CHAPTER IV

Discussion

4.1. THE COMPERATIVE EVALUATION OF SOCIOECONOMIC AND DEMOGRAPHIC AND LIFE STYLE RELATED FACTORS

In the present longitudinal study several socioeconomic and demographic and lifestyle variables were taken into consideration for the understanding of nutrition and health of the "tea laborers" children and their mothers of North Bengal. West Bengal. The Population according to latest Census of 2011 is 9,13,47,736. The Matigara Block of Darjeeling district has total population of 197,278 as per the Census 2011. Out of which 101,023 are males while 96,255 are females. The average sex ratio of Matigara Block is 953. The Sex Ratio of urban areas of the Block is highest at 981 while that of rural areas is 940. The population of Children of age 0-6 years in Matigara Block is 24760. To facilitate the administration, Matigara Block is further divided into 6 towns and 72 villages. Scheduled Castes (SC) constitutes 35.8% while Schedule Tribe (ST) was 13.4% of total population in Matigara Block. Religion wise population Hindus (87.51%), Christians (5.37%), others (7.12). Average literacy rate of Matigara Block in 2011 were 74.78% in which, male and female literacy were 81.75% and 67.43% respectively. Total number literate in Matigara Block were 129,006 of which male and female were 72,352 and 56,654 respectively. The higher literacy rate of the fathers of children were better educated than the mothers. Half of the fathers were educated up to secondary level or more; one fifth had primary level education and one fourth was illiterate. In comparison half of the mothers were illiterate. In addition to low levels of literacy there is also marked gender disparity in existence literacy rate also suggested that the literacy rate was found to low in coastal, peripheral and metropolitan areas and is high in inland and mountain areas. These regional disparities are the products of differences in the length of educational background, age at marriage, level of urbanization, standard of living

and proportion of socially conservative and backward section of the population (Sagar, 1989). The Child Ration was 978 which are greater than Average Sex Ratio (953) of Matigara Block.There were 24,760 children between ages 0 to 6 years in Matigara Block. Out of which 24,760 were male while 24,760 were female. In Matigara Block out of total population, 75,367 were engaged in work activities. 88.7% of workers describe their work as main work (Employment or Earning more than 6 Months) while 11.3% were involved in Marginal activity providing livelihood for less than 6 months. Of 75,367 workers engaged in main work, 1,510 were cultivators (owner or co-owner) while 747 were Agricultural laborers. The present study documented nearly all fathers were working as tea garden factory laborers, rickshaw pullers, small vendors like fruit and vegetable vendors, chole/jaljeera vendors and small vendors in street markets, semi-skilled jobs like carpenters, tailors, gardeners, drivers and sanitary worker (treat as manual worker). Clerk, teachers, involved in public and private service sectors and had business (treat as others). Majority of the mothers were housewives (68.25%) and were not gainfully employed outside home. About (31.75%) of mothers worked as industrial laborers and an equal proportion of mothers worked as domestic helpers. The percentage distribution of households living in permanently (67.76%)), Semi permanent (28.9%), Temporary (3.29%). People using water from different sources; from tap water (10.01%), Covered well (8.29%), uncovered well (55.51%), handpump (14.77%) tubewell/borehole (7.69%), spring River/ canal Tank/ pond/ lake Other Sources (0.14%) (0.1%), (0.11%), (1.87%) respectively. The present study documented the overall facilities of water is very poor but result showed in **Table 3.1.** The highest percentage found in using other source of water in Phase I (51.11 and 47.65), Phase II (51.30 and 42.08), Phase III (51.18 and 43.91) and Phase IV (53.52 and 50.25) of Case and Control Group respectively. And the other source of water used by study population were found higher then Case Group

in Phase I (48.49 and 52.35), Phase II (48.82 and 57.92), Phase III (48.82 and 56.09), and Phase IV (46.48 and 49.75) of Case and Control Group of study population. There were 72.25% electricity connection taken by people and 1.71 % has no light in present days. The present study documented that number of family still lack household electric power. They hocked the main wire to get electricity for household purpose and not paid any bill. The present study showed that 'no' electricity should in higher percentage found in Case Group (59.37%, 59.42%, 57.91% and 55.99%) and in Control Group (36.99%, 41.25%, 43.04 % and 49.25%) in Phase I, II, III and IV. Hygiene of Sanitation is most important for people health so there were people using 5.78%Piped sewer system, Septic tank only 27.09%, 2.83%of other system with slab/Ventilated, and 24.7% people using improved pit. In Rural area 0.67% people using latrine without slab/open pit, and 1.08% Public used open toilet. Only 55.11% people listing radio/transition and 2.08 % watching television. But now a day the scenario is become change. The present study documented number of family still lack household electric power. Study showed that 'no' electricity should in higher percentage found in Case Group (59.37%, 59.42%, 57.91% and 55.99%) and in Control Group (36.99%, 41.25%, 43.04 % and 49.25%) in Phase I, II, III and IV. And those were informed 'yes' were found in Case Group (40.63%, 40.58%, 42.09%, and 44.01%) and in Control Group (50.16%, 57.92%, 56.09% and 49.75%) in Phase I, II, III and IV. The detailed found in the **Table 3.1.**

ANTHROPOMETRIC ASSESSMENT AND NUTRITIONAL STATUS AMONG THE CHILDREN AND THEIR MOTHERS:

Anthropometric variables and the assessment of nutritional status and body composition

The present study was conducted among ICDS enrolled childre (Case Group) and unenrolled (Control Group) children aged 12-60 months and residing in the Darjeeling

district of the state of West Bengal. India. The assessment of body composition and nutritional status was evaluated using a set of anthropometric and skinfold measurement (**Table 3.4 Case Group and Table 3.5 Control Group**). The mean values of weight, height, MUAC (mid upper arm circumference), TSF (triceps skinfold), SSF (sub scapular skinfold), were documented to be significantly higher among the girls (<0.01) than the boys in each Case of Phase I, II, III and Phase IV in Case and Control Group. There has been steady increase over the 4 Phases in almost all the variables.

The Body Mass Index (BMI) and nutritional status

Assessments of nutritional status arean integral component for documenting the overall health of an individual and/or population, and are an indicator of the well-being of a particular region. Despite economic developments, prevalence of under nutrition among children especially those aged under-5 years pose a major public health problem in many of the developing countries including India (Nandy et al., 2005, Ahmed et al., 2012, Bose et al., 2007, Mondal et al., 2010). Such prevalence is generally attributed to a large population size, illiteracy, poverty, poor infrastructure and in appropriate health care facilities (NFHS-3 2005-2006, Ahmed et al., 2012, Bhutta et al., 2012, Bose 2007). It also reflects inadequate nutrition during early childhood and is likely to be a consequence of well-known phenomenon of inadequate weaning food with lower energy-density as observed in India (NFHS-3 2005-2006, Antony et al., 2008). The importance of assessing nutritional status of these nutritionally vulnerable children should be recognized, not only for improvement of the overall health condition of the future generations, but also for overall developments of the concerned region. The results of the present study undoubtedly shall be useful for policy makers in their endeavor to formulate various developmental and health care programmers and appropriate nutritional interventions and proper monitoring of the ongoing intervention

programmers. Priority interventions are necessary in terms of appropriate complementary feeding, supplementation with proper balance food, micronutrient, and breast feeding promotion and acute under nutrition and related morbidity management. In the present study, an assessment of thinness (low BMI-for-age) among pre-schoolchildren aged 12-70 months was undertaken using the newly proposed cut-offs of Cole et al., 2000. A very high prevalence of thinness has been documented (62.0%) among them (**Table 3.4** and **Table 3.6**). Existing studies have consistently reported very high prevalence of thinness among Indian children and here the studies of Biswas et al., (2009) among Bengalee children (51%), Das and Bose 2007 among Santal children (56%), Mandal and Bose 2009 also among Santal children(76%), Chakraborty and Bose in (2009) among Bengalee children (62%), Bisai and Manna in (2010) among urban children (47%), Mandal et al., (2009) among Bengalee children (85%) and Bisai et al., (2010) among Kora-Mudi children (67%) are mentionable. The present study showed that Case Group of Phase I the prevalence of thinness was found among boys to be very high (43.29%) and also amog girls (69.54%) among girls, in Phase II boys were (79.21%) and girls were (31.40%), in Phase II boys were (40.53) and girls were (51.77%), and In Phase IV boys were (39.86%) and girls (39.72%) respectively. But in Control Group the overall prevalence showed in different Phases were in Phase I, boys (50.00%) and girls (73.55%), in Phase II boys (47.97%) and girls (53.85%), in Phase III boys (66.1%) and girls (71.43%) and in Phase IV boys (65.98%) and girls (65.38%). Evidently, the problem of thinness is persistent transversely across Indian populations with consistent proportions of children, especially pre-school children being affected. It has also been observed that high prevalence of thinness is a major nutritional problem among both tribal and non-tribal pre-school children of the country. It has been estimated that more than half of the children in the age Group of below 5 years remained nutritionally affected by thinness

