groups, income groups, etc. Sheffe's post-hoc comparisons were applied to compare between groups. As there was significant age difference between these groups, age was kept as a covariate in these analyses. Students' T-tests were undertaken to find out the significance of differences in continuous variables (e.g., age, MUAC, BMI, WC, etc.) between the binary categories of other parameters (e.g., house type, illness etc.). Chi-square statistics were also calculated to see the significance of differences on percentage distribution of categorical variables across the categories of other classified variables.

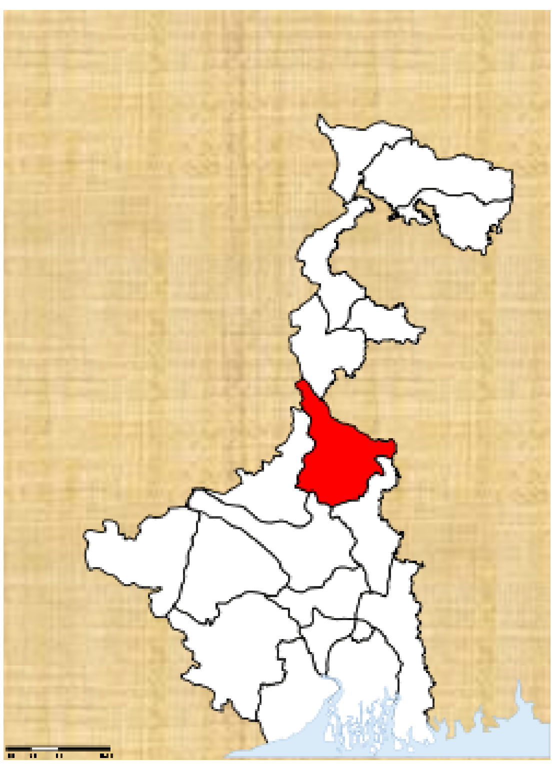
Linear regression analyses were undertaken to see the effect of age on BMI, MUAC and PBF. The procedure of 'curve estimation' in SPSS was followed to demonstrate linear and quadratic effects of age on BMI and MUAC. Linear and stepwise multiple regression analyses were run to see the independent and mutual relationships of the central adiposity measures with BMI. Sequential multiple regression analyses with the '*test*' command in SPSS *syntax* were undertaken to see the independent effects, if any, of different socio-economic status (e.g., income, education) and their different categories. This special technique in the software enables one not only to see the effect of each predictor variable, but also the separate effects of each category within every predictors, independent of the categories of other predictors in the model (Mascie-Taylor and Madsen 2001). Simple Liner regression analyses (LRA) were also utilized to estimate the relative effects of different anthropometric dimensions on age. For this purpose, Wald values for the measurements were compared. Nagelkerke R^2 values were also calculated to see relative explanatory power of the predictors.

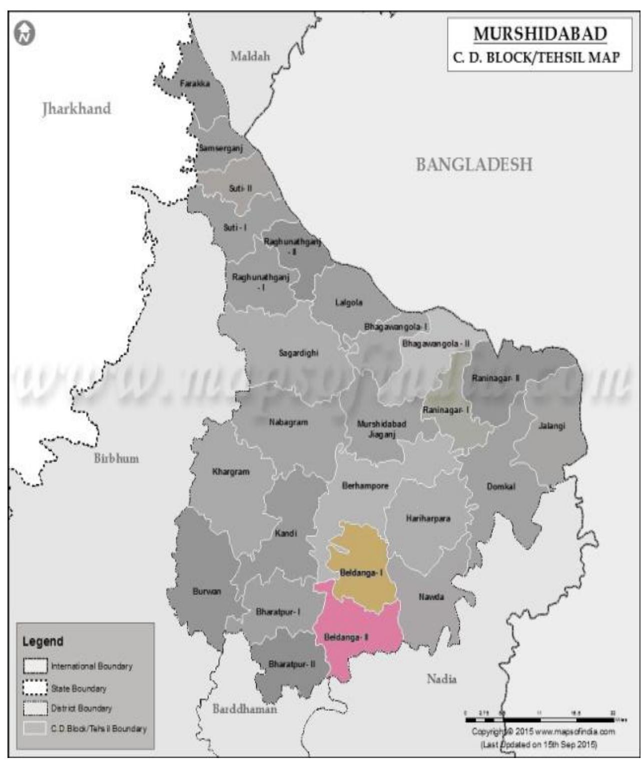
Figure (3.1): Showing the study area.

↑

MAP OF INDIA	
WEST BENGAL	MURSHIDABAD

↓ ↓





CHAPTER- IV

RESULT- I

ANTHROPOMETRIC AND BODY COMPOSITION CHARACTERISTICS OF THE SUBJECTS

CHAPTER- IV

Result- I

Anthropometric and body composition characteristics of the subjects.

4.1 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 4.1 presents the mean, SD and quartile values of HT, WT, STH, SIH, all circumference and all skin fold measurements. The mean (SD) height, weight, STH and SIH of the subjects were 163.84 (5.91) cm, 54.08 (7.19), 82.21 (3.30) and 81.62 (4.42) cm respectively. The mean (SD) MUAC, CC, WC and HPC respectively, were 24.55 (2.06) cm, 83.49 (5.08) cm, 75.95 (7.28) cm and 80.02 (5.18) cm. The mean (SD) for TSF, BSF, SSF, and SISF were 5.75 (2.97) mm, 3.66 (1.98) mm, 10.38 (5.46) mm and 7.07 (4.78) mm, respectively.

Table 4.2 presents the mean, SD and quartile values of derived variables. The mean (SD) BMI, TBW, PBF, FM, FFM, FMI, FFMI and BAI were 20.14 (2.38) kg/m^2, 34.88 (2.94) Lt, 11.13 (6.07) %, 6.32 (4.24) kg, 47.76 (4.62) kg, 2.35 (1.58) kg/m^2, 17.78 (1.32) kg/m^2 and 20.20 (2.66), respectively. The mean and SD value of MUAA, MUAMA, MUAFA and AFI were 772.69 (132.83) mm^2, 408.50 (56.76) mm^2, 364.19 (85.73) mm^2 and 46.78 (3.53), respectively. The mean and SD value of WHR, CI, WHTR and BMAI were 0.95 (0.05), 1.21 (0.07), 0.46 (0.04) and 15.43 (3.28), respectively.

The mean (SD) values of anthropometric variables for each age group are shown in table (4.3).From the table we found that, in case of WC HPC and sum of 4CM were statistical significant ($p<0.001$) differentiations among the four age group. The mean values of each variable were increased according to increase of ages. Statistical differentiations also found in SSF, Sum of 4SF ($P<0.01$) and SISF ($p<0.05$) among the age groups. The mean value of the SSF, sum of 4SF and SISF were also increased according to increase of their ages.

The mean (SD) values of derived variables of anthropometric characteristics for each age group are shown in table (4.4). Above analysis indicated that in case of TBW, BAI, WHR, CI, and WHTR were statistical significant ($p<0.001$) differentiations among the four age group. The mean values of each variable were increased according to increase of ages, except TBW, decreased mean value with the increased of age. In case of BMI and FFM the mean values of the variables according to increased age, though it were not statistically significant. Statistical differentiations also found in PBF, FM, FMI ($p<0.05$) and BMAI ($p<0.01$) among the above mention age categories. The mean value of the PBF, FM, FMI and BMAI, were also increased according to increase of their ages.

***Table*4.5** presents the Pearson correlation coefficients of the anthropometric variables with age and age squared. WC, HPC, SSF, sum of 4CM and sum of 4SF had significant positive correlation with age as well as age squared ($p<0.01$). CC had significant positive correlation with age ($p<0.05$) but not with age squared. SISF had significant positive correlation with age ($p<0.01$) but with age square ($p<0.05$). HT and SHT had negative correlation with age and age square, though it's statistically not significant.

Table (4.6) presents the correlation with age and age square. BAI, WHR, CI, WHTR and BMAI had significant positive correlations with both age and the age squared ($p<0.01$). In case of TBW had significant negative correlation with both age and age square ($p<0.01$). FM and FMI had significant positive correlation with age ($p<0.01$) and age square ($p<0.05$). FFM and FFMI had negative correlation with both age and age square, though it's statistically not significant. BMI did not show any correlation with both age and age squared.

From the table (4.7) we found that there was significant effect of age on WC, HPC ($p<0.001$), CC ($p<0.05$), SSF and SISF ($p<0.01$). Rest of the anthropometric variables have not effected by age. Table (4.1.8) simple liner regression analysis indicated that, there was significant effect on TBW, BAI, WHR, CI, WHTR, BMAI ($p<0.001$), PBF, FM and FMI (p<0.01). Others variables like, BMI, FFM, FFMI, MUAA, MUAMA, MUAFA and AFI were not affected by age.

Table (4.9) presents the Pearson correlation coefficients of the anthropometric variables with MUAC, WC, BMI and PBF. Except HT with BMI, PBF and SIH with MUAC,WC ,all anthropometric variables HT, WT, SHT, SIH, MUAC,CC, WC, HPC, TSF,BSF,SSF and SISF had significant positive correlation with age MUAC, WC, BMI and PBF (p<0.01), only negative correlation with SIH with BMI and PBF.

Table (4.10) presents the Pearson correlation coefficients of the derived variables of anthropometry variables with MUAC, WC, BMI and PBF. All the derived variables BMI, TBW, PBF, FM, FFM FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHRCI, WHTR and BMAI had significant positively correlation with MUAC, WC, BMI and PBF (p<0.01).

Summary

1. The mean values of WC, HPC and sum of 4CM were increased with the increased of age (p<0.001).The mean values of SSF, sum of 4SF (p<0.01) and SISF (P<0.05) were also increased with the increased of age. The mean values of each variables BAI, WHR, CI, WHTR (P<0.001), BMAI (P<0.01), PBF, FM, FMI (p<0.05) were increased according to increase of age, except TBW (p<0.001), decreased mean values with the increased of age.

2. WC, HPC, SSF, sum of 4CM and sum of 4SF had significant positive correlation with age as well as age squared (p<0.01). CC had significant positive correlation with age (p<0.05) but not with age squared. SISF had significant positive correlation with age (p<0.01) but with age square (p<0.05).

3. BAI, WHR, CI, WHTR and BMAI had significant positive correlations with both age and the age squared (p<0.01). In case of TBW had significant negative correlation with both age and age square (p<0.01). FM and FMI had significant positive correlation with age (p<0.01) and age square (p<0.05).

4. From the present study it was clear that, there was significant effect of age on WC, HPC ($p<0.001$), CC ($p<0.05$), SSF and SISF ($p<0.01$). Simple liner regression analysis indicated that, there was significant effect of age on TBW, BAI, WHR, CI, WHTR, BMAI ($p<0.001$), PBF, FM and FMI ($p<0.01$).

5. Pearson correlation coefficients of the anthropometric variables, HT, WT, SHT, SIH, MUAC,CC, WC, HPC, TSF,BSF,SSF and SISF had significant positive correlation with MUAC, WC, BMI and PBF ($p<0.01$), only negative correlation with SIH with BMI and PBF($p<0.01$). All the derived variables BMI, TBW, PBF, FM, FFM FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHRCI, WHTR and BMAI had significant positively correlation with MUAC, WC, BMI and PBF ($p<0.01$).

Table (4.1): Anthropometric characteristics of the studied population

Variables	Mean	SD	Percentiles		
			25	50	75
HT (cm)	163.84	5.91	160.00	163.30	168.20
WT (kg)	54.08	7.19	49.50	53.00	58.00
STH (cm)	82.21	3.30	80.30	82.20	84.45
SIH (cm)	81.62	4.42	78.60	81.40	84.35
MUAC (CM)	24.55	2.06	23.10	24.40	25.80
CC (cm)	83.49	5.08	80.00	83.00	86.00
WC (cm)	75.95	7.28	71.40	75.00	79.40
HPC (cm)	80.02	5.18	76.50	79.60	83.00
TSF (mm)	5.75	2.97	3.80	5.0	7.00
BSF (mm)	3.66	1.98	2.400	3.200	4.200
SSF (mm)	10.38	5.46	7.00	8.80	11.70
SISF (mm)	7.07	4.78	4.00	5.20	8.70

Table (4.2): Derived measurement of Anthropometric characteristics of the studied population

Variables	Mean	SD	Percentiles		
			25	50	75
BMI (kg/m^2)	20.14	2.38	18.51	19.80	21.28
TBW (lt)	34.88	2.94	32.88	34.96	36.52
PBF (%)	11.13	6.07	6.56	9.64	14.42
FM (kg)	6.32	4.24	3.38	5.14	8.08
FFM (kg)	47.76	4.62	44.58	47.85	50.70
FMI(kg/m^2)	2.35	1.58	1.24	1.92	3.02
FFMI (kg/m^2)	17.78	1.32	16.82	17.45	18.60
BAI (%)	20.21	2.66	18.43	20.02	21.70
MUAA (mm^2)	772.69	132.83	679.14	757.73	847.18
MUAMA (mm^2)	408.50	56.76	367.60	405.89	442.93
MUAFA (mm^2)	364.19	85.73	305.77	345.47	403.15
AFI	46.78	3.53	44.23	45.90	48.59
WHR	0.95	0.05	0.92	0.94	0.98
CI	1.21	0.07	1.17	1.21	1.25
WHTR	0.46	0.04	0.43	0.46	0.49
BMAI	15.43	3.28	13.21	14.78	17.06

Table (4.3): Mean (SD) values of anthropometric variables according to age Groups.

Variables		AGE CATEGORIES IN YEAR				'F' value
		18-30 (N=178)	**31-40 (N=166)**	**41-50 (N=90)**	**≥51 (N=67)**	
HT (cm)	Mean	164.11	163.63	163.78	163.70	NS
	SD	5.96	5.81	5.67	6.40	
WT (kg)	Mean	53.83	53.88	54.32	54.90	NS
	SD	6.64	7.15	7.90	7.81	
STH (cm)	Mean	82.44	82.13	82.31	81.69	NS
	SD	3.19	3.36	3.27	3.50	
SIL (cm)	Mean	81.67	81.50	81.47	82.01	NS
	SD	4.59	4.57	3.84	4.39	
MUAC (cm)	Mean	24.53	24.44	24.73	24.67	NS
	SD	2.00	2.04	2.07	2.29	
CC (cm)	Mean	83.04	83.55	83.51	84.54	NS
	SD	4.74	5.19	5.13	5.52	
WC (cm)	Mean	74.01	76.08	76.98	79.44	10.55***
	SD	5.93	7.12	7.61	8.84	
HPC (cm)	Mean	78.95	80.03	80.73	81.92	6.28***
	SD	4.75	4.91	5.39	5.99	
TSF (mm)	Mean	5.25	5.62	6.14	6.15	NS
	SD	2.82	3.00	3.05	3.13	
BSF (mm)	Mean	3.53	3.55	3.88	3.99	NS
	SD	1.73	2.00	2.14	2.28	
SSF (mm)	Mean	9.38	10.49	11.22	11.64	3.97**
	SD	4.38	5.60	5.91	6.60	
SISF (mm)	Mean	6.41	7.04	7.64	8.14	2.71*
	SD	4.13	5.12	4.93	5.14	
Sum of 4CM (cm)	Mean	260.52	263.92	265.94	270.57	5.63***
	SD	15.95	17.85	18.71	21.26	
Sum of 4SFK (mm)	Mean	24.79	26.61	28.82	29.78	2.85*
	SD	11.98	14.69	15.08	16.02	

*P<0.05, **P<0.01, ***P<0.001, Level of significant, NS= Not Significant.

Table (4.4): Mean (SD) values of derived measurements of anthropometric variables according to age Groups.

Variables		AGE CATEGORIES IN YEAR				'F' value
		18-30 (N=178)	**31-40 (N=166)**	**41-50 (N=90)**	**≥51 (N=67)**	
BMI (kg/m^2)	Mean	19.99	20.10	20.24	20.47	NS
	SD	2.22	2.28	2.65	2.67	
TBW (Lt)	Mean	35.92	34.83	34.11	33.25	18.04***
	SD	2.59	2.78	2.96	3.13	
PBF (%)	Mean	10.32	10.97	12.10	12.42	2.92*
	SD	5.43	6.23	6.32	6.67	
FM (kg)	Mean	5.77	6.22	6.93	7.21	2.64*
	SD	3.70	4.29	4.66	4.70	
FFM (kg)	Mean	48.06	47.66	47.39	47.69	NS
	SD	4.63	4.54	4.68	4.75	
FMI (kg/m^2)	Mean	2.15	2.32	2.59	2.68	2.71*
	SD	1.38	1.59	1.70	1.78	
FFMI (kg/m^2)	Mean	17.84	17.79	17.65	17.79	NS
	SD	1.36	1.24	1.33	1.40	
BAI (%)	Mean	19.61	20.27	20.57	21.16	6.67***
	SD	2.54	2.41	2.86	2.95	
MUAA (mm^2)	Mean	770.58	765.61	783.53	781.25	NS
	SD	127.87	130.91	135.85	147.38	
MUAMA (mm^2)	Mean	410.25	405.83	410.04	408.39	NS
	SD	59.25	55.07	53.71	59.04	
MUAFA (mm^2)	Mean	360.33	359.78	373.49	372.86	NS
	SD	79.61	85.27	90.48	95.87	
AFI	Mean	46.49	46.62	47.26	47.26	NS
	SD	3.42	3.60	3.51	3.61	
WHR	Mean	0.94	0.95	0.95	0.97	8.20***
	SD	0.04	0.05	0.05	0.05	
CI	Mean	1.19	1.22	1.23	1.26	24.63***
	SD	0.05	0.06	0.07	0.08	
WHTR	Mean	0.45	0.47	0.47	0.49	11.53***
	SD	0.04	0.04	0.05	0.05	
BMAI	Mean	14.89	15.23	15.75	16.45	4.126**
	SD	2.78	3.19	3.67	3.91	

*P<0.05, **P<0.01, ***P<0.001, Level of significant, NS= Not Significant.

Table (4.5): Pearson correlation between age, age ^{2} and anthropometric Variables

Variable	Age	Age^2
HT (cm)	-0.036	-0.034
WT (kg)	0.038	0.020
STH (cm)	-0.067	-0.072
SIH (cm)	0.002	0.009
MUAC (CM)	0.027	0.015
CC (cm)	0.093*	0.085
WC (cm)	0.249**	0.238**
HPC (cm)	0.202**	0.192**
TSF (mm)	0.079	0.077
BSF (mm)	0.085	0.084
SSF (mm)	0.151**	0.140**
SISF (mm)	0.120**	0.112*
Sum of 4CM (cm)	0.186**	0.175**
Sum of 4SFK (mm)	0.125**	0.118**

**p < 0.01; *p < 0.05 Level of Significant.

Table (4.6): Pearson correlation between age, age^2 and derived variables

Variable	Age	Age^2
BMI (kg/m^2)	0.062	0.052
TBW (Lt)	-0.338**	-0.339**
PBF (%)	0.122**	0.116**
FM (kg)	0.117**	0.109*
FFM (kg)	-0.049	-0.053
FMI(kg/m^2)	0.120**	0.111*
FFMI (kg/m^2)	-0.030	-0.039
BAI (%)	0.215**	0.204**
MUAA (mm^2)	0.031	0.019
MUAMA (mm^2)	-0.012	-0.026
MUAFA (mm^2)	0.055	0.046
AFI	0.081	0.082
WHR	0.121**	0.203**
CI	0.376**	0.366**
WHTR	0.264**	0.252**
BMAI	0.156**	0.144**

**p < 0.01; *p < 0.05 Level of Significant

Table (4.7): Simple liner regression of anthropometric variables with age

Variables	B	Sec-B	Beta	Ad R^2	‘t’	P
HT (cm)	-0.018	0.023	-0.036	0.000	-0.800	NS
WT (kg)	0.023	0.028	0.038	0.000	0.841	NS
STH (cm)	-0.019	0.013	-0.067	0.003	-1.505	NS
SIH (cm)	0.001	0.017	0.002	-0.002	0.054	NS
MUAC (CM)	0.005	0.008	0.027	-0.001	0.608	NS
CC (cm)	0.041	0.020	0.093	0.007	2.076	0.038
WC (cm)	0.157	0.027	0.249	0.060	5.752	0.000
HPC (cm)	0.090	0.020	0.202	0.039	4.607	0.000
TSF (mm)	0.020	0.011	0.079	0.004	1.778	NS
BSF (mm)	0.014	0.008	0.085	0.005	1.900	NS
SSF (mm)	0.071	0.021	0.151	0.021	3.411	0.001
SISF (mm)	0.050	0.018	0.120	0.012	2.704	0.007

Table (4.8): Simple liner regression of derived variables of anthropometry with age

Variables	B	Sec-B	Beta	Ad R^2	‘t’	P
BMI (kg/m^2)	0.013	0.009	0.062	0.002	1.395	NS
TBW (Lt)	-0.086	0.011	-0.338	0.112	-8.022	0.000
PBF (%)	0.064	0.023	0.122	0.013	2.738	0.006
FM (kg)	0.043	0.016	0.117	0.012	2.627	0.009
FFM (kg)	-0.019	0.018	-0.049	0.000	-1.088	NS
FMI(kg/m^2)	0.016	0.006	0.120	0.012	2.690	0.007
FFMI (kg/m^2)	-0.003	0.005	-0.030	-0.001	-0.676	NS
BAI (%)	0.049	0.010	0.215	0.044	4.919	0.000
MUAA (mm^2)	0.350	0.512	0.031	-0.001	0.683	NS
MUAMA (mm^2)	-0.057	0.219	-0.012	-0.002	-0.259	NS
MUAFA (mm^2)	0.407	0.330	0.055	0.001	1.232	NS
AFI	0.025	0.014	0.081	0.005	1.810	NS
WHR	0.001	0.000	0.212	0.043	4.855	0.000
CI	0.002	0.000	0.376	0.140	9.068	0.000
WHTR	0.001	0.000	0.264	0.068	6.120	0.000
BMAI	0.044	0.013	0.156	0.022	3.525	0.000

Table (4.9): Pearson correlation co-efficient of anthropometric measures with MUAC, WC, BMI and PBF

Variables	MUAC	WC	BMI	PBF
HT (cm)	0.136**	0.199**	-0.087	-0.016
WT (kg)	0.826**	0.816**	0.843**	0.686**
STH (cm)	0.275**	0.240**	0.144**	0.133**
SIH (cm)	-0.024	0.086	-0.224**	-0.120**
MUAC (CM)	………..	0.716**	0.843**	0.685**
CC (cm)	0.771**	0.792**	0.796**	0.665**
WC (cm)	0.716**	……….	0.798**	0.788**
HPC (cm)	0.707**	0.875**	0.754**	0.691**
TSF (mm)	0.688**	0.726**	0.735**	0.890**
BSF (mm)	0.593**	0.689**	0.694**	0.847**
SSF (mm)	0.635**	0.776**	0.744**	0.908**
SISF (mm)	0.626**	0.727**	0.740**	0.897**

**p < 0.01; Level of Significant.

Table (4.10): Pearson correlation co-efficient of derived variables with MUAC, WC, BMI and PBF

Variable	MUAC	WC	BMI	PBF
BMI (kg/m^2)	0.843**	0.798**	……….	0.782**
TBW (Lt)	0.700**	0.625**	0.652**	0.517**
PBF (%)	0.685**	0.788**	0.782**	………
FM (kg)	0.753**	0.841**	0.843**	0.976**
FFM (kg)	0.596**	0.499**	0.539**	0.173**
FMI(kg/m^2)	0.738**	0.823**	0.854**	0.982**
FFMI (kg/m^2)	0.640**	0.457**	0.785**	0.238**
BAI (%)	0.548**	0.658**	0.766**	0.654**
MUAA (mm^2)	0.998**	0.720**	0.846**	0.690**
MUAMA (mm^2)	0.904**	0.508**	0.670**	0.374**
MUAFA (mm^2)	0.947**	0.779**	0.866**	0.822**
AFI	0.578**	0.674**	0.659**	0.879**
WHR	0.450**	0.770**	0.540**	0.603**
CI	0.291**	0.809**	0.337**	0.530**
WHTR	0.667**	0.930**	0.834**	0.798**
BMAI	0.822**	0.935**	0.954**	0.828**

**$p < 0.01$; Level of Significant

Figure (4.1): Showing the mean value of waist and hip circumference according to age.

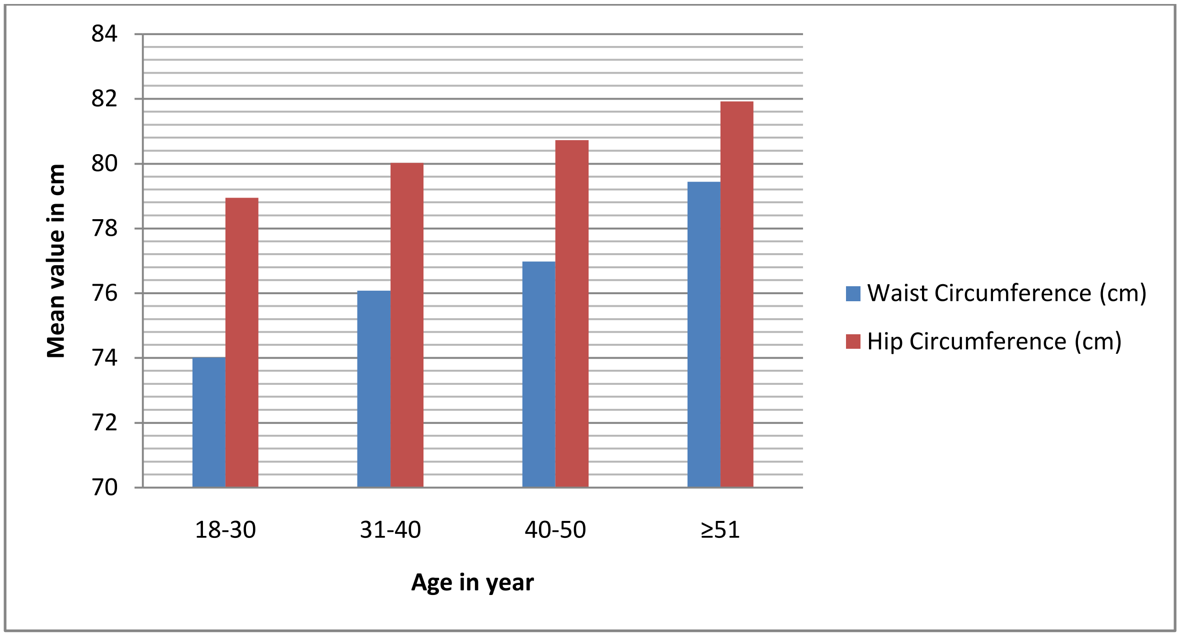


Figure (4.2) showing the mean of suprailliac and sub-scapula skinfold thickness according to age group.

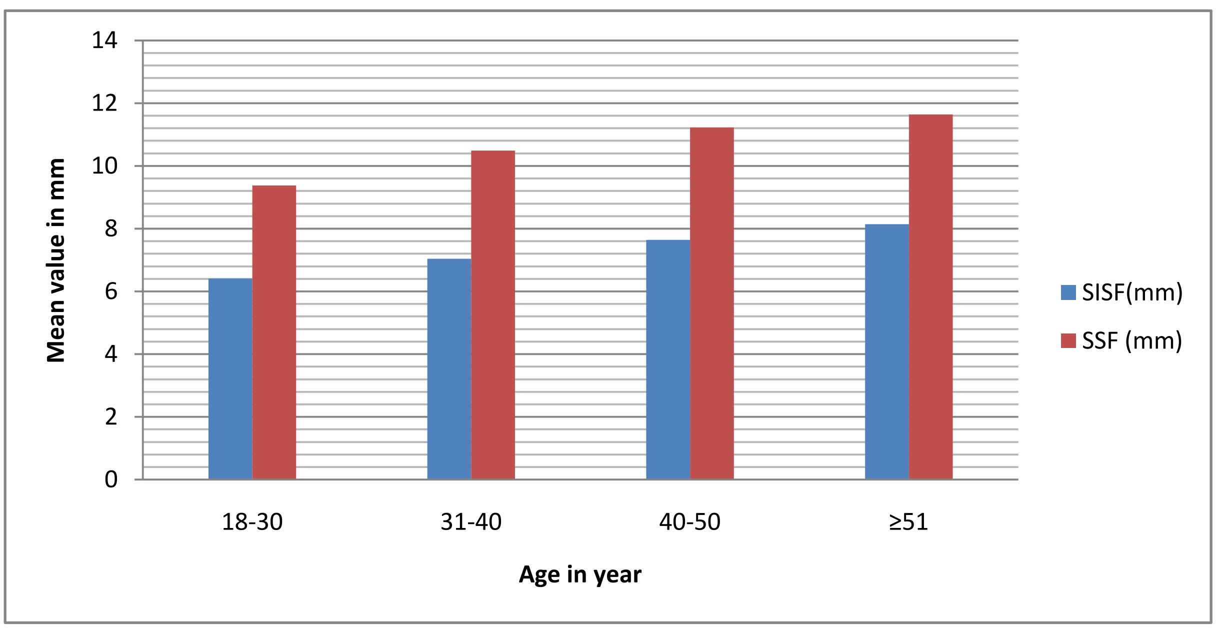


Figure (4.3): Showing mean value of WHTR, WHR and CI according to age group.

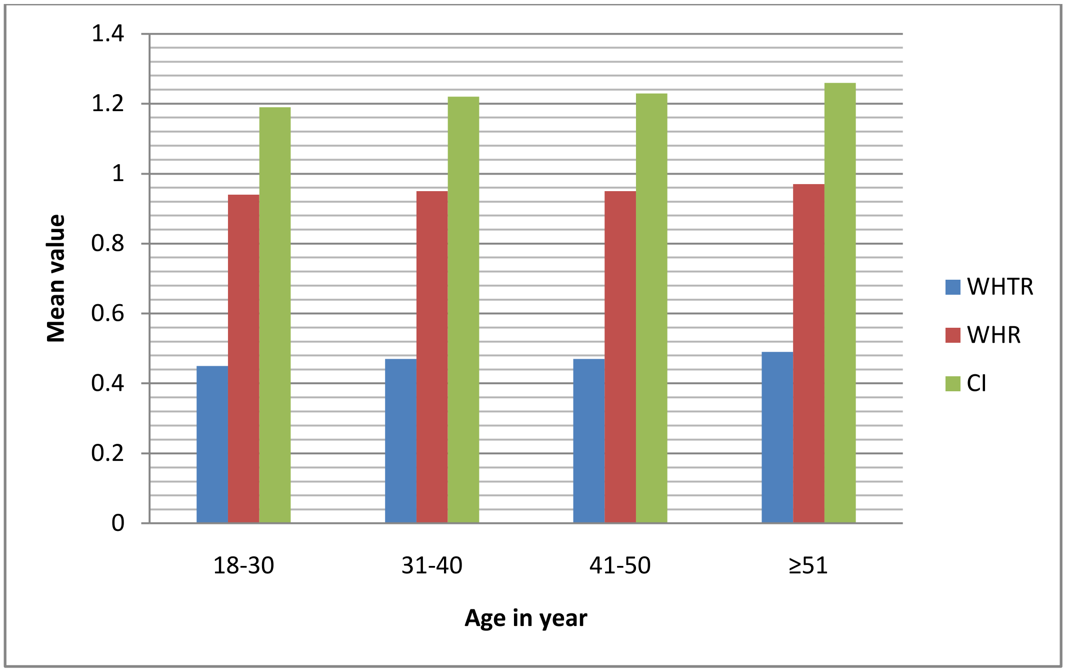
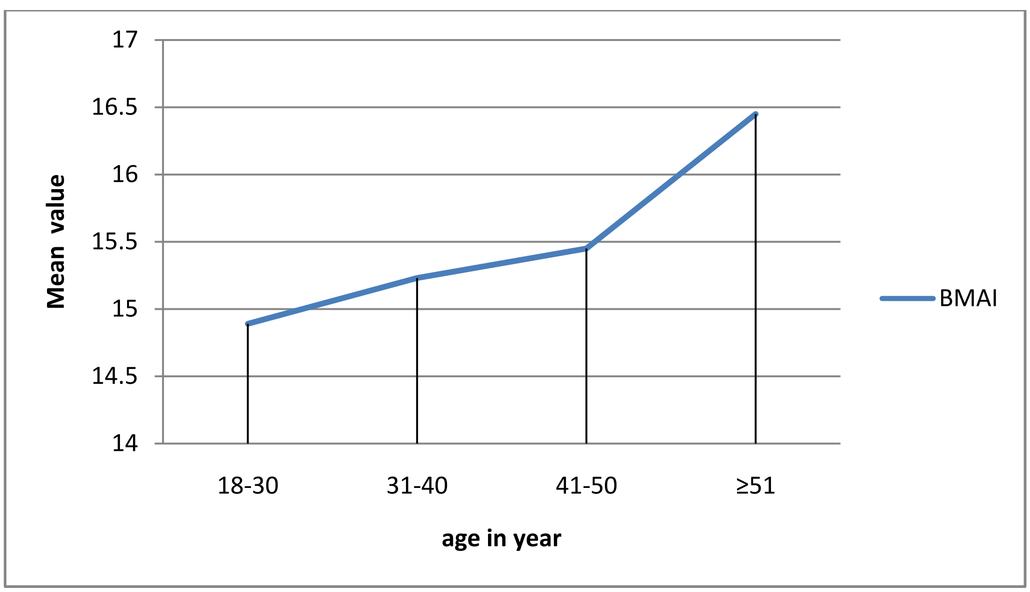


Figure (4.4): Showing the mean value of BMAI according to age group.



CHAPTER- V

RESULT – II

NUTRITIONAL STATUS OF THE SUBJECTS

CHAPTER- V

Result - II

Nutritional status of the subjects

Table (5.1) demonstrates the absolute numbers and percent of subjects 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). 24.60% of the subjects were underweight or chronic energy deficient (CED), among them CED-III, CED-II and CED-I were 1.40%, 4.00 and 19.20% respectively. The prevalence rates of overweight and obese were 4.60% and 0.20%. The rest of them (70.70%) were in the normal BMI range. Figure (5.1) also showing the nutritional status of the studied population based on BMI (WHO-1995). The rates of CED-III, CED-II and CED-I were 1.40%, 4.00% and 19.20% respectively. Only 0.20% was obese and 4.60% was overweight.

Table (5.2) shows the nutritional status based on MUAC. Overall under-nutrition was 22.80% and rest 77.20% was normal. Figure (5.2) showing the graphical representation of nutritional status of the studied population based on MUAC. The rates of under-nutrition and normal were 22.80% and 77.20% respectively. Table (5.3) presents the nutritional status based on BMI according to WHO-1995 cut off points. The overall malnutrition was 29.40%, among them 24.60% was under-nutrition and 4.60, 0.20% were overweight, obese respectively.

Table (5.4) also present the nutritional status based on BMI, according to Asia Pacific Standard (WHO-2000) cut off points. On the basis of the cut off points, the overall malnutrition was 30.10% and 64.90% was normal, among malnutrition 24.60% was under-nutrition and 5.80%, 4.80 were overweight, obese respectively. Figure (5.3) showing the nutritional status based on BMI Asia pacific cut off points (WHO 2000). The rates of CED, normal, overweight and obese were 24.6%, 64.9%, 5.8% and 4.8% respectively.

Table (5.5) present the nutritional status based on BMI (WHO-1995) according to age categories. The prevalence of CED (26.40%) was higher age group (I) than the others age groups. Only in the age group (II) was found an obese subject (0.60%) and the maximum prevalence rates of (7.50%) overweight in the age group (IV), followed by group III, II and I were 6.70%, 3.60% and 3.40% respectively. The prevalence of overweight was increased with increased of age.

Table (5.6) present the nutritional status based on BMI (WHO-2000) according to age categories. The overall malnutrition was 35.20%, among CED, overweight and obese were 24.60%, 5.80% and 4.80% respectively. The prevalence of CED (26.40%) was higher age group (I) than the others age groups. The maximum prevalence rates of (7.50%) obese in the age group (IV), followed by group III, II and I were 6.70%, 4.20% and 3.40% respectively. The prevalence of obese was increased with increased of age.

Table (5.7) shows the nutritional status based on MUAC according to age categories. The maximum and minimum rates of undernutrition were found in the age group IV (28.40%) and III (15.60%) respectively.

Table (5.8) presents the relationship between MUAC and BMI for assessment the nutritional status. The rate of undernutrition on the based on BMI was 24.60% and on the other side the rates of undernutrition basis on MUAC was 22.80%. In low MUAC (<23cm) group the rates of nudernutrition was 70.20%, was higher than the normal MUAC (≥23 cm) group (11.10%). This low MUAC was statistically significant (x^2=167.03, $p<0.001$) with BMI.

Table (5.9) shows the prevalence of obesity on the based on PBF. In the present study only 2.80% was obese on the basis on PBF.

The mean (SD) values of anthropometric characteristics for each groups based on BMI (WHO-2000) are shown in table (5.10). Above analysis indicated that in case of WT, CC, WC, HPC, TSF, BSF, SSF, and SISF were statistical significant ($p<0.001$) differentiations among the four nutritional groups. The mean values of each variable were increased according to CED/undernutrition to obese category. STH and SIH were statistically significant (p<0.05) and (p<0.01) differentiations among the four nutritional groups. In case of HT statistical differentiation was not found.

The mean (SD) values of derived variables of anthropometric characteristics for each nutritional group based on BMI (WHO-2000) are shown in table (5.11). All of the derived variables of anthropometry TBW, PBF, FM, FFM, FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHR, CI, WHTR and BMAI were statistical significant (p<0.001) differentiations among the four nutritional groups. The mean values of each variable were increased according to CED/undernutrition to obese category.

Table (5.12): described the anthropometric characteristics (mean and SD) and‘t’ test of the studied population. Two groups were divided based on MUAC undernutrition (<23 cm) and normal (≥23 cm). From the table it was clear that except, HT and SIH all anthropometric variables, WT, CC, WC, HPC,TSF, BSF,SSF, SISF, sum of 4CM and sum of 4SF were positively significant (P<0.001). In case of STH the level of significant was (p<0.01). The values all of the anthropometric variables were higher among the normal category.

Table (5.13): described the anthropometric characteristics (mean and SD) and‘t’ test of the studied population. Two groups were divided based on MUAC, undernutrition (<23 cm) and normal (≥23 cm). From the table it was clear that all derived variables of anthropometry, BMI, TBW, PBF, FM, FFM, FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHR, WHTR and BMAI were positively significant (P<0.001).Only in case of CI the level of significant was (p<0.01). The values all of the derived variables of anthropometry were higher among the normal group, than the undernutrition group.

Table (5.14): described the anthropometric characteristics (mean and SD) and‘t’ test of the studied population. Two groups were divided based on PBF, normal (≤25) and obese (>25). From the table it was clear that except, HT, STH and SIH all the anthropometric variables, WT, MUAC,CC, WC, HPC,TSF, BSF,SSF, SISF, were negatively significant (P<0.001). The values all of the anthropometric variables were higher among the obese category than the normal category.

Table (5.15): described the anthropometric characteristics (mean and SD) and‘t’ test of the studied population. Two groups were divided based on PBF, normal (≤25) and normal (>25). From the table it was clear that all derived variables of anthropometry, BMI, TBW, FM, FFM, FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHR, CI, WHTR and BMAI were negatively significant ($P<0.001$).The values all of the derived variables of anthropometry were higher among the obese group, than the normal group.

Summary

1. The prevalence of CED was 24.60%, among them CED-III, CED-II and CED-I were 1.40%, 4.00 and 19.20% respectively. The prevalence rates of overweight and obese were 4.60% and 0.20%. The rest of them (70.70%) were in the normal BMI range (WHO-1995). According to WHO-1995 cut off points, the overall malnutrition was 29.40%, among them 24.60% was under-nutrition and 4.60, 0.20% were overweight, obese respectively.

2. According to Asia Pacific Standard (WHO-2000) cut off points of BMI, the overall malnutrition was 35.20%, among them 24.60% was undernutrition and 5.80%, 4.80 were overweight, obese respectively.

3. Based on MUAC overall under-nutrition was 22.80% and rest 77.20% was normal.

4. The prevalence of CED (26.40%) was higher age group (I) than the others age groups. The maximum prevalence rates of (7.50%) overweight in the age group (IV) followed by group III, II and I were 6.70%, 3.60% and 3.40% respectively. The prevalence of overweight was increased with increased of age (WHO-1995).

5. The overall malnutrition was 35.20%, among CED, overweight and obese were 24.60%, 5.80% and 4.80% respectively. The prevalence of CED (26.40%) was higher age group (I) than the others age groups. The maximum prevalence rates of (7.50%) obese in the age group (IV) followed by group III, II and I were 6.70%, 4.20% and 3.40% respectively. The prevalence of obese was increased with increased of age.

6. The maximum and minimum rates of undernutrition were found in the age group IV (28.40%) and III (15.60%) respectively on based on MUAC.

7. In low MUAC (<23cm) group the rates of nudernutrition was 70.20%, was higher than the normal MUAC (≥23 cm) group (11.10%). This low MUAC was statistically significant (x2=167.03, p<0.001) with BMI.

8. In the present study only 2.80% was obese on the basis on PBF.

9. Above analysis indicated that WT, CC, WC, HPC, TSF, BSF, SSF, and SISF were statistical significant (p<0.001) differentiations among the four nutritional groups (based on BMI-2000). The mean values of each variable were increased according to CED to obese category. STH and SIH were also statistically significant (p<0.05) and (p<0.01) differentiations among the four nutritional groups.

10. All of the derived variables of anthropometry TBW, PBF, FM, FFM, FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHR, CI, WHTR and BMAI were statistical significant (p<0.001) differentiations among the four nutritional groups. The mean values of each variable were increased according to CED to obese category.

11. Two groups were divided based on MUAC undernutrition (<23 cm) and normal (≥23 cm). All anthropometric variables, WT, CC, WC, HPC,TSF, BSF,SSF, SISF, sum of 4CM and sum of 4SF were positively significant (P<0.001). In case of STH the level of significant was (p<0.01). All derived variables of anthropometry, BMI, TBW, PBF, FM, FFM, FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHR, WHTR and BMAI were positively significant (P<0.001).Only in case of CI the level of significant was (p<0.01). Both mean values of all anthropometry and the derived variables of anthropometry were higher among the normal group, than the undernutrition group.

12. Two groups were divided based on PBF, normal (≤25) and obese (>25). From the analysis it was clear that all the anthropometric variables, WT, MUAC,CC, WC, HPC,TSF, BSF,SSF, SISF, were negatively significant (P<0.001). The mean values all of the anthropometric variables were higher among the obese category than the normal category. All derived variables of anthropometry, BMI, TBW, FM, FFM, FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHR, CI, WHTR and BMAI were negatively significant (P<0.001).The mean values of both anthropometry and the derived variables of anthropometry were higher among the obese group, than the normal group.

Table: (5.1) Nutritional Status based on BMI (WHO 1995) according to CED grades

Nutritional Categories	Frequency	Percent (%)	Cumulative (%)
CED- III (BMI < 16 kg/m^2)	7	1.4	1.4
CED- II (BMI < 16-16.9 kg/m^2)	20	4.0	5.4
CED- I (BMI 17.0-18.4 kg/m^2)	96	19.2	24.6
Normal (BMI 18.5-24.9 kg/m^2)	354	70.7	95.2
Overweight (BMI 25-29 kg/m^2)	23	4.6	99.8
Obese (BMI ≥30 kg/m^2)	1	0.2	100
Total	501	100	

Table: (5.2): Overall frequencies (%) of Nutritional Status based on MUAC.

MUAC (cm)	Nutritional category	Frequency	Percent
<23	Under-nutrition	114	22.8
≥23	Normal	387	77.2
Total		501	100

Table (5.3): Overall frequency (%) of nutritional status by BMI (WHO- 1995)

BMI (kg/m^2)	Category /nutritional status	Frequency	Percent (%)
<18.5	CED	123	24.6 (%)
18.5-24.99	Normal	354	70.7(%)
25-29.99	Over weight	23	4.6 (%)
≥30	Obese	1	0.2 (%)
Total		501	100

Table (5.4): Nutritional Status on BMI by Asia Pacific Standard (WHO 2000).

BMI (kg/m^2)	Category /nutritional status	Frequency	Percent (%)
<18.5	CED	123	24.6 (%)
18.5-22.99	Normal	325	64.9 (%)
23.0-24.99	Over weight	29	5.8 (%)
≥25	Obese	24	4.8 (%)
Total		501	100

Table (5.5): Frequency (%) of nutritional status by BMI (WHO 1995) according to age group

Age categories (year)	Nutritional status Based on BMI Frequency (%).			
	CED (BMI<18.5kg/m^2)	NORMAL (BMI 18.5-24.9 kg/m^2)	OVERWEIGHT (BMI 25-29.9 kg/m^2)	OBESE (BMI≥30kg/m^2)
18-30 (N=178)	47 (26.4%)	125 (70.2%)	6 (3.4%)	0 (0%)
31-40 (N=166)	40 (24.1%)	119 (71.7%)	6 (3.6%)	1 (0.6%)
41-50 (N=90)	22 (24.4%)	62 (68.9%)	6 (6.7%)	0 (0%)
≥ 51 (N=67)	14 (20.9%)	48 (71.6%)	5 (7.5%)	0 (0%)
Age combined	123 (24.6%)	354 (70.7%)	23 (4.6%)	1 (0.2%)

Table (5.6): Frequency (%) of Nutritional Status by Asia Pacific BMI cut off (WHO-2000) according to age group.