(Biswas et al., 2009, Chakraborty and Bose 2009) and they require immediate attention in terms of nutritional interventions. A greater prevalence of thinness indicates current chronic energy deficiency and early detection and correction of the current energy deficit might reduce the risk of infections and related co-morbidities and also enable the children to continue in their physical growth trajectories (Ahmed et al., 2012, Ramachadran and Gopalan 2009). This is because of the fact that children suffering from thinness were more likely to develop into thin adult individuals with a low BMI (such as those suffering from chronic energy deficiency that would have an adverse impacts on their reduced work productivity and poor reproductive outcome, and lead to greater prevalence of morbidity and mortality (WHO 1995). Moreover, the prevalence of under nutrition during childhood not only delays growth attainment and cognitive development but affects the overall linear mechanism of physical growth processes (WHO 1995, Bhutta and Salam 2012). Researchers have opined that although a lot of progress has been achieved in different disciplines and unprecedented improvements in many health indicators, high under nutrition rates continue to persist so as to generally increase the societal and economic burdens among populations (Kapil and Sachdev 2012). As a result, India continues to exhibit the highest proportion of child undernourishment in the world (Ramachandran 2014). The major underlying factors for the prevalence of under nutrition in the developing countries are poor socio-economic conditions and environmental, ethnic, socio-economic and socio-demographic disparities (Mondal and Sen 2010). In almost all Indian populations, boys have a better access to food, basic amenities and resource allocation than girls and there is pronounced preference for the male child (Sen and Mondal 2012). Studies documenting nutritional status in India have further observed that girls were more affected by under nutrition than boys (Som et al, 2006, Sen and Modal 2012). The present study has also reported that girls were more affected by thinness than boys. The

odds were significantly greater among girlsthan boys in all the three Grades of thinness ($p<0.01$). Studies have reported that rural girls were more likely to be severely undernourished than rural boys (Choudhury et al., 2000). Results of multinomial logistic regression analysis showed that children belonging to higher ages (e.g., 5years) had greater risk odds to being affected by thinness, thus agreeing with the studies of Mandal et al., (2010) and Biswas et al, (2009). The children residing in the rural area were more affected by both moderate and severe thinness categories than children residing in the urban area ($p<0.05$), thereby being in accordance with the results of similar studies (eg. Ramachandran 2014). It has also been observed that children belonging to 'no-toilet' and 'no-electricity' facility households had greater odds ($p<0.05$) of being affected by thinness than those having hygienic toilets and electricity. It is further evident from the results that children belonging to poor socio-economic and adverse environments, including low income, were more affected by under nutrition (thinness), thereby agreeing with the results of other existing studies (eg. Mouhgoub et al., 2006). The present study showed the risk of moderate and overall thinness prevalence to be significantly greater among preschool children ($p<0.05$). Researchers have pointed out that the nutrition levels are not merely dependent on access to nutritious foods and several other supporting factors like clean drinking water, a proper sanitary environment and appropriate caring practices, particularly in Case of children, are equally important and play major roles in the nutritional status of children (Ramachandran 2014). The present study has observed that children belonging to tea garden having 'no toilet facilities' had greater vulnerability to under nutrition. The multinomial logistic regression analysis has also depicted greater odds ratios in Cases of poor mother's and father's education (such as illiterate) with the children being affected by thinness ($p<0.05$). The odds were significantly lower with higher mother's education (e.g. literate and above) with severe thinness ($p<0.05$).

A similar study had also reported that illiterate household showed significantly greater risks to under nutrition (Choudhury 2000). The present study has also observed significantly 1.60 times higher odds (in mild thinness) and 1.06 times higher odds (in mild moderate) for manual worker father's occupation as compared to service/other occupations ($p<0.01$). This could be attributed to higher education and occupation status that are associated with better living conditions of the family, improved environmental conditions and better awareness about the child rearing practices. Several researches have shown that prevalence of child under nutrition was higher in poor households and children born to mothers with low education levels and residing in rural habitats. Therefore, the proper dissemination of knowledge and awareness level related to nutritional requirement, use of energy dense food, feeding practices and appropriate dietary modification among nutritionally vulnerable segments would be helpful to reduce such prevalence. The details are found in Table 3.4 in each Case Group of Phase I, II, III, & IV and in Table 3.4.1 explained the each Case of Phase I, II, III and IV respectively.

Chronic Energy Deficiency (CED) based on BMI

It has been proposed by Ferro-Luzzi et al., (1992) that BMI alone was significant to define CED at the population level. The overall prevalence of under-nutrition in the present study was 23.17% (Table: 3.63). The prevalence was higher among the females (Phase IV of Control Group). The prevalence was observed to be in the high prevalence category (Case and Control study both) and this according to WHO (1995) is needed to be taken seriously (**Table 3.63**). Comparative evaluations of the prevalence of CED (BMI <18.5kg/m2) and public health risk factors associated with the prevalence of CED among the female individual of different Indian population with those obtained in the present study are depicted in (Table 3.19.3) respectively. It is evident that the prevalence of CED among individuals of the

different populations was quite high. The prevalence of CED was found to be higher among the females than the males. Using the WHO (1995) proposed classification for public health risk factor based on the prevalence of CED; it was observed that the situation remained critical in majority of the Indian populations. eg. The Dhimal, The Savar, The Santhal, The Lalung, the Miri, The Rajbanshi and The mothers of the present study were serious.

Adak et al., (2006) reported the prevalence of CED among individuals belongs to different populations of central India. They documented high prevalence of CED among the schedule castes (Khati, Koli, Kori, and Mahar: 60.3%) followed by the other backward classes (Barala, Kachi, Lohar, and Rawal: 51.7%), and finally the schedule tribes (Bhil, Gond, Kol and Korku: 51.5%). The Muslims and the general caste populations (Brahmin and Rajput) showed comparatively lower prevalence of 47.5% and 43.1% respectively.

Several studies have reported significantly gender differences in the prevalence of CED among different Indian population (Bose and Chakraborty, 2005; Bose et al., 2006b; Chakrabarty and Bharati, 2010), Bose and Chakraborty (2005) reported a high prevalence of CED among the Bathudi of Keonjhar district, Odhisa (57.90%). The prevalence was significantly higher among the females (64.5%) than the males (52.7%) ($p<0.05$). Banik (2007) reported the prevalence to be nearly 30 % among the adult Telega females (>30.00%) from Kharagpur. West Bengal. These were appreciably higher than those reported mothers in the present study.

Banik et al., (2007) reported that the overall prevalence of CED to be very high (36.4%) among adult Dhimal individuals of West Bengal. They further suggested that the prevalence was significantly higher among the female (46.40%) among adult Savar individuals of Keonjhar District. Odhisa. Similar sex Difference have not been documented in the present study only mothers data were compare in the present study (table). A higher

prevalence of CED (55.3%) was also observed among the Kora-Munda females of West Bengal (Bisai and Bose, 2009).

Several researchers have reported the discrimination made against the girl child in Indian society (Ghose, 1990; devendra, 1995; Borooah, 2004). It is probable due to prolonged nutritional deprivation and the nutritional preferences given to the boys, the females (Kishor 1993; Gopaldas and Gujral, 1995). Studies conducted on rural populations indicated higher gender difference in under nutrition among the females when compared with the males (Rousham, 1996: Miller, 1997; Yadav and Singh, 1999; Choudhury et al., 2000; Bose et al., 2006a; Gautam et al., 2006; Banik et al., 2007; Chakrabarty and bharati, 2010).