Age categories (year)	Nutritional status Based on BMI Frequency (%).			
	CED (BMI <18.5 kg/m^2)	NORMAL (BMI 18.5-22.9 kg/m^2)	OVERWEIGHT (BMI 23.0-24.9 kg/m^2)	OBESE (BMI ≥25kg/m^2)
18-30 (N=178)	47 (26.4%)	117 (65.7%)	8 (4.5%)	6 (3.4%)
31-40 (N=166)	40 (24.1%)	110 (66.3%)	9 (5.4%)	7 (4.2%)
41-50 (N=90)	22 (24.4%)	54 (60.0%)	8 (8.9%)	6 (6.7%)
≥ 51 (N=67)	14 (20.9%)	44 (65.7%)	4 (6.0%)	5 (7.5%)
Age combined	123 (24.6%)	325 (64.9%)	29 (5.8%)	24 (4.8%)

Table (5.7): Frequencies (%) of Nutritional Status by MUAC across Age Groups

Age group (years)	Undernutrition (MUAC < 23cm) Frequency (%)	Normal (MUAC ≥ 23cm) Frequency (%)
18-30 (N=178)	45 (25.3%)	133 (74.7%)
31-40 (N=166)	36 (21.7%)	130 (78.3%)
41-50 (N=90)	14 (15.6%)	76 (84.4%)
≥ 51 (N=67)	19 (28.4%)	48 (71.6%)
Age combined	114 (22.8%)	387 (77.2%)

Table (5.8): Association between MUAC and BMI (WHO-1995).

MUAC	NUTRTIONAL STATUS BASED ON BMI			
	CED	NORNAL	OVERWEIGHT	TOTAL
<23 cm	80 (70.2%)	34 (29.8%)	0 (0%)	114
≥ 23 cm	43 (11.1%)	320 (82.7%)	24 (6.2%)	387
Total	123 (24.6%)	354 (70.6%)	24 (6.8%)	501

chi-square167.026 (p<0.001),DF-2.

Table (5.9): Nutritional status based on PBF

PBF	Category	Frequency	Percent (%)
≤25%	Normal	487	97.20%
>25%	Obese	14	2.80%

Table (5.10): Mean (SD) values of anthropometric measurement according to nutritional (BMI based) categories (WHO, 2000)

VARIABLES		Nutritional status based on BMI				F
		UN (N=123)	N (N=325)	OWT (N=29)	OB (N=24)	
HT (cm)	Mean	164.23	163.12	162.31	163.64	NS
	SD	6.47	5.75	4.61	6.38	
WT (kg)	Mean	47.28	54.63	62.31	71.50	229.378***
	SD	4.00	4.79	3.60	6.92	
STH (cm)	Mean	81.56	82.33	82.64	83.32	2.750*
	SD	3.76	3.15	2.35	3.43	
SIL (cm)	Mean	82.70	81.49	79.68	80.33	5.221**
	SD	4.63	4.32	3.68	4.36	
MUAC (cm)	Mean	22.52	24.78	26.74	29.30	217.06***
	SD	1.04	1.42	1.44	1.79	
CHEST (cm)	Mean	79.08	83.80	88.50	95.93	189.093***
	SD	3.21	3.54	3.52	3.92	
WAIST (cm)	Mean	69.97	76.24	83.72	93.40	171.509***
	SD	4.04	5.24	4.81	8.05	
HIP (cm)	Mean	75.86	80.23	84.92	92.60	161.812***
	SD	3.22	3.82	2.72	5.11	
TSF (mm)	Mean	3.99	5.62	8.38	13.23	131.589***
	SD	1.36	2.29	2.92	3.56	
BSF (mm)	Mean	2.62	3.53	5.03	9.12	142.984***
	SD	0.80	1.43	1.67	3.20	
SSF (mm)	Mean	7.19	9.95	16.26	25.48	181.415***
	SD	1.99	3.81	5.82	6.55	
SISF (mm)	Mean	4.11	6.88	11.56	19.48	146.694***
	SD	1.42	3.63	4.10	6.82	

*P<0.05, **P<0.01, ***P<0.001, Level of significant, NS= Not Significant.

Table (5.11): Mean (SD) values of derived measurement according to nutritional status (BMI based) categories (WHO, 2000)

VARIABLES		Nutritional status based on BMI				'F' value
		UN (N=123)	**N (N=325)**	**OWT (N=29)**	**OB (N=24)**	
TBW (Lt)	Mean	32.70	35.07	37.38	40.35	87.600*
	SD	2.34	2.38	2.14	2.95	
PBF (%)	Mean	6.50	11.23	17.99	25.33	153.143*
	SD	3.34	4.75	4.55	3.73	
FM (kg)	Mean	3.10	6.22	11.27	18.18	244.310*
	SD	1.66	2.90	3.09	3.70	
FFM (kg)	Mean	44.18	48.41	51.04	53.32	58.034*
	SD	3.72	4.07	3.22	4.99	
FMI (kg/m^2)	Mean	1.15	2.31	4.26	6.78	257.751*
	SD	0.60	1.07	1.11	1.27	
FFMI (kg/m^2)	Mean	16.36	18.02	19.37	19.89	173.654*
	SD	0.79	0.98	0.96	0.78	
BAI (%)	Mean	18.09	20.31	23.09	26.82	150.111*
	SD	1.87	1.96	1.34	2.47	
MUAA (mm^2)	Mean	646.75	783.99	912.44	1096.20	223.900*
	SD	59.43	90.36	96.90	133.96	
MUAMA (mm^2)	Mean	356.11	417.35	457.70	497.74	104.896*
	SD	33.90	46.39	47.56	60.86	
MUAFA (mm^2)	Mean	290.65	366.64	454.74	598.47	253.33*
	SD	31.62	55.51	67.56	94.39	
AFI	Mean	44.91	46.65	49.69	54.46	84.394*
	SD	2.09	3.01	3.46	3.69	
WHR	Mean	0.92	0.95	0.98	1.01	40.868*
	SD	0.04	0.04	0.05	0.07	
CI	Mean	1.20	1.21	1.24	1.30	18.312*
	SD	0.06	0.06	0.06	0.09	
WHTR	Mean	0.43	0.47	0.52	0.57	196.043*
	SD	0.02	0.03	0.03	0.05	
BMAI	Mean	12.26	15.54	19.79	24.96	464.501*
	SD	1.04	1.77	1.26	3.13	

*P<0.001, Level of significant

Table (5.12): Differences in mean (SD) values between undernourished and Normal (based on MUAC) in anthropometric measures.

Measurements	**Under-nutrition (N-114)**		**Normal (N=387)**		***'t' value***
	Mean	**SD**	**Mean**	**SD**	
HT (cm)	163.14	6.47	164.04	5.72	NS
WT (kg)	47.47	4.33	56.02	6.70	16.15**
STH (cm)	81.34	3.72	82.47	3.13	2.94*
SIH (cm)	81.80	4.61	81.57	4.37	NS
CC (cm)	79.26	3.15	84.74	4.87	14.25**
WC (cm)	70.57	4.33	77.54	7.22	12.75**
HPC (cm)	76.18	3.65	81.16	5.02	11.65**
TSF (mm)	3.90	1.19	6.29	3.11	12.38**
BSF (mm)	2.64	0.85	3.96	2.11	9.84**
SSF (mm)	7.26	2.19	11.30	5.78	11.29**
SISF (mm)	4.34	1.76	7.88	5.09	11.53**
Sum of 4CM	248.09	9.96	268.64	17.31	16.02***
Sum of 4SF	18.11	5.06	29.34	14.91	12.56***

*p<0.01, **p<0.001, NS= Not Significant.

Table (5.13): Differences in mean (SD) values between undernourished and Normal (based on MUAC) in derived variables.

Variables	Under-nutrition (N=114)		Normal (N=387)		t
	Mean	SD	Mean	SD	
BMI (kg/m^2)	17.82	1.14	20.82	2.22	19.25**
TBW (Lt)	32.60	2.45	35.50	2.73	10.99**
PBF (%)	6.67	3.45	12.45	6.05	12.94**
FM (kg)	3.22	1.80	7.23	4.32	14.46**
FFM (kg)	44.25	3.78	48.79	4.33	10.90**
FMI(kg/m^2)	1.21	0.66	2.69	1.61	14.52**
FFMI (kg/m^2)	16.12	1.00	18.12	1.20	13.42**
BAI (%)	18.61	2.01	20.68	2.65	8.92**
MUAA (mm^2)	621.18	38.23	817.32	116.84	28.28**
MUAMA (mm^2)	342.16	22.82	428.04	48.35	26.37**
MUAFA (mm^2)	279.02	22.15	389.27	81.27	23.85**
AFI	44.90	1.90	47.33	3.70	9.38**
WHR	0.93	0.04	0.95	0.04	6.43**
CI	1.20	0.06	1.22	0.07	2.63*
WHTR	0.43	0.03	0.47	0.04	12.11**
BMAI	12.60	1.35	16.26	3.22	17.73***

*p < 0.01, **p < 0.001, Level of significant.

Table (5.14): Mean (SD) values of anthropometric measurement according to nutritional status based on PBF.

Variables	PBF Categories				't' value
	Normal (≤25)		Obese (>25)		
	Mean	SD	Mean	SD	
HT (cm)	163.81	5.88	164.69	6.87	NS
WT (kg)	53.72	6.36	73.39	8.22	-11.43*
STH (cm)	82.19	3.29	82.81	3.93	NS
SIH (cm)	81.62	4.43	81.87	4.12	NS
MUAC (CM)	24.41	1.87	29.56	2.02	-10.12*
CC (cm)	83.10	4.53	97.04	4.61	-11.38*
WC (cm)	75.35	6.38	96.79	5.97	-11.85*
HPC (cm)	79.61	4.56	94.34	5.39	-14.63*
TSF (mm)	5.47	2.48	15.32	2.75	-10.07*
BSF (mm)	3.45	1.51	10.87	2.75	-17.57*
SSF (mm)	9.82	4.33	29.90	4.85	-17.06*
SISF (mm)	6.61	3.87	23.06	6.11	-15.38*

*p<0.001, Level of Significant, NS= Not Significant.

Table (5.15): Mean (SD) values of derived measurement according to nutritional status based on PBF.

Variables	**PBF Categories**				't' value
	Normal (≤25)		**Obese (>25)**		
	Mean	**SD**	**Mean**	**SD**	
BMI (kg/m^2)	19.94	2.09	26.99	1.81	-12.51*
TBW (lt)	34.71	2.74	40.83	3.54	-8.18*
FM (kg)	5.91	3.50	20.57	2.95	-15.51*
FFM (kg)	46.61	4.50	52.82	5.95	-4.23*
FMI(kg/m^2)	2.20	1.31	7.58	0.96	-15.20*
FFMI (kg/m^2)	17.73	1.30	19.42	1.10	-4.80*
BAI (%)	20.02	2.42	26.69	2.48	-10.13*
MUAA (mm^2)	762.78	118.37	1117.00	152.81	-10.95*
MUAMA (mm^2)	406.35	55.08	483.37	65.36	-5.13*
MUAFA (mm^2)	356.43	71.78	633.88	97.69	-14.10*
AFI	46.49	3.12	56.67	2.56	-12.10*
WHR	0.95	0.04	1.03	0.04	-6.71*
CI	1.21	0.06	1.33	0.05	-7.03*
WHTR	0.46	0.04	0.59	0.03	-12.07*
BMAI	15.12	2.72	26.19	3.00	-14.96*

*p<0.001, Level of Significant.

Figure (5.1): Showing the nutritional status frequency (%) based on BMI (WHO 1995).

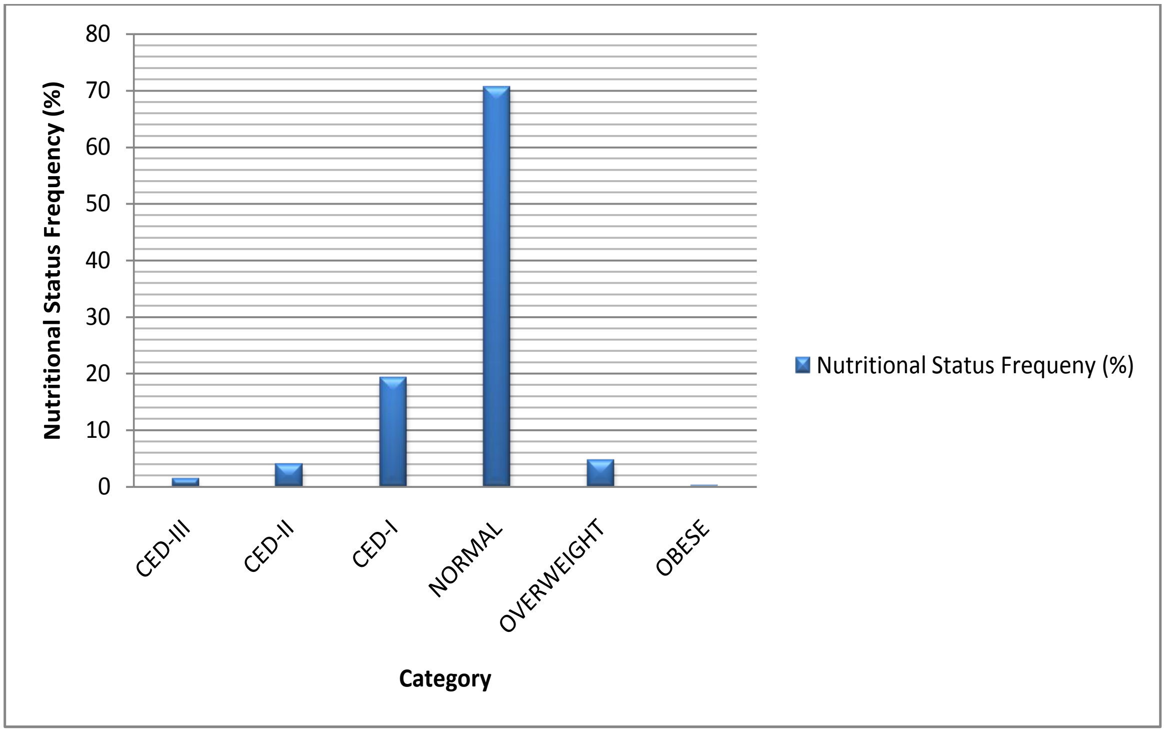


Figure (5.2): Showing the nutritional status of the studied population based on MUAC.

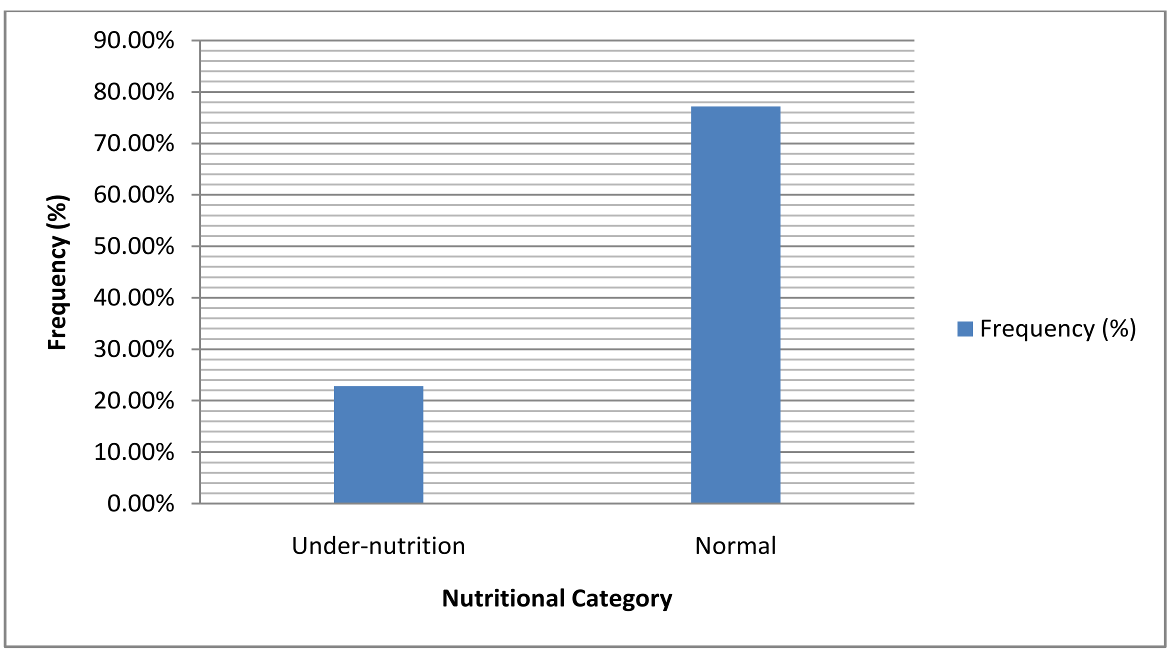
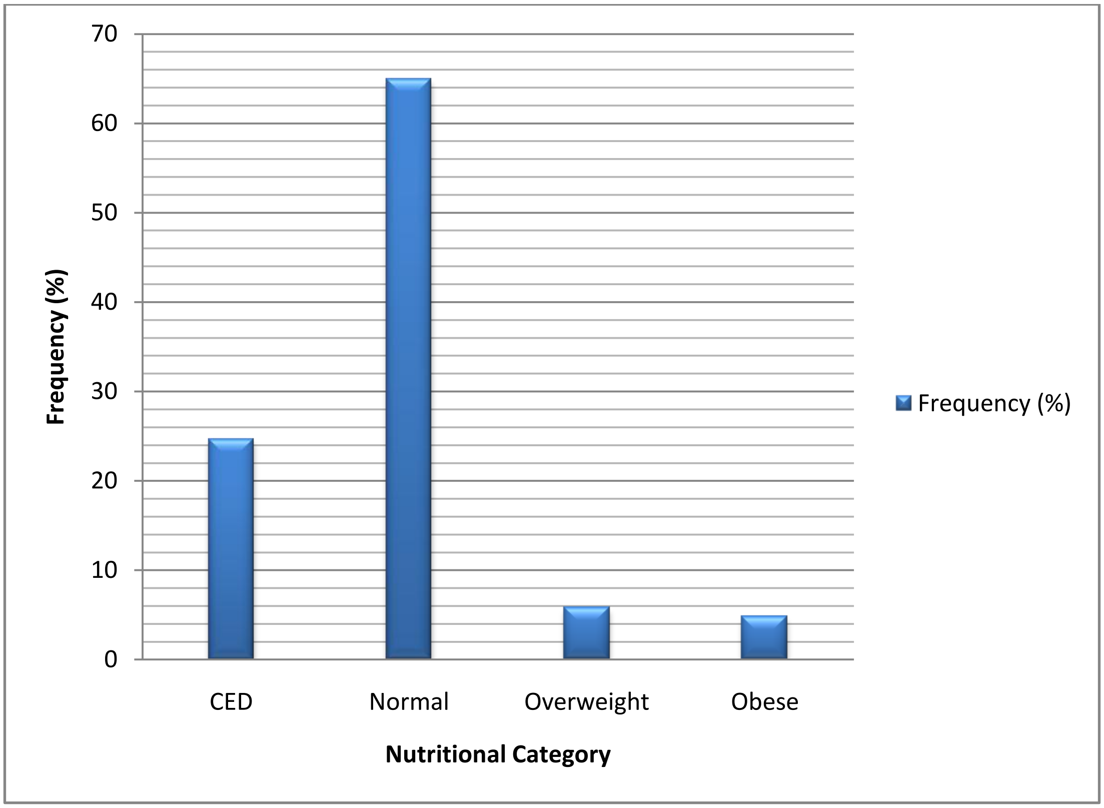


Figure (5.3): Showing the nutritional status based on BMI Asia pacific cut off points (WHO 2000).



CHAPTER-VI

RESULT- III

SOCIO-ECONOMIC, ANTHROPOMETRY AND MORBIDITY STATUS

CHAPTER-VI

Result - III

Socio-economics, Anthropometry and Morbidity status.

Table (6.1) shows the socio-demographic characteristics of the sample. The mean (SD) values of age, family members, family income/month, percapita income/month and education in years were 36.53 (11.60) years, 4.96 (1.96), Rs 7613.77 (2041.58) Rs (1651.89 (554.79) and 4.54 (6.42) years respectively. The 25th, 50th and the 75th percentiles values are shown.

Table (6.2) describes the educational status of the subjects. 65.10% subjects were illiterate and 2.40% was can only sign. Thus the literacy rate was 34.90%. 8.00% had primary education and 23.00% had completed secondary. 1.40% and 0.20% had higher secondary and undergraduate or higher level of education respectively. Table (6.3) presents the marital status of the studied population. The rates of unmarried, married and widower were 9.80%, 90.00% and 0.20% respectively.

Table (6.4) presents the distribution of the studied population basis on creed. In the present study 11.20% were Hindu and rest of 88.80% belong to Muslim Religious group.

Table (6.5) shows the housing characteristics of the subjects in terms of i) whether the individual owned the house or it was a rental one, ii) the material used for the construction of the walls, iii) the material used for the construction of the floor and iv) the material used for the construction of the roof. There were only two distinct types of walls, floor and roof, one was pucca and another was kachha. The frequency of pucca walls, floor and roof were 77.00%, 11.60% and 15.00% respectively. The frequency of kachha walls, floor and roof were 23.00%, 88.40% and 85.00% respectively. In the present study area all members had their own house.

Table (6.7) shown disease frequency of the studied population. Overall 71.30% individual were suffering from various kinds of disease last one year, minimum one time or more than one times.

Table (6.7) presents the frequency of disease, who suffered minimum one types of disease in the last one year. Overall 28.7% workers not suffered from any types of disease in the last one year. Overall frequency of the diseases, fever, nerve problem, bone joint problem, liver problem, jaundice, tuberculosis, heart problem and others were 55.5%, 3.8%, 1.8%, 3.2%, 0.6%, 0.6%, 0.4%, 2.2% and 3.2% respectively. The table also shows the disease frequency fever, nerve problem, bone joint pain, liver problem, kidney problem, jaundice, tuberculosis, heart problem and others were 77.9%, 5.3%, 2.5%, 4.5%, 0.8%, 0.8%, 0.6%, 3.1% and 4.5% respectively.

Table (6.8) presents the frequency of Hospitalization, who was suffering from any disease in the last year. 26.30% individual were visited Hospital for their treatment. Rest of 73.70% were not visited the Hospital for their treatment.

Table (6.9): described the anthropometric characteristics (mean and SD) and't' test of the studied population. Two groups were divided based on construction material of the wall pucca and kachha. From the table it was clear that WT, WC, HPC, and MUAC, CC were positively significant ($P<0.01$) and ($p<0.05$) respectively. The mean values all of the anthropometric variables were higher among the group who live in brick made wall houses, than the other group.

Table (6.10): described the derive variables of anthropometric characteristics (mean and SD) and't' test of the studied population. Two groups were divided based on construction material of the wall pucca and kachha. From the table it was clear that derived variables of anthropometry, FFM, FFMI,and MUAMA, were positively significant ($P<0.01$) and BMI, MUAA, WHR, CI, WHTR and BMAI were also positively significant ($p<0.05$).The mean values all of the derived variables of anthropometry were higher among the members who live in the house, whose wall made by brick (pucca) than the other group (kachha).

Table (6.11) presents the relationship between wall type of the house and nutritional status (based on BMI) of the study population. Overall malnutrition was higher (43.50%) among the members who live in houses whose wall was not made by brick (kachha). The prevalence of CED was higher (36.50%) among the group who live in house whose wall was not made by brick (kachha), than the other group. There were statistical significant (x2=14.40, DF=2, $P<0.001$) differentiation among the two groups.