Other significant studies documenting the nutritional deprivation among the females include those of Okojie (1994), Svedberg (1996) Miller (19970, Haddad (1999) and Adak et al., (2006). Osmani (1997) reported that female deprivation might well be a major determining factor for the high levels of CED, particularly in different South-Asian countries, including India. Nube and Ven den Boom (2003) had opined that a high level of low BMI existed among the female individuals of South-Asia and this was a major causative factor for high levels of under –nutrition. This reflects a major public health concern and warrants special attention in respect to nutrition and health. The present study also revealed that the prevalence of under nutrition was higher among the mothers working and residing a tea garden area when compared with the other study. The prevalence of age specific CED grades was seen to increase with age. The prevalence was mostly observed to be higher in the ages of 20-34 years among mothers in CED Grade II and Grade II. Banik (2011) reported that prevalence of under nutrition and thinness (eg, CED) increased with age among the Oraon

and the Sarak females of Ranchi district, Jharkhand. The studies of Banik (2008) and Delpeuch et al., (1994) are also mentionable here.

Different grades of CED among mothers

The **Table 3.63** shows the majority of the undernourished mothers of the present study comprised CED Grade I (highest in Case Group 44.44 %, ; BMI 17 kg/m^2-18.49 kg/m$^{2)}$ followed by CED Grade II (highest in Case Group 22.56 %; BMI 16 kg/m2-16.99 kg/m2) and finally CED Grade III (highest in Case (IV) 19.12 %; BMI < 16 kg/m^2). Adak et al., (2006) suggested that apparently healthy individuals affected with CED Grade I could be thin but physically active and healthy. The results of the present study appear to be in agreement with this conclusion. Adak et al., (2006). Several researchers had also concluded that linear body builds with low weight –surface area ration was one of the general features of individuals inhabiting the tropical and sub-tropical regions (Roberts, 1953; Newman and Munro, 1955; Dobzhansky, 1962; Schreider, 1968). This may be one of the resons behind the high number of individuals with CED Grade-I in most of the Indian populations including mothers of the present study.

The prevalence of CED Grade II was observed to be higher among the Dhimal (5.5%) (Banik et al., 2007), the Oraon (8%) (Mittal and Srivastve, 2006), the Savar (18.32%) (Chakrabarty and Bharati, 2010) and the Rajput (10%) (Gautam and Thakur, 2009) when compared withthat of the mothers of the present study. The prevalence of CED grade II was documented to be very low among the present study mother, s individual (3.13 %). The existing literature suggested that the prevalence severe thinness was also very high among the different population of India. The comparative evaluation of CED Grade III was higher among adult individual belonging to the Oraon (Mittal and Srivastava, 2006). The Dhimal (Banik et al., 2009) and the Savar (Chakrabarty and Bharati, 2010) populations.

Mid Upper arm circumference and nutritional status of children:

The **Table 3.18** (Case Group) and **Table 3.19** (Control Group) explained the prevalence of under nutrition, especially among pre-school children is considered as a major public health issue and cause a huge burden to overall national development. The fore most aim of nutritional assessment studies is to determine the actual magnitude of under nutrition and thereby introduce appropriate nutritional intervention programmers to improve the existing nutrition situation (WHO 1995, Sen et al., 2011, Dairo et al., 2012). Assessments of under nutrition among children bear great significance in developing countries such as India, where the vast majority of the populations remain undernourished and underprivileged (Ahmed et al., 2012, Antony and Laxmiah 2008). Studies have reported that MUAC is a very important anthropometric measure for assessment of under nutrition because it showed a good correlation with body mass index and an easy-to-use measurement to record both during emergencies and nutritional surveys (James et al., 1994).

A comparison of wasting among children belonging to ICDS is depicted in **Table 3.18** and **Table 3.19**. In Case Group of Phase I boys moderate 53.66% and sever 32.93%, among girls moderate 47.02%, severe 39.07%, in Phase II boys moderate 58.42%, and severe 42.57% among girls were found moderate prevalence was 25.12%severe 39.13%, in Phase III boys moderate prevalence was 32.48%and severe 37.58% girls moderate 41.84%, severe 39.72%, in Phase IV boys moderate 39.16%, severe 47.55% girls moderate 49.65% severe 37.59%. In Control Group of Phase I boys moderate 51.83%, severe31.71% girls moderate 43.23% severe 35.48%, in Phase II boys moderate 47.15%, severe42.28% girls moderate 32.48% severe 44.44%, in Phase III boys moderate 40.68%, severe 46.61% girls moderate 43.75% and severe 39.29%, in Phase IV boys moderate 49.48%, severe 37.11% girls moderate 45.19% and severe 43.27%. The prevalence of wasting in the present study was

observed to be 62.9%. A significantly lower prevalence of wasting among children has been reported by Kaur et al. (2005) for Punjabi children ($p<0.01$), by Chakraborty et al. (2006) for Shabar children ($p<0.01$), by Mishra and Mishra (2007) for rural-urban children of Odisha ($p<0.01$), by Biwas et al. (2010) for Bengalee Muslim children ($p<0.01$) and by Das et al. (2013) for Bauri and Santal children ($p<0.01$). A similar prevalence of wasting (64.54%) was observed among children belonging to the Bengalee population of West Bengal by Mondal and Bose in 2009. When the results of the present study were compared with available non-Indian children, a significantly greater prevalence of wasting ($p<0.01$) was observed among Ugandan (21.60%) (Nandy et al., 2005), Kenyan (47.00%) (UNICEF 2012), Nepalese (17.00%) (Sharma 2012) and Nigerian (25.70%) (19). Based on the WHO 1995 classification of the severity of under nutrition, it has been observed that a high prevalence of wasting (>15.00%) was observed among the children (**Table 3.18**). The present study has further observed a greater prevalence of under nutrition among girls than boys, which is consistent with the result reported in similar studies in the country (Som et al., 2006, Bose et al., 2007). This high prevalence of under nutrition is generally attributed to a large population size, illiteracy, poverty, poor infrastructure and inappropriate healthcare facilities (WHO 2007, Sen and Mondal 2012). It also reflects the inadequate nutrition during early-childhood and is likely to be a consequence of well-known phenomenon of prolonged breast-feeding combined with inadequate weaning food with lower energy-density in Indian children than their non-Indian counterparts (Nandy et al., 2005, Bose et al., 2007, Sen et al., 2010).

The logistic regression analysis in the present study showed that girls were 1.05 times more vulnerable than boys **Table 3.18 (Case group) to Table 3.19 (Control group**). Similarly studies have reported that rural girls were more likely to be severely undernourished than boys in Bangladesh (Choudhury 2000). The results of the present study

further showed that children belonging to higher age Groups (e.g., 2-5 years) had a significantly greater risk odds to being wasted ($p<0.05$), thus agreeing with the studies by Cheah et al., in 2010 and Choudhury et al., in 2000. Maternal education (such as illiterate and primary) also exhibited significantly 1.50 times greater odds to wasting ($p<0.05$). A similar study also reported that illiterate household heads showed significantly greater risks to wasting among children (Sandiford et al., 2004). It is also evident that children belonging to higher birth orders (e.g., >3rd) had a significantly 1.40 times greater risks for being wasted ($p<0.01$). Studies had also previously indicated that child under nutrition was strongly correlated with birth order of the children (Modal and Sen 2010). The result of the present study reveals that the prevalence of wasting were insignificantly in the income Group (Rs.2000-4000). The study further indicated that the risk of greater wasting ($p>0.05$) was observed among children with poor facilities such as 'no-electricity' and 'no-toilet facility' and belonging to the vulnerable segments of the population such as father's occupation being manual worker/labourer and father's education not exceeding primary level (Table 2). But other study had significant association found among children (Mondal and Sen 2012, Choudhury et al., 2000, Debath et al., 2016). Generally, it must be mentioned here that due to the longitudinal design (one year) of the present study, lack of information on dietary history, resource allocation, cultural practices and disease prevalence, it is difficult to draw a major conclusion and/or identify the actual cause(s) of such greater prevalence of wasting among children. The study has, however, highlighted that a significant proportion of the children in India were undernourished and suffering from different grades of wasting. Thus regular monitoring and follow-up studies based on MUAC to assess wasting and also to monitor the efficacy of ongoing nutritional intervention programmers are recommended.

Prevalence of under nutrition based on WHO Z-score of the children and mothers BMI

Ovearall prevalence of undernutrition among children depicted in **Table 3.14** (Case group), and **Table 3.15** (Control group). Under nutrition continues to be a major public health problem and a principal cause of ill-health and premature mortality among children (Nandy et al., 2005). Assessments of the under nutrition among children bear great significant in the developing countries such as India, where the vast majority of the populations are undernourished and underprivileged (Mondal and Sen, 2010). Such assessments are important for the improvement of their health and overall development of community concerned. A number of studies have been conducted among children (Lal, 1993; Lal and Sachar, 1993; Kapil and Pradhan, 1999; Kapil and Pradhan, 2000; Kapil, 2002; Mandal et al., 2008). As part of a concerted effort, India's ICDS program has been directed to human development. Over the past number of years, this program has expanded to include almost 50% of the countries most vulnerable and deprived populations. Ironically, although there was a focus on children nutrition assessment and improvement, health and nutrition education are now considered to constitute the weakest part of the ICDS scheme.

One of the most commonly used anthropometric indicators of under nutrition among children is stunting. Stunting implies gaining insufficient height relative to age and reflects a process of failure to reach linear growth potential as a result of suboptimal health and nutritional condition. In the less developed areas, where the prevalence of stunting is substantial, it may be safely assumed that most short children are stunted. It is therefore appropriate to use the stunting to represent low height-for-age. However, where the prevalence of low height-for-age is low, most children with low height-for-age are genetically short and it is then inappropriate to assume that short children are stunted. The worldwide variation of prevalence of low height-for-age (below-Moderate of the

NCHS/WHO, 1993) is considerable, ranging from 5.00% to 65.00% among the less developed countries. In many such settings, the prevalence starts to rise at the age about more than 3 months. The process of stunting slows down at around 3 years of age, after which mean heights run to the parallel to the reference value. Stunting is an indicator of chronic under nutrition, as a result of prolonged food deprivation and illness (WHO, 1993). Underweight (low weight-for-age), implies that gaining insufficient weight relative to age. The worldwide variation of low weight-for-age and its age distribution are similar to those of low height-for-age. Underweight is now used as a composite indicator to reflect both acute and chronic under nutrition, although it cannot distinguish between them. Wasting (low weight-for-height) implies gaining insufficient weight relative to height, or losing weight. Wasting is considered to be an indicator of acute under nutrition. According to National Family Health Survey (NHFC, 1998-99), in India 46.00% of the children less than 5 years of age were affected by stunting. For underweight, it was 47.00% and for wasting it was 16.00%. The prevalence of underweight (47.00%) is comparable with that reported for Bangladesh (48.00%) and Nepal (48.00%), but is much higher than all other South Asian countries and far higher than those reported for other countries of the world.

In the present study, an assessment of under nutrition among children belonging to ICDS School, and frequenting the ICDS scheme was done. The associations of a number of variables with under nutrition were evaluated. The **Table 3.15**, and **3.16** explained the present study has observed a wide range of variation on the overall incidences of stunting, under nutrition and wasting among the ICDS children (49.86%), (60.77%) and (23.16%).In Case Group of data Phase I moderate (47.56%), Severe (45.73%), moderate (49.67%), Severe (46.36%). In Phase II moderate (55.45%), Severe (39.60%), moderate (30.43%), Severe (36.71%). In Phase III moderate (36.31%), Severe (62.42%), moderate (48.94%), Severe

(81.56%). In Phase IV Moderate moderate 39.16, Severe (64.34%), moderate (38.30%), Severe (43.97%). In Control Group of Phase I moderate (42.07%), Severe (43.90%), moderate (55.48%), Severe (41.94%), in Phase II moderate (52.85%), Severe (40.65%), moderate (42.74%) Severe (41.88%), in Phase III moderate (49.15%), Severe (44.07%) moderate (41.07%) Severe (59.82%). In Phase IV moderate (42.27%), Severe (48.45%) moderate (37.50%) Severe (57.69%). Studies of Mandal et al., (2008) conducted among the children of ICDS centers of Hooghly district, West Bengal reported that the incidence of under nutrition was 48.79% (stunting), 58.83% (underweight) and 19.08% (wasting), and 50.82% (stunting), 62.52% (underweight) and 26.87% (wasting) among the boys and girls respectively. However, the present study indicates that the tribal children are found to be more affected than the general caste children. The higher prevalence of under nutrition was also reported from the children of West Bengal (stunting 45.80%, underweight 38.89% and wasting 13.94%) and Assam (stinting 36.17%, underweight 57.54% and wasting 14.42%) (Som et al., 2006). The proposed classification of WHO (1995), for assessing the severity of the public health problem of under nutrition based on the percentages of conventional nutritional indices shows that very high problem existed among the studied children. There is urgent need of nutritional intervention programmer is necessary to combat this public health problem of under nutrition. It is generally agreed fact that different ethnic Groups show variation in respect to the nutritional status in India. However, it is not clear whether casual relation existed between them (Som et al., 2006). It was well established that in India, children from the economically poor socioeconomic Groups were found to poorer in nutritional status as compared to the general caste children (Radhakrishna and Ravi 2004). The results of the present study were also supportive of this fact. There is considerable variation in the prevalence of under nutrition state-wise. Among the states, Bihar and Kerala

have the highest and lowest prevalence of under nutrition, respectively. Even in Kerala, which has the lowest prevalence, 27.00% of children below age four are stunted, 28.00% are underweight and 12.00% are wasted. In Bihar the respective values are 61.00%, 63.00% and 22.00% (Mishra, 1999). The incidences of under nutrition obtained in the present study were found to be distinctly lower. The incidences of stunting and under nutrition were found to be higher among Santal children of Purulia district of West Bengal (17.62% stunting; underweight 33.70%) as reported by Chowdhury et al. (2008). Children from Karnataka also showed higher incidences than those in the present study. The incidences were as reported by Joseph et al. (2002) was 9.04% stunting and 31.20% underweight). The prevalence of stunting in the present study was however, found to be similar to those reported for Kamar children of Chattisgarh (50.00%) (Mitra et al., 2007), Oraon of North Bengal (54.00%) (Mittal and Srivastava, 2006), tribal children of Bihar (54.00%) (Rao and Vijay, 2006). The results of the present study is also distinctly lower than those reported for tribal children of Madhya Pradesh by Rao et al. (2005) (stunting 51.60%, underweight 61.60% and wasting 32.90%) and children from Rajasthan by Singh et al. (2006) (stunting 53.00%, under nutrition 60.00% and wasting 28.00%).

The prevalence of under nutrition observed in the present study was also compared with other reported values from various developing nation. The incidence of stunting and underweight were found to be higher than those reported from Malaysian children by Marjan et al. (1998) (Stunting 29.20%, Underweight 26.10%), among Pakistani children by Mian et al (2002) (Underweight 29.50%) and Tibetan children by Dang et al. (2004) (underweight 24.70%). The incidences of under nutrition in the present study were distinctively higher than those reported from Tanzania children by Matee et al. (1997) (stunting 31.60%, underweight 14.60% and wasting 2.90%) and from Kenyan children by Chesire et al. (2008) (stunting

30.20%, underweight 14.90% and wasted 4.50%). However the prevalence of stunting was significantly lower than those reported from Bangladesh children (44.00%), Tibetan children (41.40%) and Indonesian children (55.00%) by Rahman and Chowdhury (2007), Dang et al. (2004), and Hadju et al. (1995) respectively. Furthermore, the results of the present study was observed to be higher in the underweight and wasting categories (31.50%and 11.90%) and lower in stunting category (44.30%) than those reported for Vietnamese children (Hen and Kam, 2008). In the Indian society, there is a pronounced preference for the male child (Kishor, 1993). Studies documenting nutritional status in Indian have further observed that girls are more affected then boys (Singh et al.1996; Yadav and Singh 1999; Vashist et al.2005; Bose et al.2007). According to NFHS-I and NFHS-II that there are certain Group that are more likely to be underweight (due to prolonged food deprivation) than others. In the present study, moderate and severe underweight prevalence is observed to be slightly higher among girls (48.9%) than among boys (45.5%). The results show that in overall girls were more affected than the boys. The odds are found higher in stunting, underweight and wasting. The present study also showed that higher odds were associated with tribal children compared to general caste children in underweight and wasting and hence, tribal children were found to be more affected by under nutrition (underweight). It is an accepted fact that in Indian society, there is a pronounced preference for male children (Kishor, 1993). It was also evident that there was a general increase of under nutrition among girls. Such increase of under nutrition among girls have also been observed in the studies of Choudhary et al. (2001), Bose et al. (2007) and Mondal and Sen (2010).