Table (6.12) presents the relationship between wall type of the house and nutritional status (based on MUAC) of the study population. The prevalence of undernutrition was higher (33.00%) among the group who live in house whose wall was not made by brick (kachha), than the other group (pucca). There were statistical significant (x2=8.99, DF=1, $P<0.01$) differentiation among the two groups.

Summary

1. The mean (SD) values of age, family members, family income/month, percapita income/month and education in years were 36.53 (11.60) years, 4.96 (1.96), Rs 7613.77 (2041.58) Rs (1651.89 (554.79) and 4.54 (6.42) years respectively.

2. 65.10% subjects were illiterate and 2.40% was can only sign. Thus the literacy rate was 34.90%. Among them, 8.00% had completed primary education and 23.00% had completed secondary. 1.40% and 0.20% had higher secondary and undergraduate or higher level of education respectively.

3. The frequency of pucca walls, floor and roof were 77.00%, 11.60% and 15.00% respectively and kachha walls, floor and roof were 23.00%, 88.40% and 85.00% respectively.

4. Overall 71.30% individual were suffering from various kinds of disease last one year, minimum one time or more than one times. Two groups were divided based on construction material of the wall pucca and kachha. From the table it was clear that WT, WC, HPC, and MUAC, CC were positively significant ($P<0.01$) and ($p<0.05$) respectively. Derived variables of anthropometry, FFM, FFMI, and MUAMA, were positively significant ($P<0.01$) and BMI, MUAA, WHR, CI, WHTR

and BMAI were also positively significant (p<0.05). The mean values all of the anthropometric and derive variables were higher among the group who live in brick made wall houses, than the other group.

6. The prevalence of CED was higher (36.50%) among the group who live in house whose wall was not made by brick (kachha), than the other group. There were statistical significant (x2=14.40, DF=2, P<0.001) differentiation among the two groups. The prevalence of undernutrition (based on MUAC) was higher (33.00%) among the group who live in house whose wall was not made by brick (kachha), than the other group (pucca). There were statistical significant (x2=8.99, DF=1, P<0.01) differentiation among the two groups.

Table (6.1): socio-demographic characteristics of the studied population.

Variables	Mean	SD	Percentiles		
			25	50	75
Age (year)	36.56	11.60	27.00	35.00	45.00
Family Members	4.96	1.69	4.00	5.00	6.00
Family income/month (Rs)	7613.77	2041.58	6500.00	7000.00	8000.00
Per-capita income/month (Rs)	1651.89	554.79	1250.00	1500.00	2000.00
Education in year	4.54	6.42	0.00	0.00	11.00

Table (6.2): Educational status of the studied population.

Educational Status	Frequency	Percent (%)
Illiterate	326	65.1
Can sign only	12	2.4
Primary	40	8.0
Secondary	115	23.0
Higher secondary	7	1.4
Graduate and above	1	.2
Total	501	100.0

Table (6.3): Marital status of the studied population.

Marital status	Frequency	Percent (%)
Unmarried	49	9.80
Married	451	90.00
Widower	1	0.20

Table (6.4): Distribution of the studied population basis on Creed.

Religious categories	Frequency	Percent (%)
Hindu	56	11.20
Muslim	445	88.80

Table (6.5): Frequency and percentage of the subjects according to the Housing characteristics

Criteria	Characters	Frequency	Percent (%)
Ownership	Own	501	100.0
	Rental	0	0.0
Wall Type	Pucca	386	77.0
	Kachha	115	23.0
Floor Type	Pucca	58	11.6
	Kachha	443	88.4
Roof Type	Pucca	75	15.0
	Kachha	426	85.0

Table (6.6): Suffering from any disease last one year.

Suffering any disease	Frequency	Percent (%)
Yes	357	71.3
No	144	28.7

Table (6.7): Present the disease frequency among the brick-kiln workers.

Variables	Frequency	Overall percentage	Among the group who suffer from disease (%) (n=357)
Not suffer from any disease	144	28.7	
Fever	278	55.5	77.9
Nerve Problem	19	3.8	5.3
Bone Joint pain	9	1.8	2.5
Liver Problem	16	3.2	4.5
Kidney Problem	3	0.6	0.8
Jaundice	3	0.6	0.8
Tuberculosis	2	0.4	0.6
Heart Problem	11	2.2	3.1
Others	16	3.2	4.5

Table (6.8): Hospitalization frequency who suffers from disease.

Hospitalization	Frequency	Percent (%)
Yes	94	26.30
No	263	73.70
Total	357	100

Table (6.9): Differences of anthropometric characteristics on the basis on wall type of the house of the studied population.

Variables	Wall type of the House				't' value
	Pucca (N=386)		Kachha (N=115)		
	Mean	SD	Mean	SD	
HT (cm)	164.07	5.8	163.05	5.99	1.629
WT (kg)	54.57	6.94	52.41	7.81	2.847**
STH (cm)	82.33	3.18	81.81	3.67	1.472
SIH (cm)	81.74	4.41	81.23	4.47	1.074
MUAC (cm)	24.68	1.99	24.13	2.25	2.501*
CC (cm)	83.78	4.89	825	5.59	2.291*
WC (cm)	76.51	7.18	74.09	7.34	3.141**
HPC (cm)	80.42	4.98	78.69	5.63	3.176**
TSF (mm)	5.81	2.90	5.52	3.19	0.930
BSF (mm)	3.66	1.92	3.66	2.17	-0.025
SSF (mm)	10.40	5.27	10.32	6.06	0.132
SISF (mm)	7.22	4.72	6.57	4.97	1.285

*p<0.05, **p<0.01, Level of Significant.

Table (6.10): Differences of derived variables of anthropometric characteristics on the basis on wall type of the house of the studied population.

Variables	Wall type of the House				't' value
	Pucca (N=386)		Kachha (N=115)		
	Mean	SD	Mean	SD	
BMI (kg/m^2)	20.26	2.28	19.71	2.68	2.177*
TBW (Lt)	34.97	2.90	34.58	3.05	1.245
PBF (%)	11.31	5.97	10.55	6.39	1.175
FM (kg)	6.45	4.12	5.89	4.63	1.229
FFM (kg)	48.13	4.55	46.52	4.64	3.306**
FMI(kg/m^2)	2.40	1.54	2.22	1.71	1.082
FFMI (kg/m^2)	17.86	1.27	17.50	1.46	2.636**
BAI (%)	20.32	2.59	19.85	2.87	1.667
MUAA (mm^2)	780.14	127.91	747.66	146.00	2.311*
MUAMA (mm^2)	412.13	55.47	396.33	59.53	2.636**
MUAFA (mm^2)	368.02	82.39	351.33	95.41	1.836
AFI	46.85	3.48	46.53	3.68	0.835
WHR	0.95	0.05	0.94	0.04	1.971*
CI	1.22	0.07	1.20	0.06	2.526*
WHTR	0.47	0.04	0.45	0.04	2.550*
BMAI	15.63	3.18	14.77	3.55	2.475*

*p<0.05, **p<0.01, Level of Significant.

Table (6.11): Relationship between wall type of the house and nutritional status based on BMI (WHO-1995).

Wall Type	Nutritional status based on BMI			Total
	CED	Normal	Overweight	
Pucca	81 (21.80%)	289 (74.90%)	16 (4.10%)	386
Kachha	42 (36.50%)	65 (56.50%)	8 (7.00%)	115
Total	123(24.60%)	354 (70.70%)	24 (4.80%)	501

Chi-square 14.40 (df=2), p<0.001.

Table (6.12): Relationship between wall type of the house and nutritional status based on MUAC

Wall Type	Nutritional status based on MUAC		Total
	Under-nutrition	Normal	
Pucca	76 (19.70%)	310 (80.30%)	386
Kachha	38 (33.00%)	67 (77.00%)	115
Total	114 (22.80%)	387 (77.20%)	501

Chi-square-8.99 (df=1), p<0.01.

Figure (6.1): Showing the educational status of the studied population.

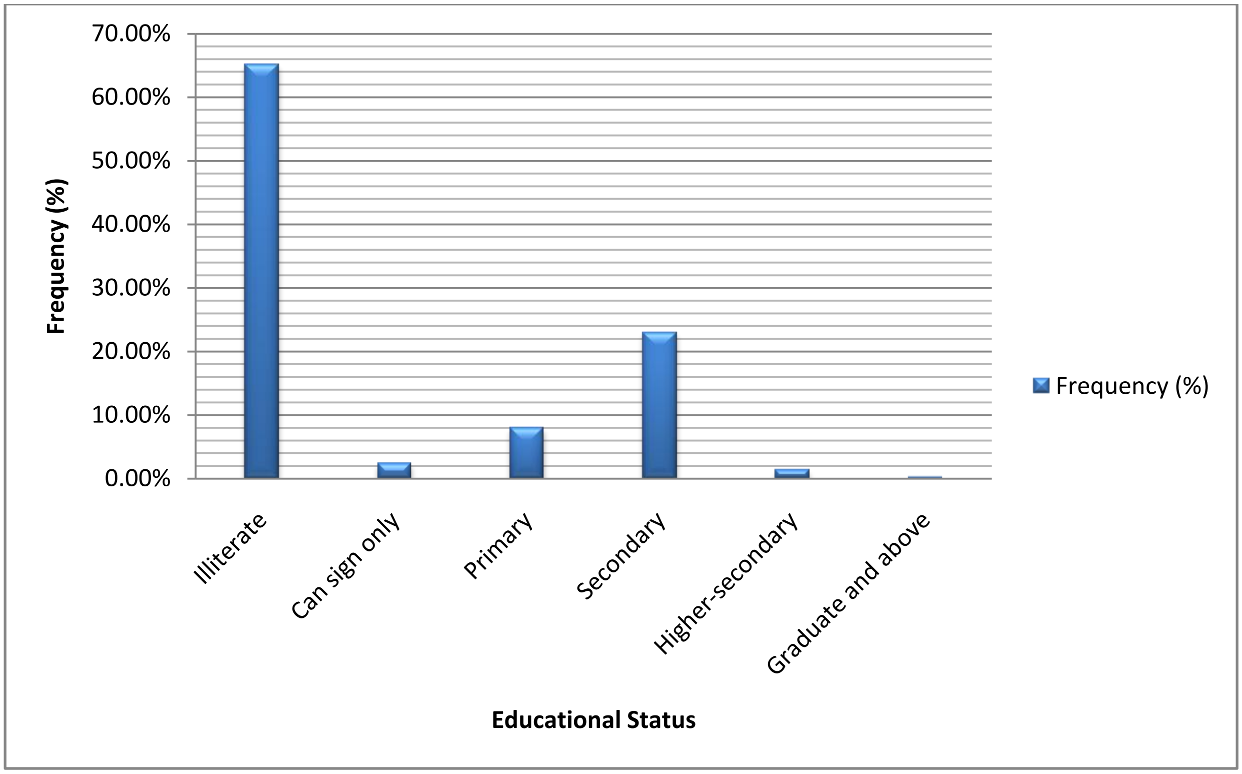
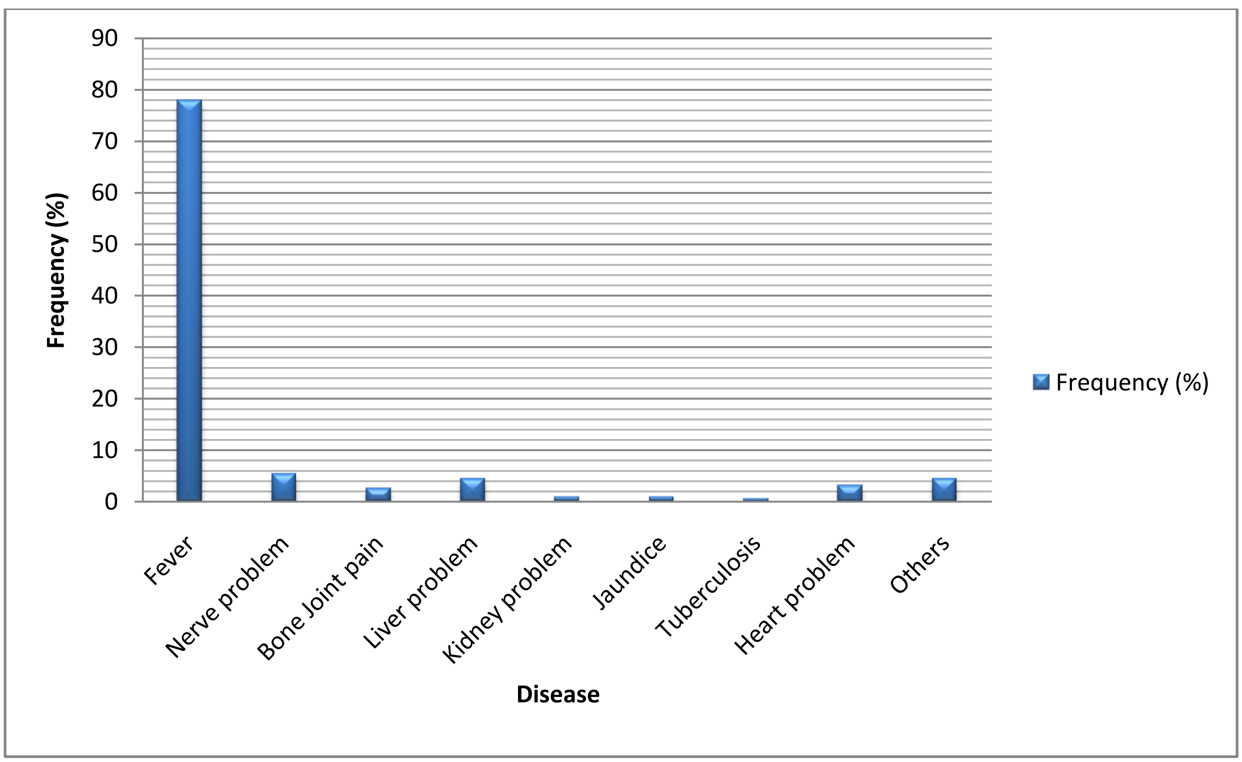


Figure (6.2): Present the disease frequency of the studied population.



CHAPTER –VII

RESULT – IV

CENTRAL ADIPOSITY

CHAPTER –VII

Result - IV

Central Adiposity

Table (7.1) present the prevalence of central obesity based on WHR, CI and WHTR. The prevalence of central obesity on WHR, CI and WHTR were 88.00%, 26.10 and 18.00% respectively. Among the three indicators of central obesity, WHR was the height frequency (88.00%), whereas on the basis on WHTR the rate was 18.00%.

Table (7.2): described the anthropometric characteristics (mean and SD) and't' test of the studied population. Two groups were divided based on WHR normal (≤0.90) and obese (>0.90). From the table it was clear that except, HT, SIH and SIH, all anthropometric variables, WT, MUAC, CC, HPC,TSF, BSF,SSF, and SISF were negatively significant (P<0.001). In case of WC the level of significant was (p<0.01). The mean values all of the anthropometric variables were higher among the obese category, than the normal category.

Table (7.3): described the anthropometric characteristics (mean and SD) and 't' test of the studied population. Two groups were divided based on WHR, normal (≤0.90) and obese (>0.90). From the table it was clear that all derived variables of anthropometry, BMI, PBF,FM, FMI, FFMI, MUAA, MUAMA, MUAFA, CI, WHTR and BMAI were negatively significant (P<0.001) and PBF, BAI and AFI were negatively significant (p<0.01) levels. Only FFM was negatively significant at (p<0.05) level. The mean values all of the derived variables of anthropometry were higher among the obese group, than the normal group.

Table (7.4) presents the relationship between WHR and nutritional status (based on BMI) of the study population. The prevalence of CED was higher (53.33%) among the normal categories based on WHR. On the other hand the prevalence of overweight was higher (11.60%) among the centrally obese category, based on WHR. There were statistical significant (x2=31.26, DF=2, P<0.001) differentiation among the two groups.

From the table (7.5) we known the anthropometric characteristics (mean and SD) and‘t’ values of the studied population. Two groups were divided based on CI normal (≤1.25) and obese (>1.25). From the table it was clear that except, HT, SIH and SIH, all anthropometric variables, WT, MUAC, CC, WC, HPC,TSF, BSF,SSF, and SISF were negatively significant (P<0.001). The mean values all of the anthropometric variables were higher among the obese category, than the normal category.

Table (7.6): described the derived measurement of anthropometric characteristics (mean and SD) and ‘t’ test of the studied population. Two groups were divided based on CI normal (≤1.25) and obese (>1.25). From the table it was clear that excepts, FFM and FFMI, all derived variables of anthropometry, BMI, PBF,FM, FMI, BAI, MUAA, MUAFA, AFI, WHR, WHTR ,BMAI were negatively significant (P<0.001) and MUAMA negatively significant at the level (p<0.01). The mean values all of the derived variables of anthropometry were higher among the obese group, than the normal group.

Table (7.7) presents the relationship between CI and nutritional status (based on BMI) of the study population. The prevalence of CED was higher (28.10%) among the normal categories on based on CI. On the other hand the prevalence of overweight was higher (13.70%) among the centrally obese category, based on CI. There were statistical significant (x2=36.98, DF=2, P<0.001) differentiation among the two groups.

Table (7.8): described the anthropometric characteristics (mean and SD) and‘t’ test of the studied population. Two groups were divided based on WHTR normal (≤0.50) and obese (>0.50). From the table it was clear that except, STH all anthropometric variables, WT, MUAC, WC, HPC,TSF, BSF,SSF,SISF were negatively significant (P<0.001) and SIH was positively significant at the (p<0.01) level. HT was positively significant at (p<0.05) level. The mean values all of the anthropometric variables were higher among the obese category, than the normal category.

Table (7.9): described the derived measurement of anthropometric characteristics (mean and SD) and ‘t’ test of the studied population. Two groups were divided based on WHTR normal (≤0.50) and obese (>0.50). From the table it was clear that, all derived variables of anthropometry, BMI, PBF,FM, FFM, FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHR, CI, and BMAI were negatively significant (P<0.001). The mean values all of the derived variables of anthropometry were higher among the obese group, than the normal group.

The relationship between WHTR and nutritional status (based on BMI) of the study population was presented in the table (7.10). The prevalence of CED was higher (29.70%) among the normal categories on based on WHTR. On the other hand the prevalence of overweight was higher (25.60%) among the centrally obese category, based on WHTR. There were statistical significant (x2=123.41, DF=2, P<0.001) differentiation among the two groups.

Summary

1. The prevalence of central obesity cut off value of WHR, CI and WHTR were 88.00%, 26.10 and 18.00% respectively. 't' test between two groups (based on WHR), all anthropometric variables, WT, MUAC, CC, HPC,TSF, BSF,SSF, and SISF were negatively significant (P<0.001). Only WC the level of significant was (p<0.01). All derived variables of anthropometry, BMI, PBF,FM, FMI, FFMI, MUAA, MUAMA, MUAFA, CI, WHTR and BMAI were also negatively significant (P<0.001) and PBF, BAI and AFI were negatively significant (p<0.01) levels. Only FFM was negatively significant at (p<0.05) level. The mean values all of the anthropometric and derived variables were higher among the obese category, than the normal category. The prevalence of overweight was higher (11.60%) among the centrally obese category, based on WHR. There were statistical significant (x2=31.26, DF=2, P<0.001) differentiation among the two groups.

2. All anthropometric variables, WT, MUAC, CC, WC, HPC, TSF, BSF, SSF, and SISF were negative significant (P<0.001) differentiation among the two groups based on CI. All derived variables of anthropometry, BMI, PBF,FM, FMI, BAI, MUAA, MUAFA, AFI, WHR, WHTR ,BMAI were also negatively significant (P<0.001) and MUAMA negatively significant at the level (p<0.01). The mean values all of the anthropometric variables were higher among the obese category, than the normal category. The prevalence of overweight was higher (13.70%) among the centrally

obese category, based on CI. There were statistical significant (x2=36.98, DF=2, P<0.001) differentiation among the two groups.

3. All anthropometric variables, WT, MUAC, WC, HPC, TSF, BSF, SSF, SISF were negatively significant (P<0.001) and SIH, HT were positively significant at the (p<0.01), (p<0.05) level respectively, among the two groups, based on WHTR. All derived variables of anthropometry, BMI, PBF,FM, FFM, FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHR, CI, and BMAI were negatively significant (P<0.001). The mean values all of the anthropometric and derived variables were higher among the obese category, than the normal category. The prevalence of overweight was higher (25.60%) among the centrally obese category, based on WHTR. There were statistical significant (x2=123.41, DF=2, P<0.001) differentiation among the two groups.

Table (7.1): Prevalence of central obesity based on WHR, CI and WHTR.

WHR	Category	Frequency	Percent (%)
≤0.90	**Normal**	60	12.00
>0.90	**Obese**	441	88.00
CI			
≤1.25	**Normal**	370	73.90
>1.25	**Obese**	131	26.1
WHTR			
≤0.50	**Normal**	411	82.00
>0.50	**Obese**	90	18.00

Table (7.2): Mean and SD of anthropometric characteristics according to WHR.

Variables	WHR category				't' value
	Normal (≤0.90)		Obese (>0.90)		
	Mean	SD	Mean	SD	
HT (cm)	164.22	6.92	163.78	5.76	NS
WT (kg)	50.21	6.75	54.60	7.10	-4.53**
STH (cm)	82.07	3.68	82.23	3.25	NS
SIH (cm)	82.16	4.71	81.55	4.38	NS
MUAC (cm)	23.37	1.81	24.72	2.04	-4.86**
CC (cm)	80.24	4.66	83.94	4.97	-5.44**
WC (CM)	68.36	4.11	76.99	7.00	-9.33**
HC (cm)	78.07	4.78	80.29	5.18	-3.14*
TSF (mm)	4.46	1.99	5.92	3.04	-4.94**
BSF (mm)	2.78	1.00	3.78	2.05	-6.22**
SSF (mm)	7.86	2.83	10.73	5.64	-6.32**
SISF (mm)	4.52	2.43	7.42	4.92	-7.40**

*p<0.01, **p<0.001 Level of significant, NS= Not significant.

Table (7.3): Mean and SD of derived measurement of anthropometric characteristics according to WHR.

Variables	WHR category				't' value
	Normal (≤0.90)		Obese (>0.90)		
	Mean	SD	Mean	SD	
BMI (kg/m^2)	18.58	1.92	20.35	2.36	-5.54***
TBW (Lt)	33.88	3.09	35.01	2.90	-2.81**
PBF (%)	7.43	4.47	11.64	6.09	-6.51***
FM (kg)	3.88	2.71	6.65	4.31	-6.83***
FFM(kg)	46.33	5.38	47.95	4.48	-2.56*
FMI (kg/m^2)	1.43	0.97	2.48	1.60	-7.16***
FFMI (kg/m^2)	17.15	1.41	17.87	1.29	-3.99***
BAI	19.15	2.34	20.35	2.67	-3.32**
MUAA (mm^2)	699.09	111.38	782.70	132.47	-4.67***
MUAMA (mm^2)	381.08	56.77	412.23	55.78	-4.00***
MUAFA (mm^2)	318.01	60.90	370.47	86.75	-4.53***
AFI	45.35	2.79	46.97	3.58	-3.38**
CI	1.14	0.05	1.22	0.06	-13.06***
WHTR	0.42	0.02	0.47	0.04	-14.83***
BMAI	12.75	1.87	15.80	3.27	-10.61***

*p<0.05, **p<0.01, ***p<0.001, Level of significant.

Table (7.4): Relationship between WHR and nutritional status based on BMI (WHO-2000).

WHR Categories	Nutritional status based on BMI			Total
	CED	Normal	Overweight	
Normal (≤0.90)	32 (53.33%)	26 (43.33%)	2 (3.33%)	60
Obese (>0.90)	91 (20.60%)	299 (67.80%)	51 (11.60%)	441
Total	123 (24.60%)	325 (64.90%)	53 (10.60%)	501

Chi-square-31.26, (DF=2) p<0.001.

Table (7.5): Mean and SD of anthropometric characteristics according to CI

Variables	CI category				't' value
	Normal (≤1.25)		Obese (>1.25)		
	Mean	SD	Mean	SD	
HT (cm)	163.62	5.96	164.45	5.72	NS
WT (kg)	52.75	6.14	57.82	8.54	-6.24*
STH (cm)	82.16	3.36	82.35	3.15	NS
SIH (cm)	81.46	4.47	82.09	4.27	NS
MUAC (cm)	24.23	1.80	25.48	2.44	-5.38*
CC (cm)	82.34	4.22	86.75	5.85	-7.93*
WC (cm)	73.17	4.88	83.83	7.19	-15.72*
HC (cm)	78.54	4.18	84.21	5.45	-10.83*
TSF (mm)	4.99	2.07	7.87	3.94	-7.96*
BSF (mm)	3.19	1.33	4.98	2.77	-7.09*
SSF (mm)	8.75	3.36	14.99	7.32	-9.42*
SISF (mm)	5.85	3.37	10.52	6.29	-8.11*

*p<0.001, Level of Significant, NS= Not significant

Table (7.6): Mean and SD of derived measurement of anthropometric characteristics according to CI

Variables	CI category				't' value
	Normal (≤1.25)		Obese (>1.25)		
	Mean	SD	Mean	SD	
BMI (kg/m^2)	19.69	2.00	21.38	2.96	-6.07**
TBW (Lt)	34.58	2.72	35.71	3.34	-3.81**
PBF (%)	9.39	4.75	16.05	6.69	-10.50**
FM (kg)	5.11	3.00	9.72	2.27	-9.47**
FFM (kg)	47.64	4.63	48.10	4.60	NS
FMI (kg/m^2)	1.91	1.14	3.60	1.94	-9.37**
FFMI (kg/m^2)	17.78	1.30	17.78	1.37	NS
BAI	19.58	2.27	21.99	2.88	-8.67**
MUAA (mm^2)	751.09	113.22	833.68	162.50	-5.37**
MUAMA (mm^2)	405.15	55.11	417.97	60.39	-2.14*
MUAFA (mm^2)	345.94	64.84	415.71	112.76	-6.70**
AFI	45.89	2.67	49.28	4.37	-8.34**
WHR	0.93	0.04	0.99	0.04	-16.19**
WHTR	0.45	0.03	0.51	0.04	-14.81**
BMAI	14.48	2.29	18.12	4.08	-9.65**

*p<0.05, **p<0.001 Level of significant, NS= Not Significant

Table (7.7): Relationship between CI and nutritional status based on BMI (WHO-1995)

CI Category	Nutritional status based on BMI			Total
	CED	Normal	overweight	
Normal (≤1.25)	104 (28.10%)	260 (70.30%)	6 (1.60%)	370
Obese (>1.25)	19 (14.50%)	94 (71.80%)	18 (13.70%)	131
Total	123 (24.60%)	354 (70.70%)	24 (4.80%)	501

Chi-square 36.98 (DF=2) p<0.001.

Table (7.8): Mean and SD of anthropometric characteristics according to waist-height ratio

Variables	Waist-height ratio category				't' value
	Normal (≤0.5)		Obese (>0.5)		
	Mean	SD	Mean	SD	
HT (cm)	164.11	5.92	162.59	5.72	2.22*
WT (kg)	52.34	5.72	61.99	7.94	-10.93***
STH (cm)	82.23	3.40	82.12	2.85	NS
SIH (cm)	81.88	4.39	80.46	4.39	2.77**
MUAC (cm)	24.06	1.68	26.78	2.19	-11.09***
CC (cm)	82.6	3.92	89.56	5.37	-12.38**
WC (CM)	73.49	4.73	87.22	6.22	-19.74***
HC (cm)	78.57	3.92	86.64	5.10	-12.55***
TSF (mm)	4.86	1.84	9.82	3.66	-14.12***
BSF (mm)	3.11	1.08	6.19	2.95	-9.76***
SSF (mm)	8.61	2.89	18.98	6.94	-13.24***
SISF (mm)	5.64	2.84	13.62	6.19	-11.69***

*p<0.05, **p<0.01, ***p<0.001, Level of Significant, NS= Not significant

Table (7.9): Mean and SD of derived measurement of anthropometric characteristics according to waist-height ratio

Variables	Waist-height ratio category				't' value
	Normal (≤0.5)		Obese (>0.5)		
	Mean	SD	Mean	SD	
BMI (kg/m^2)	19.42	1.69	23.41	2.37	-15.20*
TBW (Lt)	34.44	2.65	36.87	3.36	-6.44*
PBF (%)	9.02	4.30	19.95	5.10	-18.61*
FM (kg)	4.97	2.61	12.64	4.53	-15.56*
FFM (kg)	47.41	4.52	49.36	4.75	-3.56*
FMI (kg/m^2)	1.83	0.95	4.76	1.64	-16.43*
FFMI (kg/m^2)	17.59	1.27	18.65	1.21	-7.47*
BAI	19.42	1.99	23.82	2.32	-16.69*
MUAA (mm^2)	740.64	103.95	919	151.51	-10.63*
MUAMA (mm^2)	400.88	52.94	443.30	60.75	-6.13*
MUAFA (mm^2)	339.76	57.20	475.72	104.37	-11.97*
AFI	45.76	2.47	51.43	3.89	-13.26*
WHR	0.94	0.04	1.01	0.04	-16.40*
CI	1.20	0.05	1.30	0.05	-16.75*
BMAI	14.32	1.92	20.53	3.41	-16.72*

*p<0.001 Level of significant

Table (7.10): Relationship between WHTR and nutritional status based on BMI (WHO-1995).

WHTR	Nutritional status based on BMI			Total
	CED	Normal	overweight	
≤0.50	122 (29.70%)	288 (70.10%)	1 (0.20%)	411
>0.50	1 (1.10)	66 (73.30%)	23 (25.60%)	90
Total	123 (24.60%)	354 (70.70%)	24 (4.80%)	501

Chi-square- 123.41 (DF=2) p<0.001.

CHAPTER-VIII

RESULT – V

LIFESTYLE PATTERN OF THE SUBJECTS

CHAPTER-VIII

Result - V

Lifestyle pattern of the subjects

On the basis of the result of the pilot study, the frequency of consumption of the following most commonly eaten food items were calculated: egg, milk, fish, chicken, mutton, beef, ghee (clarified butter), butter, potato (in any form), fresh vegetables (except potato), leaf vegetables, fruits, Bengali sweets, chop, soft drinks and fried snacks. The results are presented in table (8.1) milk, chiken, mutton, ghee, Butter, milk, fruits, chop, soft drinks, fried snack and other fast food were almost never consumed by 74.10%, 68.30%, 95.40%, 98.20%, 99.50%, 67.30%, 64.70%, 97.40%, 98.50% and 99.20% of the subjects, respectively. Potato was consumed seven times or more in a week by 99.5% of the subjects. 71.40%, 78.40%, 70.40%, 58.40% and 51.80% of the subjects consumed egg, fish, beef, leaf vegetables, and sweets respectively, 1-3 times in a week. 85.50% of the subjects were consumed fresh vegetables 4-6 times in a week.

Table (8.2) presents the frequency of smoking habits of the studied population. 70.10%, 13.00% and 17.00% were regular smoker, occasional smoker and non-smoker respectively. Table (8.3) shows the relationship between the smoking habits and health status. From the table we found that frequency of illness were higher (67.80%) among the regular smoker group than the others two groups. In case of occasional smoker the frequency of illness was lower (12.00%) than the non smoker (20.00%). There were a statistical significant differences found among smoking habits and health status (chi-square=9.25, DF=2, $P<0.05$).

Table (8.4) presents the alcohol intake frequency of studied population. In the present study 5.60% was regularly intake alcohol. 23.60% was occasionally intake alcohol and 70.90% was never intake alcohol. Table (8.5) also; present the frequency of tobacco-chew habits among the studied population. In the present study 3.80% was belong to regularly category. 24.60% was occasional category and 71.70% was never practiced tobacco-chew.

Table (8.6) shows that the frequencies of consumption various types of foods were correlated. The frequency of consumption of milk with fish and chicken, were positively correlated ($p<0.05$) and milk with fresh vegetables, fresh leaf vegetables were negatively correlate ($p<0.01$). Beef and mutton were negatively correlated ($p<0.01$).others fast food were positively correlated with fresh fruits, sweets and soft drinks ($p<0.01$). Chicken, beef and mutton were negatively correlated with fresh vegetables and leaf vegetables ($p<0.01$).

The mean (SD) values of anthropometric characteristics for each groups based on smoking habits shown in table (8.7). Above analysis indicated that in case of WT and WC were statistically significant ($p<0.05$), and MUAC, HPC, BSF and SSF were significant at the level of ($p<0.01$). TSF and SISF were statistical significant ($p<0.001$) differentiations among the three smoker groups. The mean values of the significant variables variable were increased smoker to occasional and nonsmoker.

The mean (SD) values of derived variables of anthropometric characteristics for each group based on smoking habits were shown in table (8.8). Derived variables of anthropometry, BMI, PBF, FMI, BAI and AFI were statistically significant ($p<0.001$). MUAA, MUFA and BMAI were significant at ($p<0.01$) level. In case of WHTR was significant at the level of ($p<0.05$). The mean values of significant variables were increased smoker to occasional and nonsmoker.

Table (8.9) presents the relationship between smoking habits and nutritional status (based on BMI) of the study population. The prevalence of CED was higher (30.20%) among the regular smoker group, than the others two groups. There were statistical significant ($x2=21.12$, $DF=4$, $P<0.001$) differentiation among the groups. The prevalence of overweight was 4.27%, 4.60% and 7.10% among the smoker, occasional and nonsmoker groups respectively.

Table (8.10) presents the relationship between smoking habits and nutritional status (based on MUAC) of the study population. The prevalence of undernutrition was higher (27.10%) among the regular smoker group, than the others two groups. There were statistical significant (x2=14.12, DF=4, P<0.001) differentiation among the groups. The prevalence of normal individuals were 72.90%, 92.30% and 83.500% among the smoker, occasional and nonsmoker groups respectively.

Summary

1. Milk, chicken, mutton, ghee, Butter, milk, fruits, chop, soft drinks, fried snack and other fast food were almost never consumed by 74.10%, 68.30%, 95.40%, 98.20%, 99.50%, 67.30%, 64.70%, 97.40%, 98.50% and 99.20% of the subjects, respectively. Potato was consumed seven times or more in a week by 99.5% of the subjects.

2. The frequency of smoking habits were 70.10%, 13.00% and 17.00%, regular smoker, occasional smoker and non-smoker respectively.

3. 5.60% was regularly intake alcohol. 23.60% was occasionally intake alcohol and 70.90% was never intake alcohol.

4. The frequency of tobacco-chew habits 3.80% was belonging to regularly category. 24.60% was occasional category and 71.70% was never practiced tobacco-chew.

5. Milk with fresh vegetables, fresh leaf vegetables were negatively correlate (p<0.01). Beef and mutton were negatively correlated (p<0.01).others fast food were positively correlated with fresh fruits, sweets and soft drinks (p<0.01). Chicken, beef and mutton were negatively correlated with fresh vegetables and leaf vegetables (p<0.01).

6. Smoking habits effect on anthropometric and body composition characteristics. WT and WC were statistically significant (p<0.05), and MUAC, HPC, BSF and SSF were significant at the level of (p<0.01). TSF and SISF were statistical significant (p<0.001) differentiations among the three smoker groups.). Derived variables of

anthropometry, BMI, PBF, FMI, BAI and AFI were statistically significant ($p<0.001$). MUAA, MUFA and BMAI were also significant at ($p<0.01$) level. In case of WHTR was significant at the level of ($p<0.05$). The mean values of the significant variables variable were increased smoker to occasional and nonsmoker.

7. The prevalence of CED was higher (30.20%) among the regular smoker group, than the others two groups. There were statistical significant (x2=21.12, DF=4, P<0.001) differentiation among the groups. The prevalence of overweight was 4.27%, 4.60% and 7.10% among the smoker, occasional and nonsmoker groups respectively. Based on MUAC the prevalence of undernutrition was higher (27.10%) among the regular smoker group, than the others two groups. There were statistical significant (x2=14.12, DF=4, P<0.001) differentiation among the groups. The prevalence of normal individuals was 72.90%, 92.30% and 83.500% among the smoker, occasional and nonsmoker groups respectively.

Table (8.1): Percentage of subjects consuming different food items in different Weekly frequencies

Food items	Times per week			
	0	1-3	4-6	≥ 7
Egg	12.6%	71.4%	12.3%	3.4%
Milk	74.7%	5.6%	3.8%	15.7%
Fish	3.9%	78.4%	15.2%	2.6%
Chicken	68.3%	30.9%	0.8%	0.0%
Mutton	95.4%	4.6%	0.0%	0.0%
Beef	29.6%	70.4%	0.0%	0.0%
Ghee	98.2%	0.3%	0.7%	0.8%
Butter	99.5%	0.5%	0.0%	0.0%
Fresh vegetables	0.3%	9.0%	85.8%	4.9%
Leaf vegetables	0.5%	58.4%	40.5%	0.5%
Fruits	67.3%	31.9%	0.6%	0.3%
Sweets	46.4%	51.8%	1.6%	0.3%
Chop	64.7%	32.2%	2.6%	0.5%
Soft-drink	97.4%	2.6%	0.0%	0.0%
Fried snack	98.5%	1.5%	0.0%	0.0%
Others fast food	99.2%	0.8%	0.0%	0.0%

Table (8.2): Frequency of smoking habits of the studied population

Categories	Frequency	Percentage (%)
Regular Smoker	351	70.1%
Occasional Smoker	65	13.0%
Non-smoker	85	17.0%

Table (8.3): Relationship between smoking habits and health status

Illness	Smoking status			Total
	Regular smoker	**Occasional smoker**	**Non-smoker**	
Yes	242 (67.80%)	43 (12.00%)	72 (20.20%)	357
No	109 (75.70%)	22 (15.30%)	13 (9.00%)	144
Total	351 (70.10%)	65 (13.00%)	85 (17.0%)	501

Chi-square= 9.25, df=2, $p<0.01$

Table (8.4): Alcohol intake frequency of the studied population

Categories	Frequency	Percentage
Regular intake alcohol	28	5.6%
Occasionally intake alcohol	118	23.6%
Never intake alcohol	355	70.9%

Table (8.5): Tobacco-chew habits among the studied population

Categories	Frequency	Percentage
Regular	19	3.8%
Occasional	123	24.6%
Never	359	71.7%

Table (8.6): Showing Pearson Correlation within various types of food, consumed by the studied population

Food item	Fish	Chicken	Mutton	Beef	Ghee	Butter	Fresh vegetables	Fresh leaf vegt	Fruits	sweets	Cops	Soft drinks	Chips	Others fast food
Milk	0.12*	0.13*	NS	NS	0.13**	0.15**	-0.18**	-0.21**	0.20**	0.28**	0.21**	NS	0.18**	NS
Fish		0.14**	NS	NS	NS	-0.20**	-0.11*	0.18**	0.27**	0.21**	NS	NS	NS	NS
Chicken			NS	NS	NS	NS	-0.31**	-0.19**	0.163**	0.20**	0.25**	0.14**	NS	NS
Mutton				-0.25**	0.24**	NS	-0.20**	-0.19**	NS	NS	NS	NS	NS	NS
Beef					NS	NS	-0.11*	-0.23**	NS	NS	0.13**	NS	NS	NS
Ghee						NS	NS	-0.10*	NS	0.17**	0.12*	NS	0.11**	NS
Butter							NS	NS	NS	NS	NS	NS	NS	NS
Fresh vegt								0.67**	-0.17**	-0.24**	-0.12*	NS	-0.11*	NS
Leaf vegt									-0.16**	-0.28**	-0.12*	NS	NS	NS
Fruits										0.34**	0.22**	NS	0.31**	0.13**
Sweets											0.51**	0.13**	0.14	0.16**
Cops												0.13**	0.11*	NS
Soft drinks													0.26**	0.25**
Chips														NS

*P<0.05, **P<0.01 level of significant

Table (8.7): smoking habits and anthropometric characteristics of the studied population

Variables		Smoking Habits			'F' value
		Regular Smoker (N=351)	**Occasional Smoker (N=65)**	**Non-smoker (N=85)**	
HT (cm)	Mean	164.03	164.34	162.66	2.132
	SD	5.96	5.22	6.07	
WT (kg)	Mean	53.46	55.98	55.17	4.596*
	SD	7.53	6.01	6.25	
STH (cm)	Mean	82.15	82.90	81.92	1.795
	SD	3.47	2.41	3.14	
SIL (cm)	Mean	81.87	81.44	80.73	2.362
	SD	4.41	4.20	4.54	
MUAC (cm)	Mean	24.35	25.06	25.00	5.653**
	SD	2.11	1.85	1.89	
CHEST (cm)	Mean	83.22	84.55	83.84	2.129
	SD	5.19	4.88	4.68	
WAIST (cm)	Mean	75.43	77.34	77.04	3.034*
	SD	7.32	7.06	7.12	
HIP (cm)	Mean	79.58	80.66	81.37	4.698**
	SD	5.33	4.71	4.67	
TSF (mm)	Mean	5.39	6.51	6.63	8.626***
	SD	2.80	3.03	3.30	
BSF (mm)	Mean	3.46	4.15	4.11	6.241**
	SD	1.87	1.79	2.41	
SSF (mm)	Mean	9.85	10.87	12.20	6.754**
	SD	5.32	5.32	5.75	
SISF (mm)	Mean	6.48	7.91	8.89	10.230***
	SD	4.39	4.65	5.83	

Level of significant *p<0.05, **p<0.01, ***p<0.001.

Table (8.8): smoking habits and derived measurement of anthropometry

Variables		Smoking Habits			'F' value
		Regular Smoker (N=351)	**Occasional Smoker (N=65)**	**Non-smoker (N=85)**	
BMI (kg/m^2)	Mean	19.85	20.73	20.87	8.792***
	SD	2.43	2.01	2.22	
TBW (Lt)	Mean	34.71	35.43	35.15	2.126
	SD	3.08	2.45	2.61	
PBF (%)	Mean	10.30	12.60	13.44	11.778***
	SD	5.80	5.96	6.50	
FM (kg)	Mean	5.82	7.27	7.66	8.530***
	SD	4.19	4.01	4.25	
FFM (kg)	Mean	47.64	48.71	47.51	1.613
	SD	4.79	4.08	4.25	
FMI (kg/m^2)	Mean	2.16	2.70	2.91	9.924***
	SD	1.53	1.50	1.64	
FFMI (kg/m^2)	Mean	17.69	18.03	17.96	2.694
	SD	1.36	1.16	1.26	
BAI	Mean	19.92	20.32	21.29	9.437***
	SD	2.62	2.41	2.75	
MUAA (mm^2)	Mean	760.48	803.26	799.73	5.047**
	SD	135.59	122.60	122.02	
MUAMA (mm^2)	Mean	405.46	417.42	414.22	1.741
	SD	58.58	48.79	54.13	
MUAFA (mm^2)	Mean	355.01	385.85	385.51	6.871**
	SD	85.57	83.75	82.01	
AFI	Mean	46.34	47.70	47.88	9.384***
	SD	3.27	3.62	4.09	
WHR	Mean	0.95	0.96	0.95	1.619
	SD	0.04	0.04	0.05	
CI	Mean	1.21	1.22	1.21	0.029
	SD	0.06	0.07	0.07	
WHTR	Mean	0.46	0.47	0.47	4.481*
	SD	0.04	0.04	0.05	
BMAI	Mean	15.12	16.14	16.18	5.416**
	SD	3.37	2.94	3.00	

Level of significant *p<0.05, **p<0.01, ***p<0.001.

Table (8.9): Relationship between smoking habits and nutritional status based on BMI (WHO-1995).

Smoking Habits	**Nutritional Status based on BMI**			Total
	CED Frequency (%)	**Normal Frequency (%)**	**Overweight Frequency (%)**	
Regular Smoker	106 (30.2%)	230 (65.5%)	15 (%)	351
Occasional Smoker	6 (9.2%)	56 (86.2%)	3 (4.6%)	65
Non-smoker	11 (12.9%)	68 (80.0%)	6 (7.1%)	85
Total	123 (24.6%)	354 (70.7%)	24 (4.8%)	501

Chi-square 21.12, (DF=4), $p<0.001$.

Table (8.10): Relationship between smoking habits and nutritional status based on MUAC.

Smoking Habits	**Nutritional Status based on MUAC**		Total
	Under-nutrition Frequency (%)	**Normal frequency (%)**	
Regular Smoker	95 (27.1%)	256 (72.9%)	351
Occasional Smoker	5 (7.7%)	60 (92.3%)	65
Non-smoker	14 (16.5%)	71 (83.5%)	85
Total	114 (22.8%)	387 (77.2%)	501

Chi-square 14.12, $p<0.001$ (DF=2)

CHAPTER- IX

Result – VI

RELATIONSHIP OF WORK TYPE WITH ANTHROPOMETRY AND BODY COMPOSITION

CHAPTER- IX

Result - VI

Relationship of work type with Anthropometry and Body composition

The mean (SD) values of anthropometric characteristics for each groups based on type of work in the brick-kilns were shown in table (9.1). Above analysis indicated that in case of WT, WC and SSF were statistically significant differentiation ($p<0.05$) among the groups. TSF and BSF were also statistical significant ($p<0.001$) differentiations among the work groups.

The mean (SD) values of derived variables of anthropometric characteristics for each group based on type of work in the brick-kilns were shown in table (9.2). Derived variables of anthropometry, BMI, PBF, FM, FFM, FMI, MUFA, AFI, WHTR and BMAI were statistically significant differentiation ($p<0.05$) found the work group. TBW was statistically significant at the level ($p<0.001$).

Table (9.3) presents the relationship between type of work in the brick-kilns and nutritional status (based on BMI) of the study population. The CED was higher (53.10%) among the fireman, than the others groups. There were statistical significant (x2=23.39.12, DF=4, P<0.001) differentiation among the groups. The prevalence of CED were 17.60%, 23.30%, 25.30%, 18.20% and 22.00% among rubbishman, beldar, reza, patraman and unskilled workers respectively.

Table (9.4) presents the relationship between types of works in the brick kiln area and health status. The frequency of disease among beldar, fireman, reza, patraman, rubbishman and unskilled worker were 90.00%, 78.10%, 72.90%, 70.90%, 58.80% and 61.50% respectively. From the study we found that the worker, who work at near the brick kiln area the frequency of diseases were higher, than the worker, who work far from the kiln area. There was statistical significant differentiation among workers and health status (chi-square=11.64, DF=5, $p<0.05$).