A number of socio-economic, demographic and maternal factors have been found to have strong association with the prevalence of under nutrition (Madzingira, 1995; Syamala, 2004; Zottarelli et al., 2007; Hien and Kam, 2008). The major underlying factors for the

prevalence of under nutrition were poor socio-economic conditions in different Asian countries and due to environmental and ethnic differences (Frongillo et al. 1997). Existing studies have shown selected socioeconomic characteristics were significantly associated with stunting (Rahman and Chowdhury, 2007), underweight, and wasting (Madzigira, 1995; Som et al., 2005; Zottarelli et al., 2007; Hein and Kam, 2008; Sen and Mondal, 2010). The multinomial logistic regression analysis in the present study has depicted a higher odds ratio between father's occupations, study area, mother's education and hence shows associations with under nutrition.

It is evident from **Table 3.63** that most of the mothers included in the present study suffered from different grades of CED. Studies have consistently reported that prevalence of CED was very high among women from India. Using data from the Indian National Family Health Survey 2000, Bharati et al. 2007 reported an overall prevalence of CED of 31.20% among women aged 15–49 years. The prevalence of CED was high (20–39%) among Bengalee women as observed by Bose et al., 2009. Arlappa et al., in 2009 observed a very high prevalence of CED (52%) among women from Rajasthan. In a recent study, Bandyopadhyay and Sen (2016) reported very high levels of CED among women working in brick fields of West Bengal. High levels of CED were reported from women belonging to different tribal populations by Bisai and Bose (2009), Chakrabarty and Bharati (2010), Banik (2011), and Ghosh (2014). However, very recent studies from the country have reported that prevalence of CED is decreasing among women in the country. Rai in (2015), while utilizing data from the National Family Health Survey (NFHS) 1998-1999 and NFHS 2005-2006, documented high levels of CED among Indian women but also indicated an almost 3% reduction in CED and a 6% increase in overweight/obesity during 1998–2006. In another very recent study, Meshram et al. 2016 observed that prevalence of CED had declined from

52% during 1975–79 to 34% during 2011-12. The present study enabled direct evaluation of association nutritional status. Significant associations between maternal BMI and children nutritional status were observed. India is currently in the midst socioeconomic, demographic, nutritional, and epidemiological transition and still under nutrition continues to affect large segments of the population. The early detection and effective management of current energy deficit as assessed by mother's BMI may reduce increased susceptibility to under nutrition among children. It was also observed that mean Z-scores for WAZ, HAZ, WHZ, and BMIZ of children had increasing trends associated with an increase in maternal BMI status (**Table 3.64, 3.65, 3.66 and 3.67) .**The stepwise regression model revealed that maternal BMI was most predictive variable of HAZ, WAZ, and BMIZ (model 1 in each Case and Control) and this explained the significant variations in these three dependent variables. Results indicated that correlations between mother's and child's anthropometry were significant. Studies on the association between the nutritional statuses of mothers with that of their off springs are scarce in the exiting literature. Some studies are available in the domain of BMI between mothers and their children. There were significant associations between maternal BMI with children weight and height Z-score and it was observed by many researchers (e.g., Bouzitous et al., 2005) that an increase in BMI status was associated with a lower rate of childhood under nutrition. It was noted more than twenty years ago by Rahman et al., in the year 1993 that a child's nutritional status, as indicated by weight-for-age (as a percentage of NCHS median), was associated with BMI of mother (p< 0.001). Study from Bangladesh showed that mothers who were underweight were 2.5 times more likely to have underweight children (Islam et al., 1994). A Chilean study observed direct correlation (p< 0.001) between children's BMI Z-score and their mothers' BMI. (Santos et al., 2009). In a recent study, Kulasekaran (2012) reported that women with poorer nutritional status, as indicated by BMI, had registered

higher risk of severe thinness (height-for-age) and severe underweight (weight-for-age) (27.10% and 23.30%, resp.) among their children. The study also reported that severe wasting (weight-for-height) in children was also associated with mothers' BMI. In yet another recent publication, Negash et al., (2015) observed that HAZ was positively associated with maternal height. Significant positive association between maternal BMI and children BMI was also noted by Ajslev et al., 2014, and Ray (2004). Anthropometric measurements recorded on children aged 3 years showed that boys have higher metric values in Case of height, HAZ *Z*-score, and BMIAZ *Z*-score than girls. But mean weight, BMI, WAZ *Z*-score, and WHZ *Z*-score of girls increased. Net increase in BMI, HAZ, WAZ, and BMIZ in Case of boys aged 4 years in Case of except height and weight over that of girls was noted by Rolland-Cachera et al. 1984. Possibly, it is important to note that, during infancy, the relationship between mother and child malnutrition is affected by biological consequences of maternal malnutrition during lactation. Thus, interventions by improving maternal nutritional status could have a significant role in the prevention of childhood malnutrition. One additional issue that needs to be highlighted is "adiposity rebound," which refers to the second increase in BMI during early childhood. It is of concern that between-population differences in the patterns of adiposity rebound may exist, in particular, between populations in industrialized and developing countries. This may affect the estimate of obesity prevalence for children at around the age of adiposity rebound when the international BMI references based upon data collected in a particular wealthy society are used. This pattern of change in BMI means that the age of adiposity rebound inevitably predicts later BMI (Rolland-Cachera et al., 1984). This association between changes in BMI applies at all ages, not just at around 5 years, so the adiposity rebound should not be viewed as a critical period for obesity development. The NCHS/WHO growth references have played an important role in the past for international

use in assessing child and adolescent growth and nutritional status. WHO has recently developed and recommended the use of a new international reference for infants and preschool children.

Prevalence of under nutrition based on head circumference of the children

Head circumference, a non-invasive and inexpensive anthropometric measure of both nutritional status and brain development, is the most relevant physical index associated with intellectual ability among children (Leiva Plaza et al., 2001; Ivanovic et al., 2004). It has been defined as the most sensitive anthropometric measure of prolonged under nutrition during infancy, associated with intellectual impairment and poor cognitive development (Ivanovic et al., 2004). Any significant reductions in HCs observed in undernourished children may have serious implications for their future performance and achievement (Oyedeji et al., 1997). This circumference is looked upon as one of the most important anthropometric measurements in infancy and early childhood, since it reflects the intracranial volume and brain growth attainment (Hall et al., 2007). Therefore, this measurement became very important for assessment and evaluation of growth and development of children aged below 5 years (WHO, 2007). The present study shown in **Table 3.16**. The result of Case Group in Phase I (boys were found moderate undernourished 26.22%, severe 36.59% and among girls were found moderate undernourished 46.36%, severe 49.01%). In Phase II (boys were found moderate undernourished 49.50% and severe 41.5% among girls were found moderate 29.95%, severe 41.55%). In Phase III (boys were found 41.40%, severe 35.67% and among girls moderate 39.01%, severe.81%), in Phase IV boys were moderate 27.27 % and severe 32.87% and among girls moderate 31.21% and severe 36.17%.