Table (9.5) presents the relationship between type of work in the brick-kilns and obesity (based on WHTR) of the study population. The prevalence of obesity was higher (28.60%) among the unskilled workers, than the others groups. There were statistical significant ($x2=13.36$, $DF=5$, $P<0.05$) differentiation among the groups. The prevalence of obesity were 9.40%, 17.60%, 6.70%, 19.00% and 12.70% among fireman, rubbishman, beldar, reza, and patraman respectively.

Summary

1. Type of work in brick-kiln area was effect anthropometric and body composition characteristics. WT, WC and SSF were statistically significant differentiation at ($p<0.05$) level, and TSF, BSF were also statistical significant at ($p<0.001$) level.

2. Derived variables of anthropometry, BMI, PBF, FM, FFM, FMI, MUFA, AFI, WHTR and BMAI were statistically significant differentiation at ($p<0.05$) level. TBW was also statistically significant at the level ($p<0.001$).

3. The rates of CED was higher (53.10%) among the fireman, than the others groups. There were statistical significant ($x2=23.39.12$, $DF=4$, $P<0.001$) differentiation among the groups.

4. The prevalence of obesity (based on WHTR) was higher (28.60%) among the unskilled workers, than the others groups. There were statistical significant ($x2=13.36$, $DF=5$, $P<0.05$) differentiation among the groups.

Table (9.1): Mean and SD values of anthropometric variables according to work-type in the brick-kiln area

Variables		Fireman	Rubbishman	Beldar	Reza	Patraman	Un-skw	F
HT (cm)	Mean	162.42	162.03	166.43	164.14	163.25	163.79	2.201
	SD	4.79	5.27	5.23	5.92	6.01	6.19	
WT (kg)	Mean	50.13	53.41	54.97	54.34	53.49	55.37	2.903*
	SD	6.03	5.32	5.55	7.43	6.92	7.68	
STH (cm)	Mean	81.91	81.20	83.13	82.24	81.39	82.47	1.20
	SD	3.10	3.14	3.32	3.26	3.29	3.49	
SIL (cm)	Mean	80.51	80.23	83.30	81.90	81.32	81.31	1.750
	SD	3.23	3.04	4.31	4.60	4.32	4.60	
MUAC (cm)	Mean	23.73	24.43	24.65	24.48	24.56	24.99	1.592
	SD	1.93	1.44	2.09	2.15	1.76	2.25	
CC (cm)	Mean	81.15	83.19	83.93	83.85	83.08	83.87	1.890
	SD	3.19	4.01	4.00	5.26	4.65	5.94	
WC (cm)	Mean	72.09	76.48	75.32	76.29	75.35	77.33	2.812*
	SD	6.11	6.14	5.24	7.10	7.06	8.63	
HPC (cm)	Mean	77.05	80.03	80.14	80.60	79.21	80.62	3.523**
	SD	4.37	4.56	4.26	5.07	5.00	5.90	
TSF (mm)	Mean	4.65	5.45	5.13	5.83	5.35	6.66	3.396**
	SD	1.67	2.30	2.06	3.13	2.52	3.51	
BSF (mm)	Mean	3.12	3.36	3.18	3.52	3.69	4.38	3.616**
	SD	1.23	0.91	1.04	1.89	2.29	2.21	
SSF (mm)	Mean	8.56	9.99	9.31	10.65	9.74	11.59	2.286*
	SD	3.17	4.60	3.06	5.50	4.89	6.98	
SISF (mm)	Mean	5.78	6.72	5.76	7.17	6.82	8.10	1.865
	SD	3.21	3.74	2.51	5.17	4.06	5.60	

Level of significant *p<0.05, **p<0.01

Table (9.2) Mean and SD values of derive variables according to work- type in the brick-kiln area.

Variables		Fireman	Rubbishman	Beldar	Reza	Patraman	Un-skw	F
BMI (kg/m^2)	Mean	18.98	20.33	19.85	20.16	20.05	20.63	2.476*
	SD	1.98	1.63	1.85	2.49	2.22	2.60	
TBW (Lt)	Mean	33.03	33.86	35.56	35.19	34.43	35.27	4.772***
	SD	2.76	2.03	2.60	2.95	2.81	3.06	
PBF (%)	Mean	8.97	10.28	9.99	11.25	10.65	12.74	2.561*
	SD	4.34	5.44	4.32	6.23	5.71	6.89	
FM (kg)	Mean	4.61	5.64	5.67	6.43	5.96	7.43	2.750*
	SD	2.56	3.24	2.81	4.45	3.94	4.83	
FFM (kg)	Mean	45.52	47.77	49.30	47.91	47.52	47.95	2.336*
	SD	5.02	4.07	3.65	4.65	4.46	4.79	
FMI (kg/m^2)	Mean	1.75	2.15	2.03	2.39	2.23	2.77	2.717*
	SD	1.02	1.24	0.99	1.64	1.65	1.83	
FFMI (kg/m^2)	Mean	17.22	18.18	17.81	17.77	17.82	17.86	1.541
	SD	1.42	0.98	1.28	1.36	1.25	1.31	
BAI	Mean	19.27	20.81	19.34	20.39	20.01	20.51	2.185
	SD	2.47	1.73	1.87	2.74	2.48	2.99	
MUAA (mm^2)	Mean	721.18	762.42	778.71	768.86	771.48	801.49	1.907
	SD	117.83	90.72	132.15	139.44	112.93	146.04	
MUAMA (mm^2)	Mean	391.94	406.91	419.20	405.12	412.54	414.41	1.229
	SD	62.92	45.90	61.19	57.82	47.63	61.72	
MUAFA (mm^2)	Mean	329.24	355.51	359.51	363.73	358.94	387.04	2.536*
	SD	59.67	55.72	75.34	91.39	72.98	96.67	
AFI	Mean	45.57	46.51	45.92	46.90	46.25	47.87	3.510*
	SD	2.30	3.10	2.43	3.64	3.09	4.16	
WHR	Mean	0.93	0.95	0.94	0.94	0.95	0.96	1.689
	SD	0.05	0.04	0.03	0.05	0.04	0.05	
CI	Mean	1.19	1.22	1.20	1.22	1.21	1.22	1.378
	SD	0.06	0.06	0.06	0.06	0.06	0.08	
WHTR	Mean	0.44	0.47	0.45	0.46	0.46	0.47	2.607*
	SD	0.04	0.04	0.03	0.04	0.04	0.05	
BMAI	Mean	13.77	15.61	15.00	15.23	15.23	16.13	2.756*
	SD	2.43	2.31	2.16	3.38	3.09	3.76	

*p<0.05, ***p<0.001,Level of Significant.

Table (9.3): Nutritional status of the studied sample based on BMI (WHO-1995) according to their work categories

Work Categories	CED Frequency (%)	Normal Frequency (%)	Overweight Frequency (%)
Fireman (N=32)	17 (53.1%)	15 (46.9%)	0 (0.0%)
Rubbishman(N=17)	3 (17.6%)	14 (82.4%)	0 (0.0%)
Beldar (N=30)	7 (23.3%)	23 (76.7%)	0 (0.0%)
Reza (N=221)	56 (25.3%)	152 (68.8%)	13 (5.9%)
Patraman (N=110)	20 (18.2%)	86 (78.2%)	4 (3.6%)
Unskilled worker (N=91)	20 (22.0%)	64 (70.3%)	7 (7.7%)
Total (N=501)	123 (24.6%)	354 (70.7%)	24 (4.8%)

Chi-square-23.386, p<0.01

Table (9.4): Relationship between types of work in brick field and health status.

Type of work in brick-kiln area.	Health status(illness)		Total
	Yes	No	
Fireman	25 (78.10%)	7 (21.9%)	32
Rubbishman	10 (58.80%)	7 (41.20)	17
Beldar	27 (90.00%)	3 (10.00%)	30
Reza	161 (72.90%)	60 (27.10%)	221
Patraman	78 (70.90%)	32 (29.10%)	110
Unskilled-workers	56 (61.50%)	35 (38.50%)	91
Total	357 (71.30%)	144 (28.70%)	501

Chi-square=11.64, DF=5, p<0.05

Table (9.5): Relationship between WHTR and type of work in brick-kiln area

Work Category	WHTR Categories		Total
	Normal (≤0.50)	Obese (>0.50)	
Fireman	29 (90.60%)	3 (9.40%)	32
Rubbishman	14 (82.40%)	3 (17.60%)	17
Beldar	28 (93.30%)	2 (6.70%)	30
Reza	179 (81.00%)	42 (19.00%)	221
Patraman	96 (87.30%)	14 (12.70%)	110
Unskilled worker	65 (71.40%)	26 (28.60%)	91
Total	411 (82.00%)	90 (18.00%)	501

Chi-sqare-13.36, (DF=5), p<0.05

Figure (9.1): Showing the mean body weight (kg) according to their work category.

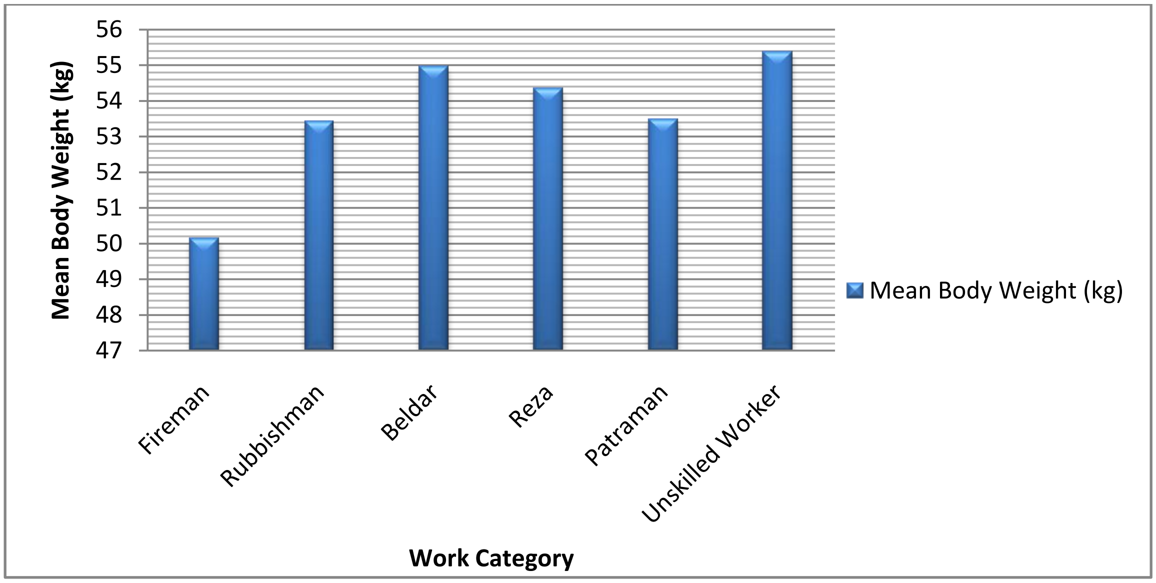


Figure (9.2): Showing the mean TSF (mm) according to their work category.

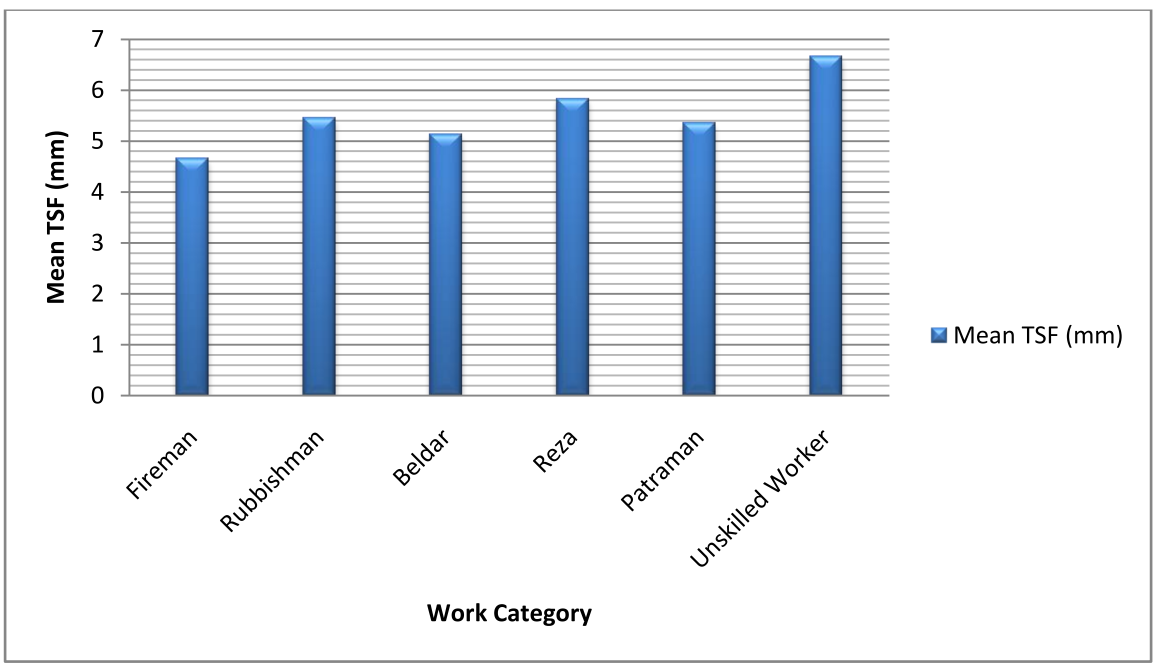


Figure (9.3): Showing the mean BSF (mm) according to their work category.

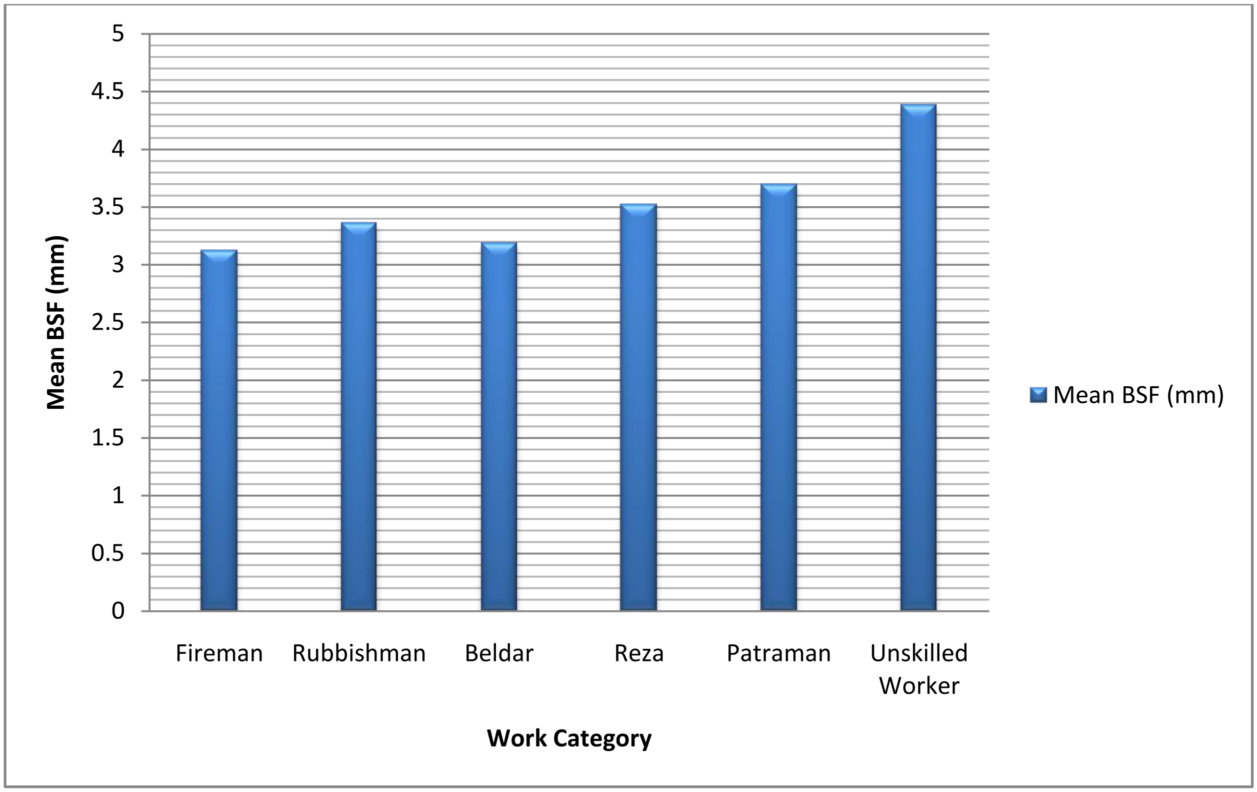


Figure (9.4): Showing the mean SSF (mm) according to their work category.

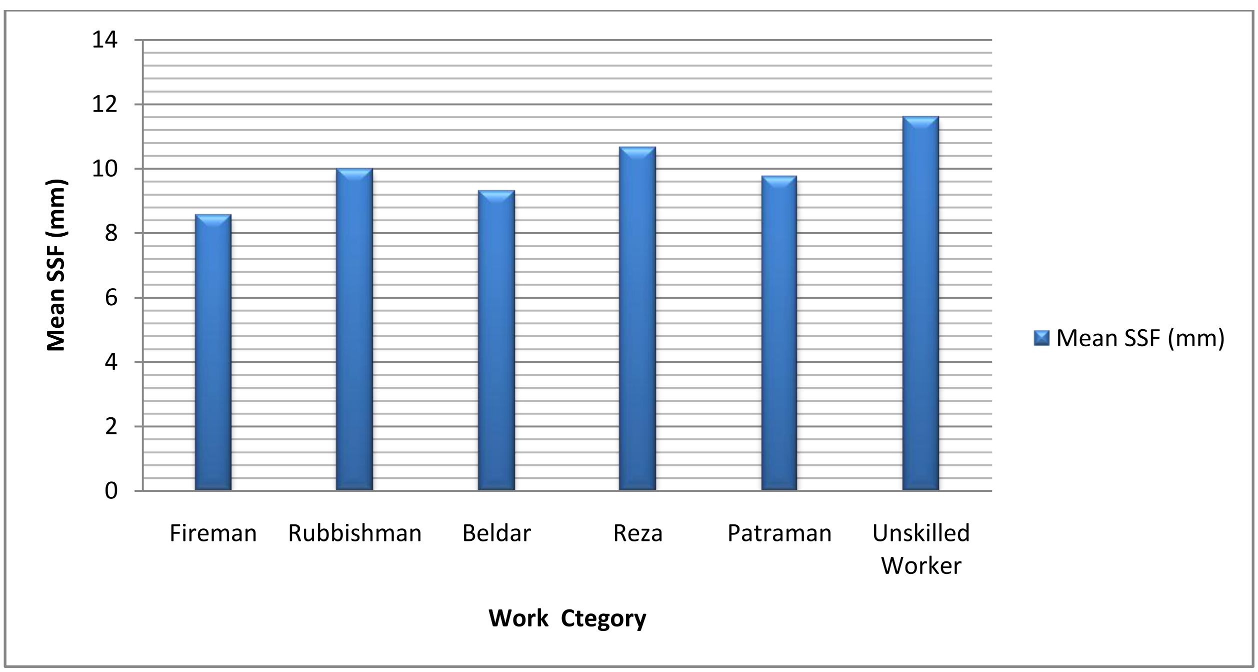


Figure (9.5): Showing the mean BMI (kg/m^2) according to their work category.

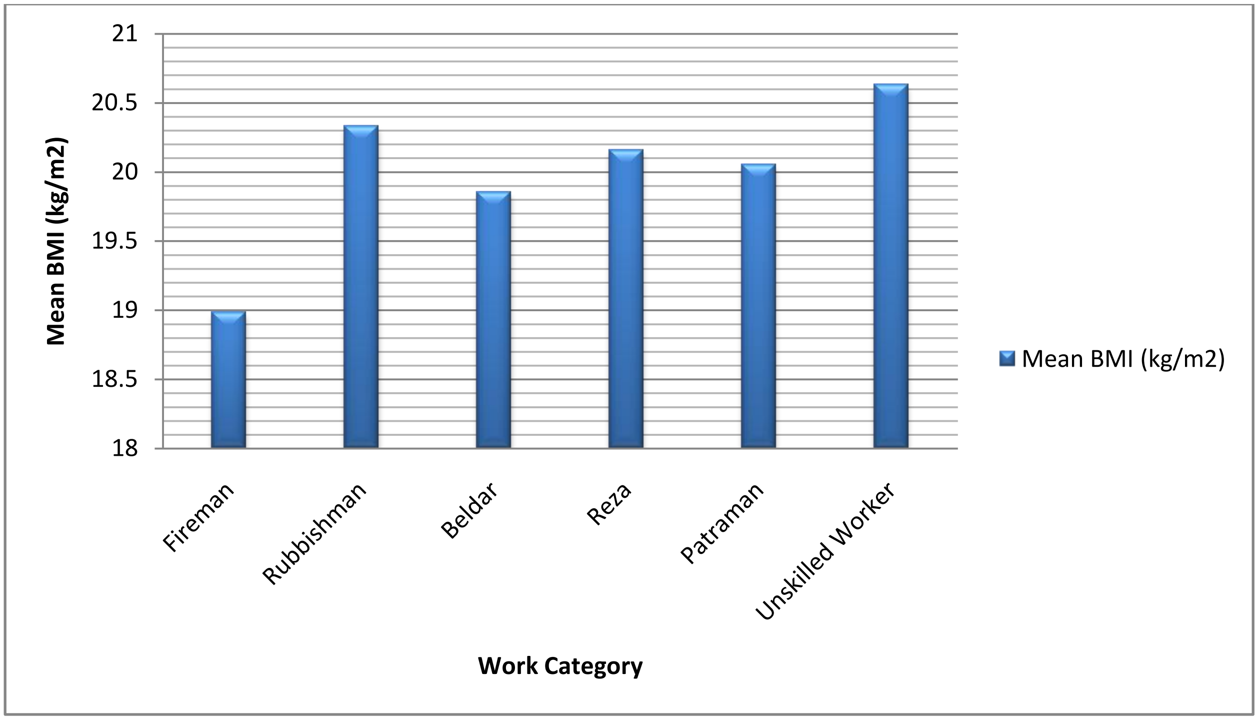


Figure (9.6): Showing the mean TBW (Lt) according to their work category.

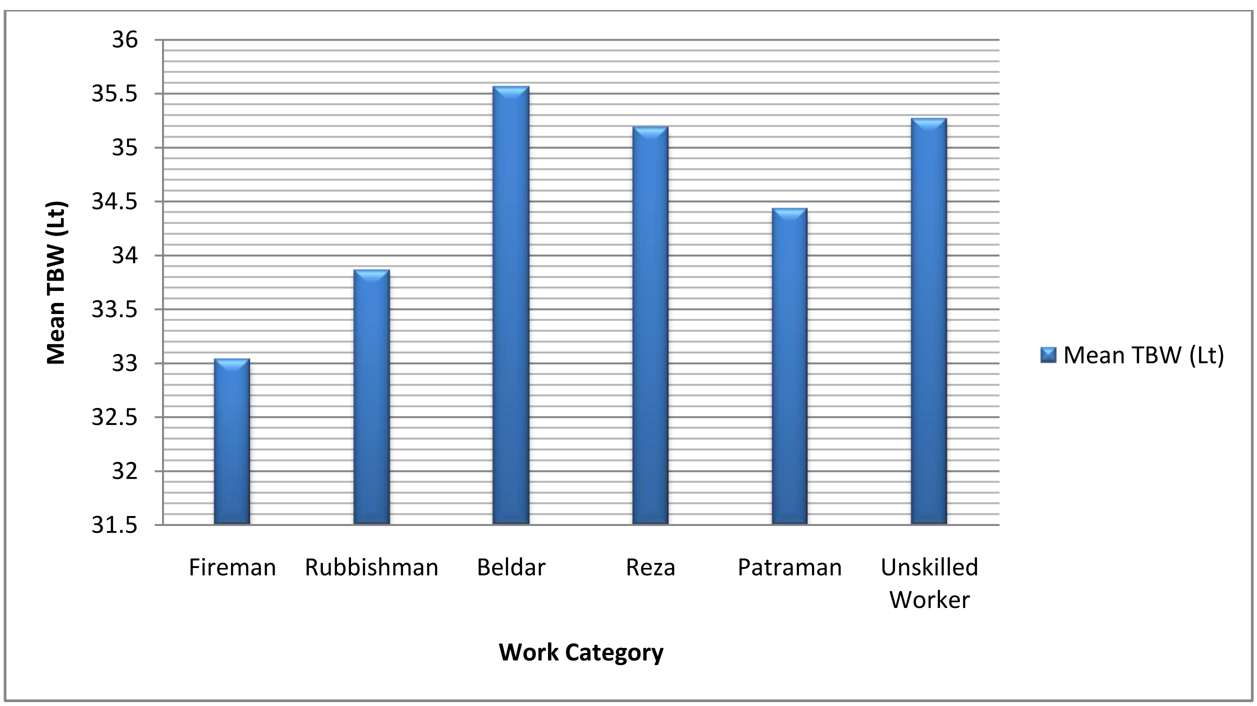


Figure (9.7): Showing the mean PBF (%) according to their work category.

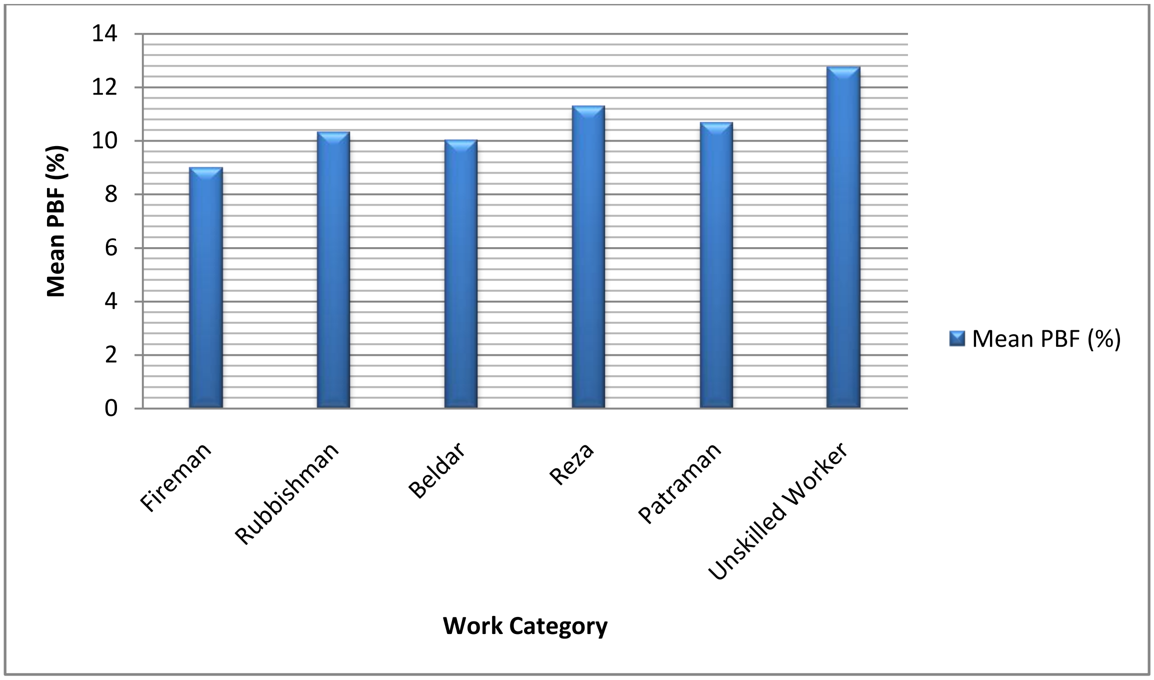


Figure (9.8): Showing the mean FM (kg) according to their work category.

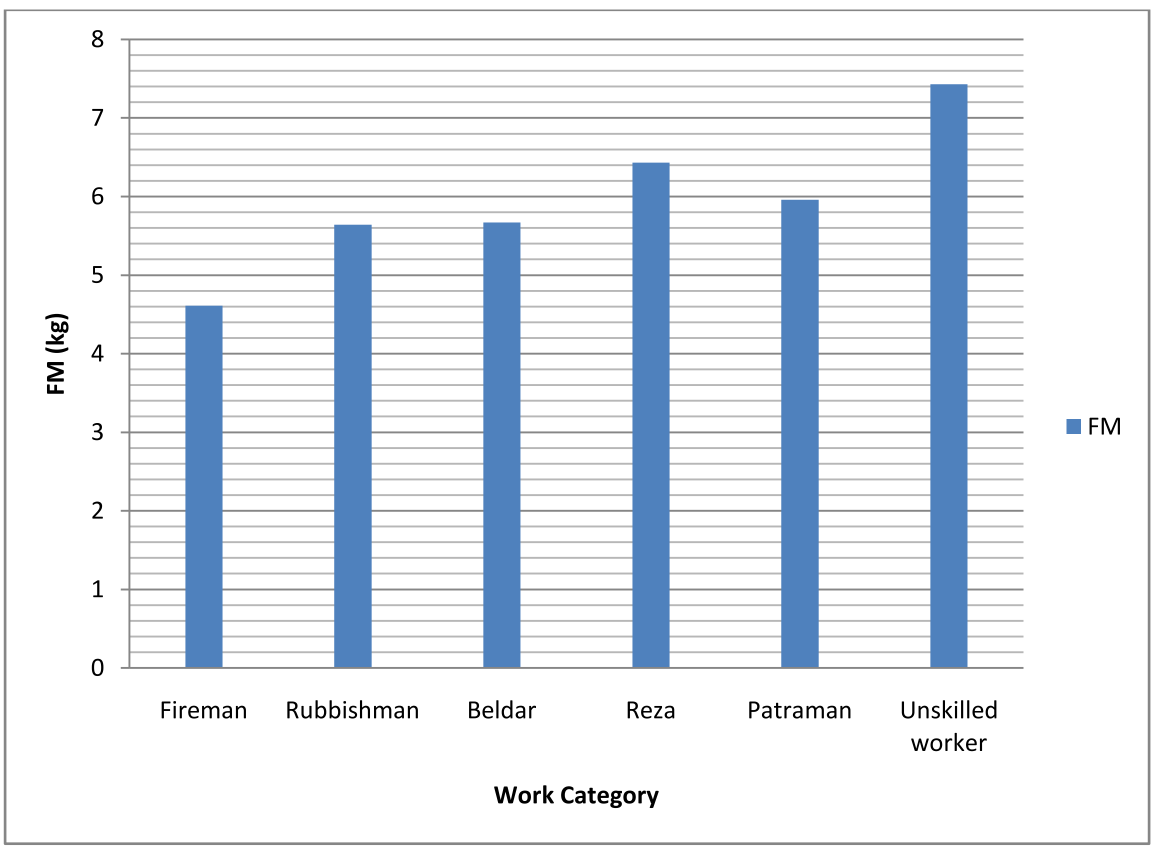


Figure (9.9): Showing the mean FFM (kg) according to their work category.

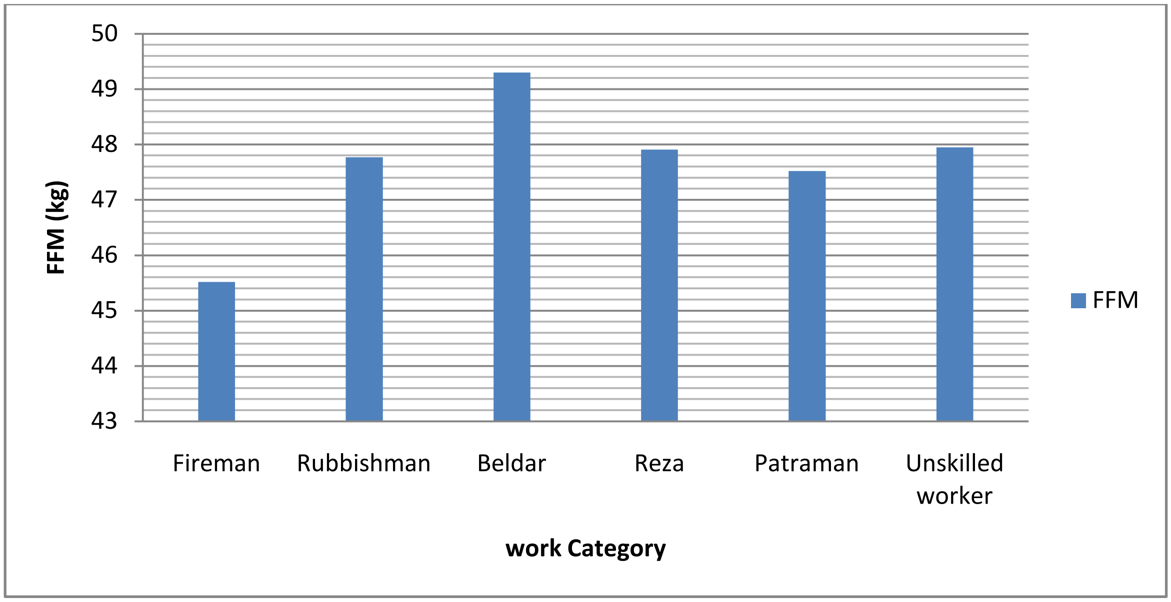


Figure (9.10): Showing the mean FMI (kg/m^2) according to their work category.

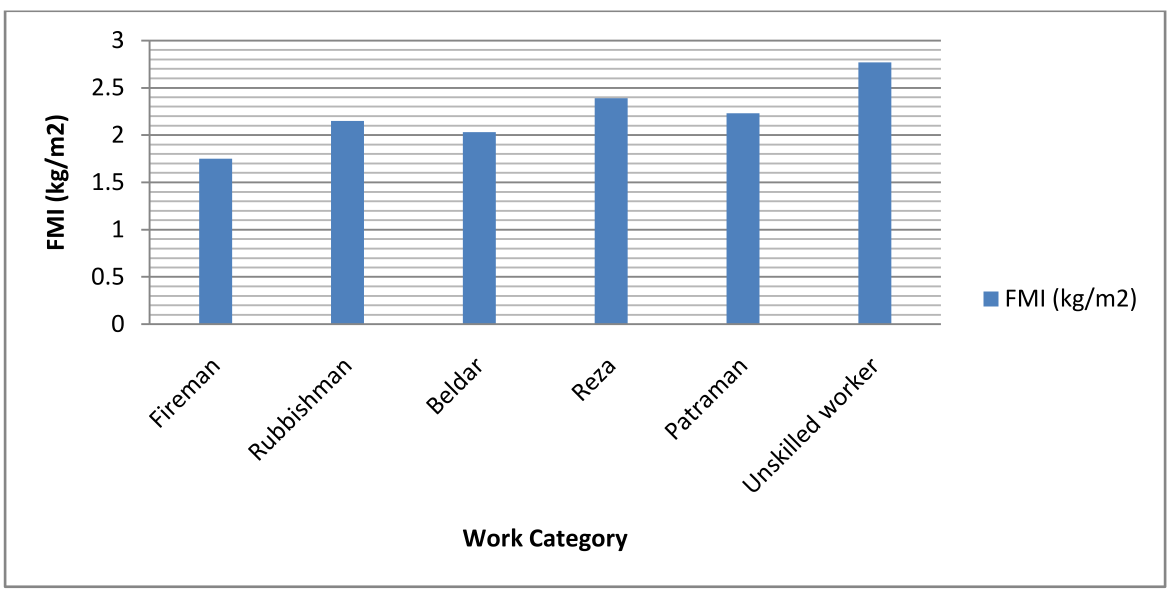
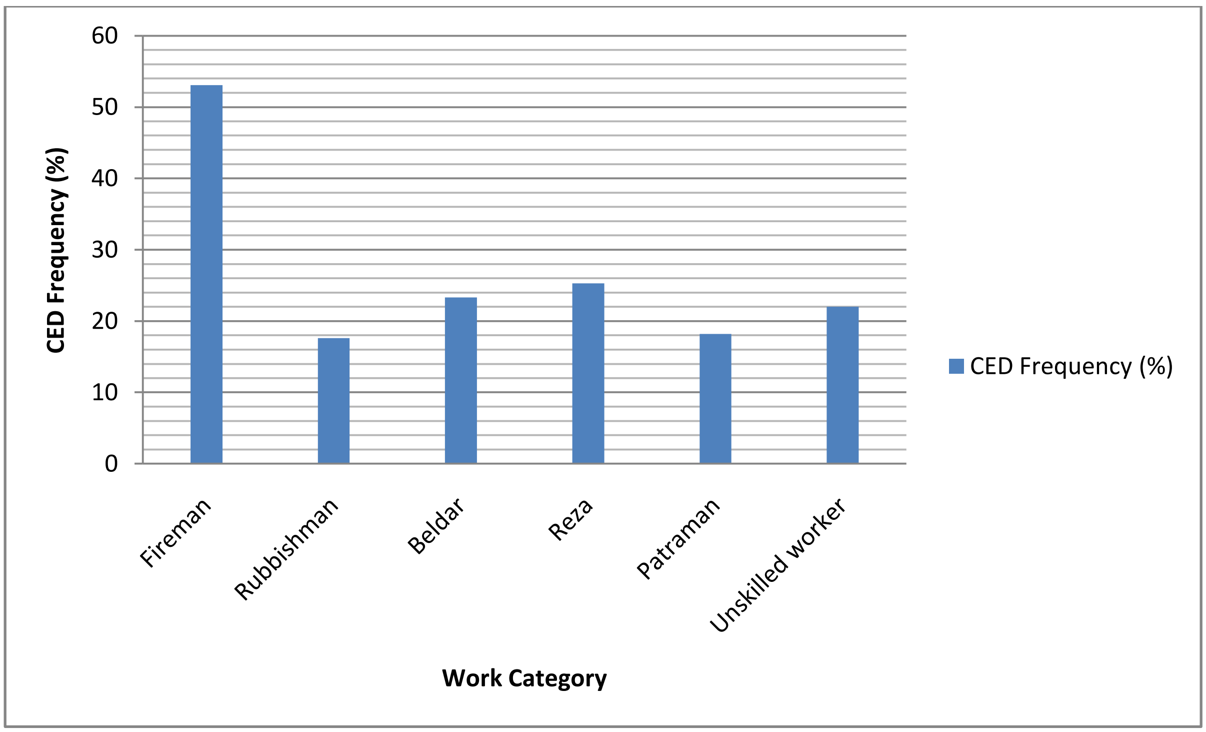


Figure (9.11): Showing the CED frequency (%) according to their work category.



CHAPTER- X

DISCUSSION

CHAPTER- X

Discussion

Brick kiln operating areas are known to be a leading cause of ambient air pollution. The prevalence of occupational health hazards has been reported as high among people of India (Das & Gangopadhyay 2012). The primary reason, in brick-kiln area for air pollution and health hazards is the use of poor quality fuel in inefficient and outdated technology. Most of the brick-kilns use Assam coal, which contains high level of sulphur. Burning of this coal produces high level of sulphur dioxide. It not only has bad effect on human health, but also damages the metallic chimney of kilns so they don't last long. According to a study, 70% of the fuel used by brick kilns is coal, 24% is saw dust and the remaining 6% is wood and others (ENPHO 2001). The consequence of exposure to ambient air pollutants is very hazardous to human health effects leading to high mortality and morbidity (World Bank 2003). Most brick kilns workers reported physiological stress during different activities in the process of brick making. The hearts rate is the best indicator of the physiological parameters. In a brick-kiln area, a brick carrier bends forward to collect the bricks, the muscles of the abdomen contract and the muscles of the back are stretched. This contracting and stretching of the muscles requires more energy. Thus the hearts rates are increased (Das 2014) and body weight are lost.

To know the effect of brick-kilns on environment and human health, a study was done in Kathmaundu Valley, 330 individuals were interviewed, majority of them expressed about smoke related respiratory discomfort at home and surrounding. The study indicated that who were located near to brick kiln area than who far away from brick kilns, statistically significant high odd ratio for respiratory problem like tonsillitis (4.17, 95% C.I 2.05, 8.45)and acute pharyngits is (4.08 95% C.I 2.01, 8.33) (Joshi & Dudani 2008).

Prevalence of respiratory diseases of the brick kilns workers when compared to stone grinders and industrial workers of west Bengal (Mandal & Majumdar 2013), it was found that 27.66% and 26.60%stone grinders suffered from chest pain or tightness and chronic cough respectively in comparison to the cement workers (28.90% and 23.30%), cotton workers (32.27% and 33.07%), jute workers (36.96% and 28.40%), paint industry workers (24.50% and 24.00%) and only 3.66% brick kilns workers suffered from chest pain and chronic cough. But in the present study we found that 71.30% brick-kiln workers suffered from any kinds of disease in the last one year. Over-all 55.70% workers suffered from fever, and 3.80%, 1.80%, 3.20%, 2.20% suffered from nerve problem, bone joint pain, liver problem, heart problem respectively. And also suffered from kidney problem, jaundice and tuberculosis were 0.60%, 0.60% and 0.40% respectively. These problems might be due to prolong heavy loaded work, high level of sulphur dioxide and silica nearer the air of the brick kiln area.

Most of the brick field workers reported discomforted in different body parts. Most brick field workers felt discomfort mainly in the lower back (98%), hands (93%), knees (86%), wrist (83%) and shoulders (76%), respectively. The study also showed that a large proportion of these problems lasted for more than 1 year, with many brick field workers experiencing prolonged discomfort (pain) for more than 5 years. However the majority of those with a discomfort fleeing were still able to continue their work. The control subjects suffered from pain especially in the lower back (22%) and knees (20%) and the pain in other parts of the body was negligible. Most of reported discomfort during spading for mud collection (98%), followed by carrying bricks (95%), molding (87%), loading and unloading (84%), setting brick in the kiln (81%) (Das 2014).

Table (10.1) presents the mean (SD) values of anthropometric characteristics of the subjects. Results shows that, in case of control group all means values of all variables were higher than the others groups. Among, these four groups the mean values were lower among stone grinders followed by brick kiln workers of Hooghly and present study.

The functional and economic significance of a high prevalence of CED has already been established (Ferro-Luzzi et al 1992). Therefore, efforts must be made to investigate the consequences of the functional impairments commonly associated with low BMI in various ethnic groups. It is also essential to ascertain the relationship of the high prevalence of under-nutrition with morbidity and mortality among adults. The outcome of the present study clearly indicated that the prevalence of CED among adult male brick-kiln workers was high on the basis of either BMI (25.0%) or MUAC (23.4%).

Both of these percentages are greater than 20% placing the population in the serious situation according to WHO recommendation.

Table (10.2) presents the mean age, height, weight and BMI prevalence among adult brick-kiln workers of India (Das 2014, Bandyopadhyay & Sen 2014). The mean height, weight and BMI ranged from 149.0 to 169.0 cm, 39.6 to 55.2 kg and 18.4 to 19.54 kg/m2 respectively. Low mean height, weight and BMI were found among the female workers of Hooghly and 24 Parganas of West Bengal.

High rates of CED have also been reported from other brick-kiln area of India. Table (10.3) present the high rates of CED prevalence among the adult brick-kiln workers of India (Bandyopadhyay & Sen 2014, Shewale et al 2013). The rates of CED range from 25.0% to 58.0%; these values are classified as high (20% - 39%) to very high (≥40%) rates according to WHO (1995). Among them, the rates of CED were very high among the adult female worker (58.0%) of Hooghly and 24 Parganas (s) of West Bengal. These results clearly indicated that both adult male and female of this occupational group were under serious or critical nutritional stress.

In the present study, the prevalence of undernourished individuals (MUAC< 23 cm) was significantly higher among the CED individuals (Chi-square=169.40, $p<0.001$), which indicated that these measures were well correlated. This implies that both these measures could be used to evaluate nutritional status among adult male brick-kiln workers. However, the difference in the prevalence of CED according to the two measures may have public health implications, especially in large population surveys. Moreover, as MUAC is much easier to measure than BMI (WHO 1995, Ulijaszek & Kerr 1999), the use of MUAC should be preferred in large scale studies. It may be appropriate to the use of MUAC for human population's survey, especially among rural population of developing countries. Thus, although both BMI and MUAC could be used to evaluate nutritional status, MUAC may be preferred for its simplicity.

The prevalence of under-nutrition of the worker of the present study might be due to heavy work load. Low wages structure, lack of medical facilities, improper work rest cycle and unhygienic work environment. The present study revealed that the brick-kiln workers of Murshidabad district experienced critical nutritional stress, according to

World Health Organization. The overall prevalence of CED was 24.60% based on BMI and prevalence of under-nutrition (22.80%) based on MUAC. Though, the prevalence of under-nutrition of the present study has not greater prevalence than others studied population enlisted in the above table. In present study, the rates of CED was (53.10%) higher among fireman than the others workers of the brick-kiln area.

The present study also revealed that the workers of brick-kiln area were suffered various types diseases (71.30%) all over the year. It is recommended that immediate appropriate nutritional intervention programmers be initiated among these workers; along with serious efforts to increase their per-capita income and awareness programs and local group discussion are essential for improving their health status of these working communities.

In West Bengal, all the workers are mostly illiterate; it is desirable to impart health education to them, to apprise them of the ill effects of work and the remedial measures. Although there are several types of intervention that can relate occupational stress like stress management programme, cognitive behaviour intervention, etc, but in West Bengal no such kinds of programme in the labours of the unorganized sector have ever been taken care of. From the study, it is recommended that redesigning the workplace and rescheduling the work-rest cycles of these male workers, along with proper counseling of food habits and maintaining hygienic conditions, is necessary to upgrade their quality of life. An economically designed sitting stool is suggested for the brick moulders and assistive load carrying or carrying bricks loaded on a cart would reduce the workers' work load in the work place. Awareness programs and local group discussions are essential for improving the health status of these working communities.

From the previous study and present study we give some suggestion or recommendation to improving the health status and reducing malnutrition among the brick-kiln workers.