In Control Group Phase I (**Table 3.17**) (boys were found moderate undernourished 45.12%, and severe 39.63% and girls were found moderate 55.48%, and Severe 39.35%), in Phase II (boys moderate 58.54%, and severe 29.27%, and girls were found 35.9%, and severe 54.7%). In Phase III (boys were found moderate 59.32%, and Severe category 33.05% girls in moderate category 33.93%, severe 55.36%), in Phase IV boys were found moderate 30.93%, and severe 41.24% and among girls were found moderate 31.73%, and in severe category 30.77%). The results of the present study reported mean values of Head Circumference to be significantly lower among girls than boys ($p<0.01$). Similar studies had earlier reported that mean Head Circumference values were significantly lower in girls than boys (Zaki et al., 2008; Oyedeji et al., 1997; Singh and Grover, 2003; Mandal et al., 2010). The age and sex-specific HC mean comparison with the WHO reference (WHO, 2007) showed that most of the children remained undernourished (<-Moderate), except girls aged 2 years and 5 years. Some Indian studies have also reported that mean HC values were lower than the WHO/NCHS reference population among urban pre-schoolchildren of Faizabad, Uttar Pradesh (Singh and Bisnoi, 2005), Punjabi pre-school children (Singhand Grover, 2003) and Bengalee pre-school of Midnapore, West Bengal (Maiti et al., 2012).Though the overall prevalence of under nutrition using the HC among girls seems to be higher (58.16%) than that in Case of boys (53.85%), yet this difference is statistically not significant ($p>0.05$) (Table 2). On the contrary, some studies have reported that prevalence of under nutrition to be higher among girls than boys. Mandal and Bose (2010) reported high prevalence of under nutrition (boys: 64.90%; girls: 62.80%) among rural pre-school children of Hooghly district of West Bengal. Significantly lower prevalence of under nutrition ($p<0.05$) was reported among Bengalee pre-school boys of Midnapore, West Bengal (boys: 19.20%; girls: 22.60%) by Maiti et al. (2012) ($p<0.05$). However, Sukanya et al. (2014) in their study among pre-school

children of urban slums from Karnataka observed that boys were more affected than girls (boys: 37.03%; girls: 28.23%) ($p<0.05$). Several studies have reported that gender differences in the prevalence of under nutrition were more pronounced in poor socio-economic Groups and lower segments of the tribal populations with girls being more undernourished than boys (Bose et al., 2007; Mondal and Sen, 2010a; Sen and Mondal, 2012; Maiti et al., 2012;Tigga et al., 2015a,b). Such high prevalence of under nutrition may be attributed to the fact that the children residing in rural areas have poor access of health care facilities, literacy and socio-economic conditions (Ball and Pust, 1993; Mondal and Sen, 2010a; Sen and Mondal, 2012; Tigga et al., 2015a, b). The age-specific magnitude of under nutrition was greater among children in the higher age Groups (e.g., 4 years and 5 years). Similar trends in the age-specific prevalence were reported among urban slum pre-school children of Karnataka (Sukanya et al., 2014) and Bengalee pre-school children of Midnapore, West Bengal (Maiti et al., 2012).

Percent of body fatness related to risk factors and body fitness assessed using percent of body fat

Research has indicated that individuals who exhibit excessive body weight and body fat show an increased prevalence of cardiovascular disease, diabetes and cancer (WHO, 1990; Manson et al., 1995), several studies have reported the association between body fatness and diseases risk factors with BMI among different Indian populations (Zaadstra et al., 1993; Misra et al., 2001, 2003, 2004; Bose et al., 2003; Ghose and Das Chaudhuri, 2005; Ghose et al., 2006; Ghose and Bandhopadhyay, 2007). It has been reported by Durnin and Womersley (1974), Gibson (1990), Neiman (1995) and Lee and Neman (2005) that body composition, anthropometric dimensions and and morphological characteristics play vital roles in the determination of body fatness. These parameters are sensitive indicators of growth progress

and nutritional status of a population and are ultimately relevant to the specific event in which the individual excels (Chatterjee et al., 2006; Wilmore and Costill, 1999). The observations in the present study reflects lower fatness among the children of present study.

Total body fatness as determined by PBF is considered to be a risk indicator of cardiovascular disease in childhood and adulthood too. In the present study gender difference fat distribution based on the PBF was evaluated using the body fitness scale proposed by Neiman (1995) and Lee and Neiman (2005). It has been observed that majority of the individuals comprised the risky body fitness category (boys; %; females; %) ($p<0.01$) (Table 3.6). The sex specific prevalence of fair (2.58 % vs. 16.35%) and good (15.81 % vs. 27.16%) body fitness was low among the male and females. However, the gender specific prevalence in body fitness in fair and good categories were found to be statistically significant ($p<0.001$). When the age and sex specific body fitness pattern is attributed the corresponding decrease of PBF with the advancement of the age among both genders. Several studies have reported the similar trends showing the decreasing of PBF with age among children's in developing countries including India (Flegal et al., 1998; Rosmond, 2004; Das and Bose, 2006). The detailed explained into the Table 3.11 and 3.12 and figure of LMS also **in 3.32 for Case data and Control data.**

Effect of the socioeconomic, demographic and lifestyle–related variables on nutritional status

The poor demographic socioeconomic and environmental conditions are related to under nutrition, which is defined as BMI<18.5 kg/m^2 (James et al., 1988; Ferro-Luzzi et al., 1992; james et al., 1994; WHO 1995; Ferro-Luzzi and James, 1996: Ahmad et al., 1998: James et al., 1999: Khongsdier, 2001, 2005; Subramanian and Smith, 2006; Subramanian et al., 2007; Azami et a., 2009; Chakraborty and Bharati 2010). In the present study multinomial

logistic regression analysis was done to assess the effect of different socioeconomic, demographic and life style related variables with CED (BMI<18.5 kg/m2) among the tea garden working female. Several studies have reported that the females residing in rural environments were more vulnerable to under nutrition than the males (Ferro-Luzzi et al., 1990; Zerihun et al., 1997, Nube et al., 1998: Teller and Yamen 2000; Arlappa et al., 2005). It has also been observed that in India 31% of the females exhibit a high prevalence of nutritional deficiency (BMI< 18.5 kg/m2) and that most of them resided in the rural areas and belonged to illiterate schedule caste and schedule tribe populations with low standards of living indices (IIPS and ORC Macro,2000). The present study has also observed that the prevalence of under nutrition was higher among the girls when compared to the boys (p>0.05) (**Table 3.24** and **3.25**). Subramanian and Smith (2006) suggested a positive association between nutrition and socioeconomic status. This is a characteristic of the early stages of socio-economic and nutritional transitions in the developing countries such as India. The results in the present study support the fact that the prevalence of CED is of primary significance among the tribal and rural populations of India, as opined by Naidu and Rao (1994) and Reddy (1998). This can be attributed to the country's immense population size. Socio-economic disparities insufficient resources, faulty feeding practices, poor economic conditions and poor health care facilities (Mondal and Sen, 2010a). It has also been suggested that higher adiposity and BMI were associated with income and standard of living in the developing countries such as Chakraborty et al., 2009). The multinomial logistic regression analysis suggested that lower monthly income was strongly associated with a higher prevalence of under nutrition in both genders among the children of present study (**Table 3.26** to **3.27**). The association was significantly among the female individuals belonging to lower (<Rs 2000/-) and middle (4000/- and above) income Groups (**Table 3.24** to **3.25**). The

results further suggested that the odds values we more than 1.11 times higher among the children belonging to lower income (odds 1.11; 95% CI 0.78-1.59 in Rs.4000/-). Bose et al., (2009) reported that children belonging to the lowest family income Group had the lowest mean BMI (19.1 kg/m2) and the highest rate of CED (46.3%) while those comprising the highest family income Group had the largest mean BMI (20.8 kg/m2) and lowest rate of CED (30.2%). Similar conclusion was also made for adult slum dwellers of Kolkata (Chakraborty et al., 2009) and Malaysian adults (Azmi et al., 2009). The present study is also agreement with other studies (Bose et al., 2007a) with respect to the fact that the prevalence of CED was observed to be higher among the individual belonging to lower income Groups (males; 23.23 % ; female 34.46%) than those in the higher income Groups (males; 14.93%; females 14.77%). The multinomial logistic regression analysis indicated that occupation had a pronounced effect on the prevalence of under nutrition among the children's parents. The results suggested that the 'manual worker' category (odds; 0.97; 95% CI 0.79-1.20) and among mother's (odds: 1.00; reference Group) among the manual worker (odds; 1.07; 95% CI 0.83-1.38) and (odds; 1.27; 95% CI 1.00-1.55 and 1.37; 1.06-1.77) among the males exhibited higher odds for under nutrition. The females were more affected by under nutrition as they had to perform both the heavy agricultural duties and also the household chores. Lukmanji (1992) had aptly described the rural female in the developing countries as bearing the burden of a double day in order to fulfill both their working roles. Rao et al., (20100 went to report that in India, females engaged in farming had a similar domestic workload as that of non-farming females. Barker et al., (2006) observed that the male and female individuals from farming households in India were thinner than those who were engaged in other occupation. It has also been documented that joint families were associated with adverse health outcomes in children and young females (Das Gupta, 1999, Bloom et al., 2001). It has