Recommendation/Suggestions:

1. The work schedule should be changed by increasing the number of short rest breaks to avoid excessive physical stress.

2. Different types of stretching exercises should be practiced during the breaks.
3. Job rotation among the brick kiln workers should also be considered.
4. Mask should be used especially during molding to avoid the inhalation of dust particles.
5. The brick kiln workers should frequently change their posture to avoid discomfort.
6. The brick carriers should carry the brick in the trolley, and not the upper extremities.
7. Smoker and alcohol intake group should reduce their smoking habits and alcohol intake; otherwise the physiological parameters will seriously affect their health condition.

Protection to workers health:

Covering of the kiln area top with a continuous layer of bricks or tiles. A full face mask is to be provided to workers to protect their eyes, ears and nose. Hand gloves are to be provided to workers to protect their hands from ill effects of coal handling and also from hot flue gases coming out of fire hole during the charging. Special coat/apron and shoes are to be provided to the workers for their protection against these hazards.

Monitoring:

Since the process of loading, unloading and firing system is totally manual and its performance and efficiency depends on the efficiency and skill of the workers, it is utmost important to monitor the activities, especially the feeding and operating practices in the kiln by using instrumentation, installing monitoring gadgets. It should be made mandatory for a kiln owner to employee a supervisor with minimum 10+2 qualification who will keep the log of temperature in the firing zone, in the side flue and chimney. A temperature gauge shall be installed in the kiln chimney to monitor the temperature of flue gas.

Table (10.1): comparison between of various anthropometric characteristics among control group, stone grinders and brick-kiln workers

Variables	Control group (n= 145)	Stone grinders (n= 94)	Brick kiln workers of Hooghly (n= 82)	Present study (n= 501)
WT (kg)	67.18 (10.82)	48.15 (6.55)	50.60 (6.97)	54.08 (08)
HT (cm)	167.17 (6.72)	161.89 (6.39)	159.43 (17.15)	163.48 (5.91)
SSF (mm)	24.45 (9.84)	8.90 (3.10)	9.08 (2.76)	10.38 (5.46)
BMI (kg/m^2)	24.02 (3.47)	18.35 (2.07)	19.34 (1.90)	20.14 (2.38)
PBF (%)	28.78 (10.12)	9.86 (6.34)	10.09 (6.73)	11.13 (6.07)

Table (10.2) Mean age, height, body weight and body mass index (BMI) among various brick-kiln workers of India.

Study Area	Sex	Sample Size	Mean age (year) ± SD	Mean Height (cm) ± SD	Mean Weight (kg) ± SD	Mean BMI (kg/m^2) ± SD	Reference
Hooghly, West Bengal	Male	220	33.5 ±6.2	169.2 ±4.1	55.2 ±6.2	18.8 ±1.8	Das (2014)
Hooghly & 24 p (s), West Bengal	Fem ale	55	24.4 ±4.16	149.0 ±4.62	39.6 ±3.44	17.9 ±1.80	Bandyopadhyay & Sen (2014)
Murshidabad, West Bengal.	Male	505	36.5 ±11.59	163.5 ±5.89	54.1 ±7.20	20.1 ±2.39	Present Study

Table (10.3): Prevalence of CED (based on BMI) among brick-kiln workers of India

Study Area	Sex	Sample Size	CED (%)	Reference
Hooghly & 24 p (s), West Bengal.	Female	55	58.0%	Bandyopadhyay & Sen (2014)
Thane, Mumbai.	Male	86	44.6%	Shewale et al (2013)
Murshidabad, West Bengal.	Male	505	24.6%	Present Study

Figure (10.1): Showing the mean values of body weight among the various work groups.

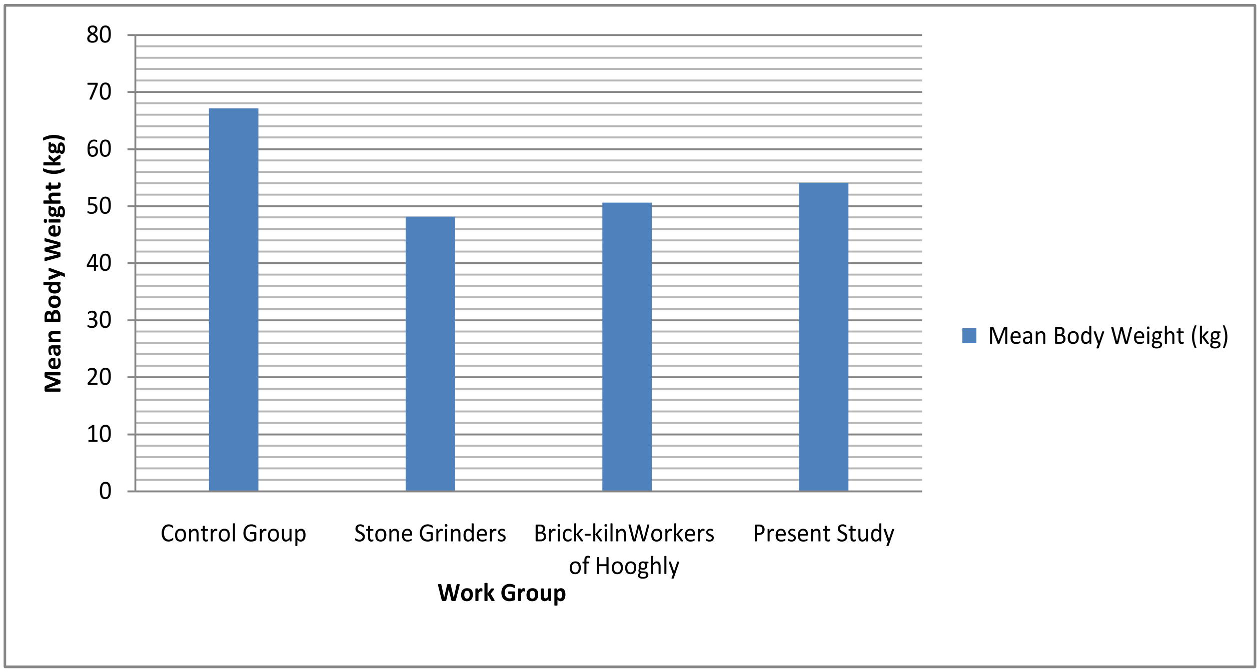


Figure (10.2): Showing the mean values of sub-scapula skinfold thickness (mm) among the various work groups.

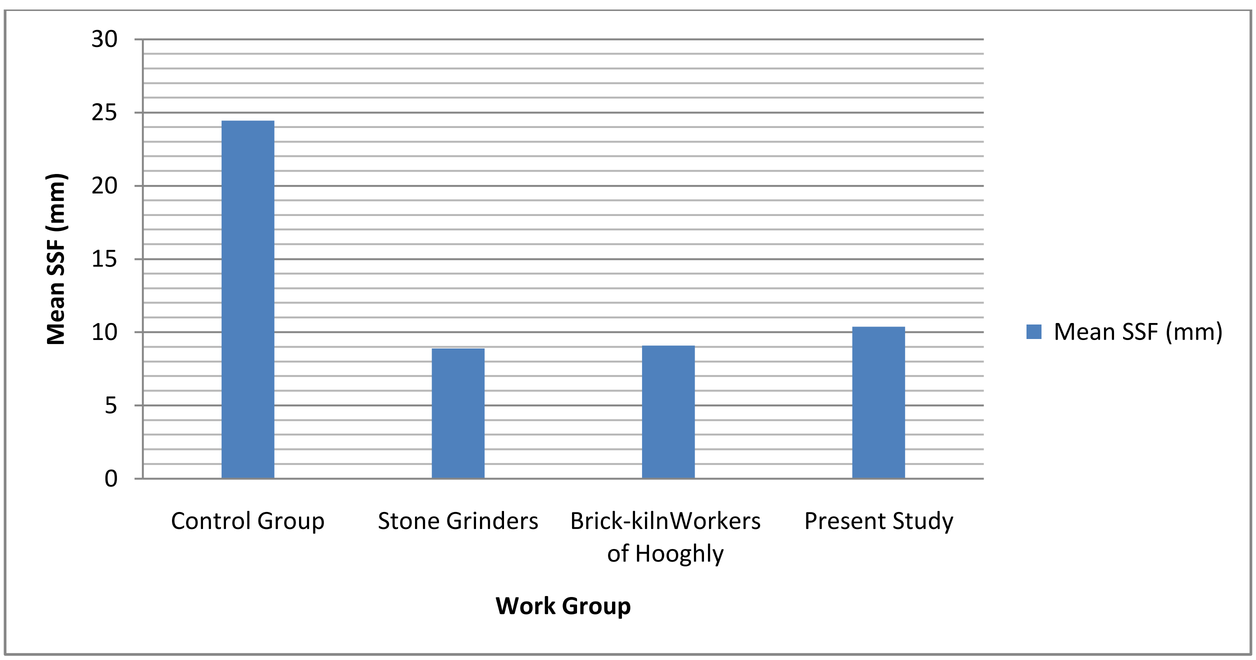


Figure (10.3): Showing the mean BMI of various work groups.

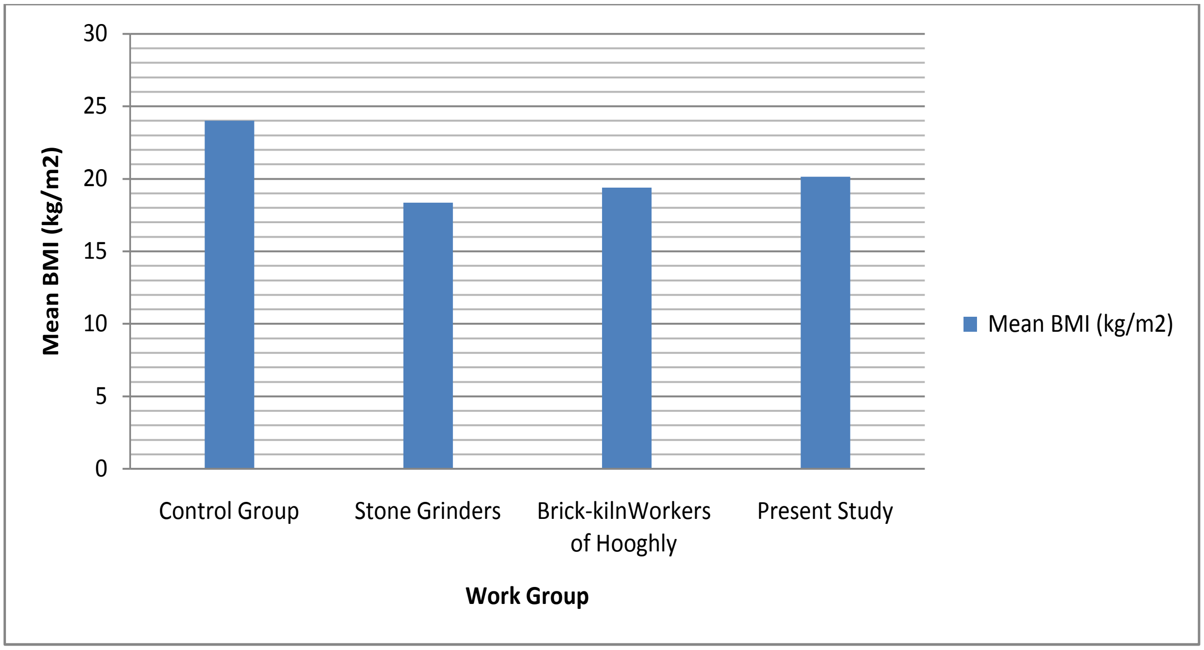


Figure (10.4): Showing mean PBF (%) among the various work groups.

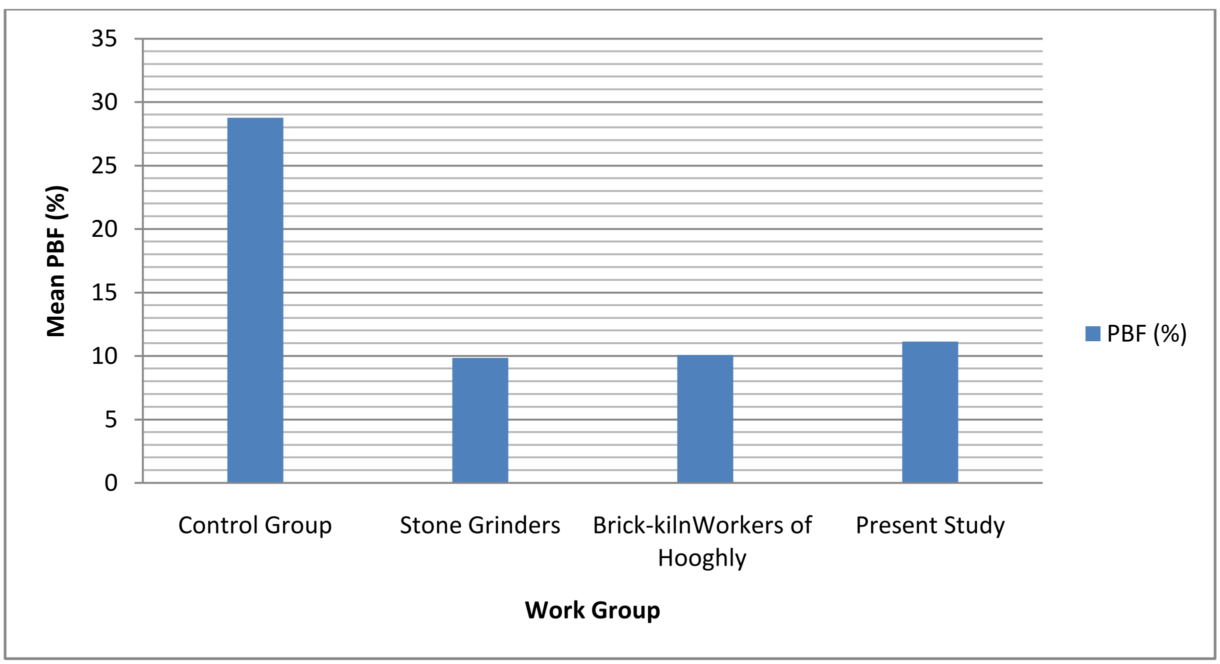


Figure (10.5): Showing the mean BMI among the various Brick-kiln workers of West-Bengal.

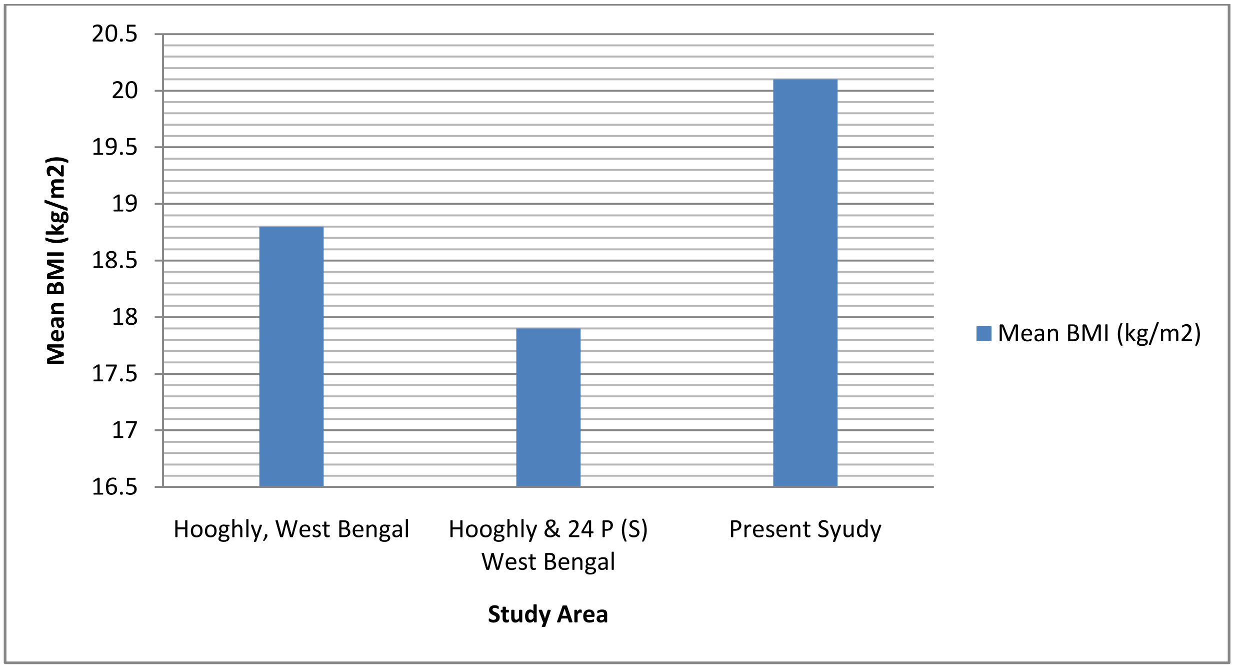
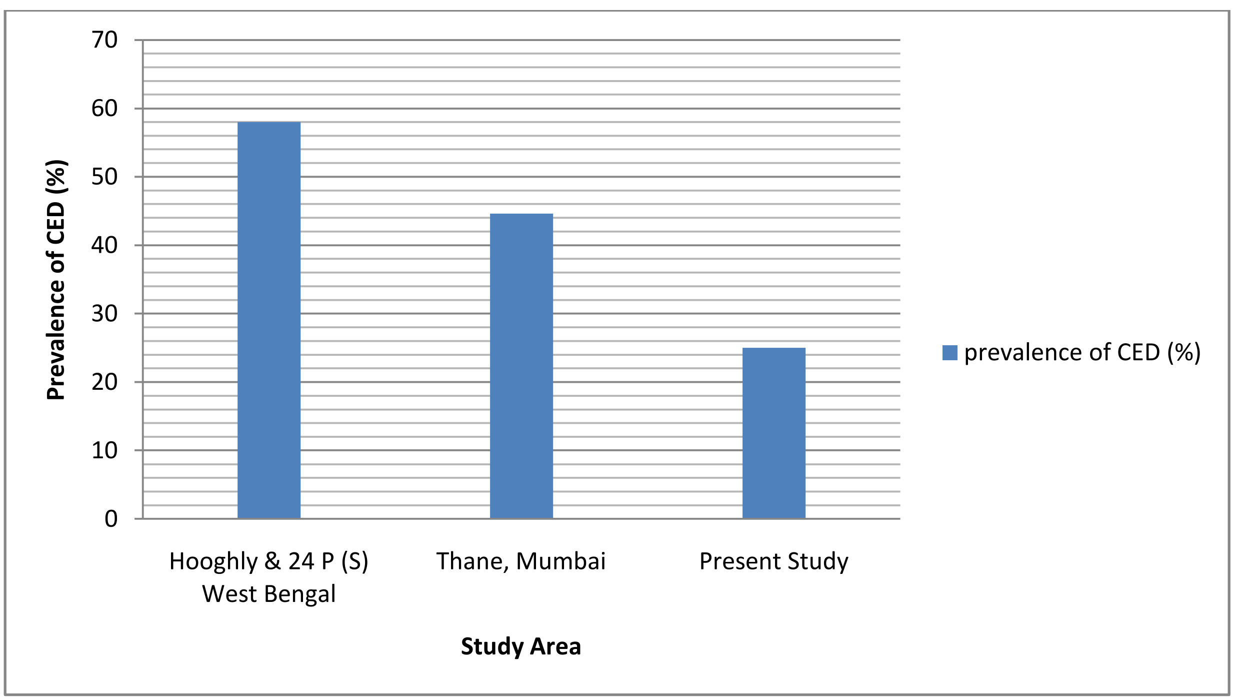


Figure (10.6): Showing the prevalence of CED (based on BMI) among the Brick-kiln workers of India.



CHAPTER- XI

SUMMARY AND CONCLUSION

CHAPTER-XI

Summary and Conclusion

1. The mean values of both variables anthropometric and derived, WC, HPC, sum of 4CM, SSF, SISF, sum of 4SF, BAI, WHR, CI, WHTR, BMAI, PBF, FM, and FMI were increased according to increase of age, except TBW decreased mean values with the increased of age.

2 CC, WC, HPC, sum of 4CM, SSF, SISF, and sum of 4SF had significant positive correlation with age as well as age squared.

3 FM, FMI, BAI, WHR, CI, WHTR and BMAI had significant positive correlations with both age and the age squared. TBW had significant negative correlation with both age and age square.

4 There was significant effect of age on WC, HPC, CC, SSF and SISF. Simple liner regression analysis also, indicated that, there was significant effect of age on TBW, BAI, WHR, CI, WHTR, BMAI, PBF, FM and FMI.

5 Pearson correlation coefficients of the anthropometric variables, HT, WT, SHT, SIH, MUAC, CC, WC, HPC, TSF, BSF, SSF and SISF had significant positive correlation with MUAC, WC, BMI and PBF, only negative correlation found SIH with BMI and PBF. All the derived variables BMI, TBW, PBF, FM, FFM FMI, FFMI, BAI, MUAA, MUAMA, MUAFA, AFI, WHRCI, WHTR and BMAI had significant positively correlation with MUAC, WC, BMI and PBF.

6 The overall rates of CED was 24.60% which is a ‘high’ one indicating ‘serious’ situation (WHO 1995). The overall rate of undernutrition according to MUAC cut off value was found to be 22.80%.

7 In low MUAC (<23cm) group the rates of nudernutrition was 70.20%, was higher than the normal MUAC (≥23 cm) group (11.10%). This low MUAC was statistically significant with BMI.

8 In the present study only 2.80% was obese on the cut off value of PBF.

9 The mean values of both variables anthropometry and derive were increased according to undernutrition to obese category. (based on BMI and MUAC)

10 In the present study 65.10% subjects were illiterate and 2.40% was can sign only.

11 The mean values all of the anthropometric and derive variables were higher among the group who live in brick made wall houses, than the other group.

12 The prevalence of central obesity cut off value of WHR, CI and WHTR were 88.00%, 26.10 and 18.00% respectively

13 Smoking habits effect on anthropometric and body composition characteristics. The prevalence of CED was higher (30.20%) among the regular smoker group, than the others two groups.

14 The rates of CED was higher (53.10%) among the fireman, than the others groups.

From the above, we can conclude that the nutritional condition of studied population was unsatisfactory. This implied that most of these were experiencing sever to critical nutrition stress. Proactive nutritional supplementation programmers are mandatory to improve the nutritional profile of these populations. These interventions should be monitored regularly to determine their efficacy in combating undernutrition.

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Annexure-I

List of publications (Ph. D. Data)

1. Datta Banik S, Ghosh M, Bose K. (2016). Anthropometric and body frame size characteristics in relation to body mass index and percentage body fat among adult Bengalee male brick-kiln workers from Murshidabad, West Bengal, India. Anthropol. Anz. Journal Biol. Clin.Anthopol.

2. Ghosh M and Bose K. (2016). High prevalence of undernutrition among male brick-kiln workers of Murshidabad District, West Bengal, India: A comparison of body mass index and mid-upper arm circumference. Al Ameen Journal of Medical Science; 9(4): 265-271.

3. Ghosh M and Bose K. (2017). Statistical association of adiposity measures with body composition among adult brick-kiln workers of Murshidabad District, West Bengal, India. International Conference on Bioinformatics and Biostatics for Agriculture Health and Environment. Published by Access to information (a2i), Prime Minister’s Office, Bangladesh. Higher Education Quality Enhancement Program (HEQEP).