also been suggested that SES appeared to be important determinant for under nutrition in populations (Delpeuch et al., 1994; reddy, 1998; Ahmed et al., 1998; Subermaniam and Smith, 2006; Faruque et al., 2006; Bharati et al., 2007; Subermanium and Smith, 2007; Bose et al., 2009; Chakarbarty and Bharati, 2010). The SES of the individuals in the present study was evaluated using the modified scale of Kuppuswami (Mishra and Singh, 2003; Kumar et al., 2007). The results reported a 1-times higher odds value (odds; 1.66; 95 % CI 1.28-2.14; p>0.01) associated with under nutrition among the female of the present study individuals belonging to lower SES. This indicated that the females of the lower SES were significantly at risk to suffer from wasting (**Table 3.24**). A study from Bangladesh showed that better –off females were observe to have 0.77 times lower odds to be affected by CED when compared with the females from poor households (Ahmed et al., 1998). Furthermore, the odds value in the present study was also higher among the male individual belonging to a higher SES than a lower SES (Reddy 1998; Faruque et al., 2006; Subramanium et al., 2007). Subramanium and Smith (2006) and Suberamanium et al., (2007) have reported very clear associations of SES with nutritional status among females of low socio-economic positions in India. The pattern found in the present study was also consistent with the studies of Reddy (1998 and Shukla et al., (2002) which showed similar associations between SES and under nutrition.

The present study also assessed the standard of living conditions using house types and living conditions. It has been reported by Nube et al., (1998) that adult BMI was considered to be useful indicator for the standard of living. Chakraborty et al., (2009) reported that the prevalence of CED was significantly higher in the bamboo-fenced houses (i.e. non-bricked) among the adult slum dwellers of Kolkata. In the present study, higher proportions of the adult individuals (males; 23.19%; females; 29.63%) having non-bricked house type were suffering from under nutrition (table and). Those individuals belonging to

low to medium household living conditions exhibited significantly higher odds for the males (odds ; 1.7; 95% CI ; 1.1-2.6) and the females (odds; 1.74; 95% CI; 1.09-2.8) to be undernourished (e.g., with CED) than those from the higher living condition category ($p<0.05$). The results of logistic regression analysis further indicated that the odds value for individuals living in non-bricked houses were higher among the males (odds: 1.48; 95% CI 1.12-3.01; $p>0.05$) and the female (odds: 2.16; 95% CI; 1.18-3.95; $p<0.05$) (Tables 3.34 and). The results further suggested that the tea garden labors having 'no' toilet facility' had significantly higher odds values among the males (odds 1.63; 95% CI; 1.08-2.45; $p>0.05$) and the females (odds) (Table 3.12). Hence house type, living conditions and toilet facilities play a significant role in the prevalence of under nutrition.

It had been suggested that there was a negative relationship between a female's higher level of education and the proportion of undernourished female's higher level of education and the proportion of undernourished females (Berdasco, 1994; Ahmed et al., 1998; Teller an Yimar 2000). Bharti et al., (2007) also reported that education, especially among females, was one of the regulatory factors enhancing the awareness of health and hygine in the society and that the nutritional status of females went together with the enhancement of their educational status and standard of living. In the present study higher prevalence of CED was observed in the 'illiterate' education category (male; 24.04 % female; 32 .48%) (**Table 3.24)**. It was also observed that the tea garden laborer individuals comprising the 'illiterate' education category were more susceptible to under nutrition (eg CED) than those of the higher educational levels. The odd values were documented to be higher among both the males (Odds) (**Table 3.25**). Bose et al., (2009) reported significantly higher rates of CED ($p<0.001$) associated with individuals having 'no formal education' among Bengalee males and females. Betdaco 1994) reported that the lower educational levels were directly related to

higher percentages of CED among Cuban female individuals. A similar study showed that rural females who received one or more years of formal education were nearly half as likely to suffer from CED as those with no schooling in Bangladesh (Ahmed et al., 1998).

Prevalence of under nutrition based on CIAF (composite index of anthropometric failure)

The prevalence of CIAF depicted in **Table 3.22** for Case Group and **Table 3.23** for Control GroupAs the use of the CIAF is a recent development, there are a handful of studies that have reported the extent of prevalence of under nutrition among Indian children using the CIAF (Nandy et al. 2005; Seetharaman et al. 2007; Biswas et al. 2009; Das and Bose 2009; Deshmukh et al. 2009; Mandal and Bose 2009; Mukhopadhyay et al. 2009, Sen et al. 2011b). Nandy et al. (2005), utilizing data from the National Family Health Survey (NFHS-2) of 1998–1999, reported the prevalence of under nutrition to be 59.8% while Seetharaman et al. (2007) reported that 68.6% of children of Tamil Nadu were under-nourished. Studies on the CIAF also reported a very high prevalence of under nutrition among children from different districts of West Bengal. The overall prevalence of the CIAF in the present study was found to be slightly lower (63.6%) than the reported values from Hooghly (73.1%) by Mandal and Bose (2009), Purulia (66.3%) by Das and Bose (2009) and Darjeeling (65.6%) by Mukhopadhyay et al. (2009), but higher than that reported from Nadia (60.4%) by Biswas et al. (2009). The CIAF has been disaggregated based on its sub-Groups (Groups B–Y) to find out the possible risk factors and to correlate with the cause-specific mortality and morbidity patterns where the conventional anthropometric indices have failed to identify the Groups of children with multiple failure (Seetharaman et al. 2007; Mahgoub et al. 2009). The use of the CIAF helps to visualize the exact figures and identify the high risk Groups. This disaggregation provides for a far more comprehensible depiction of under nutrition, which

the conventional indices are unable to predict (Nandy et al. 2005; Seetharaman et al. 2007). In the present study shown in **Table 3.22** and **3.23** that 43.9% of the children showed combined double and/or multiple failures (Groups C, D and E) as compared to combined single anthropometric failure (19.7%) (Groups B, F and Y). A review of the longitudinal studies showed that prevalence of under nutrition (wasting and underweight) was almost twice as common among deceased children (Boerma et al. 1992). Therefore, these interesting applications of the CIAF as a tool of assessment under nutrition among vulnerable segment of the population would be considerably helpful for the health and policy planners, a fact that has been stated earlier by Nandy et al. (2005). In almost all Indian populations, boys have better access to food and basic amenities than girls and there is found to be a pronounced preference for the male child (Kishor 1993). In the present study, girls (11.1%) were found to be significantly more affected than boys (7.6%) in the multiple anthropometric failure Groups (Group D) ($p \geq 0.01$). the above detailed depicted in **Table 3.22** and **3.23**.

Time Series

The time series analysis shows that in some cases, the ICDS enrolled children (Case Group) height increases leter compared to control of Phase I. There in Height of Case -II marked fall can be noticed compared to the height of Control phase boys. Similarly decreased in height during Phase III & IV of boys can be observed in contrast to respectively control group. Early decrease in weight incase of Case I boys was in sharp contrast to cControl Phase I boys. Unlike Control II boys Case II boys exressive shows increasing weight. In Case of Boys of Phase III there is marked docline in weight before it take off agin.the observed bend is similar in Phase III boys of Control group, however not marked as in Case (ICDS) children In Case –IV boys weight rises and decline again , where as in Control there was decline in weight first and risen again.

In the measurements like MUAC,HC, TSF, SSF and BMI changes was evident from the trend line of the Control boys which was absent in Case Group, excluding BMI of Phase I. Steady change be observed in measurements is like MUAC, HC, TSF,SSF and BMI of Control compare to Case of boys.

CONCLUSION AND RECOMMENDATIONS

The assessment of nutritional status is considered to be the measure of health status and standard of living of an individual or population. It is necessary to mentions that these data would be more helpful for policy planners and public health professional to better understand the current nutritional situation in relation to food and nutritional and to improve conducted to assess the nutritional status of children of ICDS aged 2-5 years (12-60 months) of North Bengal, India. The nutritional status was evaluated using different derived economic, demographic and lifestyle related factors were also obtained to describe the useful in the formation and/or implement of appropriate development and nutritional supplementary programmers to promote the health condition of the population under study. The present study assessed the nutritional status of the children utilizing the different anthropometric indices that appeared to be reliable indicators for the assessment of under nutrition (e.g. CED) among them. The use of BMI and MUAC depicted the existence of a high prevalence of undernourishment. The results further conformed that the pronounced gender-related undernourishment. It was evident that the proposition of nutritional deprivation was the major nutritional concern among children belongs to Case and Control study.

Despite the increasing prevalence of under nutrition continues among the Indian populations to be a major public health problem in most of the rural populations in India including the ICDS children as document in the present study. The existing literature further revealed that the under nutrition was considered to be major problem in the low

socioeconomic populations than the high socio-economic populations in India. The results of the present study support the inference that in the Indian rural populations. CED remained of primary significance rather than obesity or overweight, which was in contrast with the populations of the western countries. The results further suggested that an urgent nutritional support programmers should be launched focusing to the female for reducing the magnitude of under nutrition in the population concerned. Further studies should be conducted to determine the effects of nutritional supplementations on the anthropometric parameters and functional ability among the ICDS children the following conclusion derived from the present study:

ANTHROPOMETRY AND NUTRITIONAL STATUS

The result indicated the mean weight, height, MUAC, SSF and TSF were considered higher among the boys when compared with the girls. The mean Head Circumference was observed to slightly higher among the girls (34.22± cm) belong to Case study when compared with the girls belong to Control study. The skin-fold measurements of tsf and ssf were higher among the girls. Age variations in the anthropometric variables among these children were found to be strongly associated with the age Groups (1-2, 2-3, 3-5years).

The derived anthropometric indices showed that BMI were higher among the girls then the boys. However, the male individuals had higher mean values of FFM, FM and FFMI than the females in Case of the nutritional and body composition variables of PBF% ration, mean values are higher among the girls than the boys. When age specific effects was taken into consideration, the results indicate that most of anthropometric variables were observed to be higher in age Group of 1-2 years in Case of the boys and in the age Group of 3-4 years in Case of the girls.

- The results of the Pearson correlation analysis between the anthropometric variables showed that most of anthropometric variables were significantly correlated with each other ($p>0.05$). Age was significantly higher correlated with ffm, fm. Height and weight were significantly correlated with all the anthropometric variables.
- Linear regression analysis showed that anthropometric and body composition variables were significantly associated with BMI, PBF ($p>0.05$).
- In countries like India and the many developing countries the appropriate health care and nutritional strategies should be implemented to improve the nutritional status especially in the populations where prevalence of thinness and chronic energy deficiency (CED) were very high. This includes the ICDS children and their mother too of the North Bengal. Utilizing the WHO (1995) proposed criteria based on BMI. It was shown that the mothers belong to Case study comprised a high undernourishment Group (CED >20%) and suffering from different grades of CED. The overall prevalence of under nutrition (%) respectively. It has been observed that using z-score to assess under nutrition among children. The mother were also observed overweight and underweight using CED BMI comparison.
- The gender specific prevalence of different grades of under nutrition among the children was assessed using BMI showed that most of the undernourished individuals comprised mild under nutrition followed by moderate under nutrition (CED grade II: 4.05 % and finally severe under nutrition (CED Grade III: 1.74%) among the ICDS children.
- Nutritional status was also assessed using the sex specific cut-off points of MUAC <23 cm for boys and <22 cm for girls, as specified by James et al., (1994). The results are shown that the overall prevalence of under nutrition was 40-64%. The sex specific

prevalence of under nutrition was observed to be slightly highly among the males than the females (40.97% vs 40.17%) ($p>0.05$).

- When the nutritional status of the ICDS children were classified using the combination MUAC with BMI. It was observed that 17.26% and 20.76% of the girls and boys were affected by under nutrition. The sex difference was however, found to be statistically not significant.

- When the children and their mothers were categorized in terms of fitness status based on CED, More than half of the individuals exhibited risky fitness status (51.11%), followed by good (20.37%), then excellent (19.59%) and finally fair fitness status (8.11%), Risky fitness status exhibited by 64.68%, and 32.93 % of the males and females ($p<0.01$). The amount of risk factors associated with CED among the mother showed that the majority of them had an optimal risk (76.16%). The individual comprising the slightly overweight and lean categories were observed to be 12.26% and 7.72% respectively.

- A multinomial logistic regression analysis model was fitted on the socioeconomic, demographic and lifestyle related variables to estimate the odds of being girls were undernourished. The association of BMI with the different predictor variables among the boys indicate that several variables had significant influences in determining whether an individual was under and/or over-nourished. The results further suggested that toilet facility, household living condition and age , income, family type, toilet facility, house type , socioeconomic status and house hold living condition (among the females) were significantly ($p<0.05$) associated with CED.

- The association of thinness and wasting with the socioeconomic, demographic and life style related factors showed that several variables were significantly associated with higher level of adiposity patterns among the female individuals.

RECOMMENDATIONS AND PROPOSED SUGGESTIVE MEASURES

The present study revealed a poor nutritional status among the children and their mothers of North Bengal. There are some recommendation and suggestive measures to improve the individual status, and therefore the health of these individuals. The recommendations or suggestive measures are as follows:

- The nutritional status should be improved by introducing the good environment (like clean sanitation, water facilities and overall infrastructure of locality etc.). The government should provide supplementation of good amounts of protective food and nutrients in the ICDS (Integrated Child Development Center) for children and their mothers.
- The installations of hygienic toilets are required to improve the health conditions.
- Furthermore, the Government should play a proactive role in reducing the prevalence of under nutrition among the population under study. Nutritional intervention programmers are needed to be implemented among the children.
- There was also the prevalence of different grade of thinness, stunting, wasting and underweight among children. Therefore appropriate strategies should be initiated to reduce such prevalence and also improve the public health conditions by checking the manifestation of non-communicable diseases

include hypertension, diabetes and chronic heart disease among children and their mothers.

- Appropriate awareness should be imparted among the individual in respect to ill-health conditions caused by thinness and CED. The individuals comprising the less educated, lower socio-economic background, poor income Group a high dependency ration family Groups should be targeted. There is also a need for integrated health policy to alleviated thinness and CED.
- The health care facilities must be expanded and found to be within the reach of the individuals. The proper utilization of health care facilities should be ensured in terms of health cheek up camps in regular basis and health personnel should encouraged and motivated within the community. The government and non-government organizations (NGOs) should be strive hard to popularize the utilization of existing health care facilities in order to combat ill-health and under nutrition condition.
- The rapid treatment of nutritional diseases would be helpful to minimize the nutritional burden among children and their mothers. Well trained health professionals and medicine practitioners should be encouraged to hold health camps.
- The necessary nutritional and health related educations should be imparted for a better understanding of the problems and adoption of redial measures.
- Proper education should be provide to make the individuals aware of the major issues relating to nutrition, health and disease.
- The effective orientation programmers relating to the importance of proper nutritional status should be recognized.

GENERAL OBSERVATION AND CONCLUDING REMARKS

Finally, the promotion of health of the children and lifestyle to reduce the burden of under nutrition (eg: CED) and its consequences requires a multi-dimensional approach. The result has established a high prevalence of under nutrition among the children and their mother. The results also showed a gender specific nutritional deprivation. More importance should be given to improve the nutritional status of children. One well-known fact is the adverse health effects of low BMI or under nutrition has to increase the risk of low birth weight babies.

The results of the present study emphasize the importance of empowering women through engagement and education and of maintaining the healthy physical environment (e.g. water and sanitation). The study highlights the importance of supporting initiatives the address these issues not only for their core benefits, but also for the potential benefits to nutritional status. The present study warrant interdisciplinary approaches from researcher's policy makers and extension health workers in popularizing the beneficial effects of food products in ICDS center, encouraging their wide use which would ensure nutritional security to rural populations. It may be concluded that to reduce the problem of under nutrition among the children and their mothers of North Bengal, both the Government and Non-Government Organization (NGOs) should adopt initiatives so as to improve nutritional status by appropriate health and nutritional intervention programmers so as to ameliorate the under nutrition.

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