THE CONSEQUENCE OF CHRONIC ENERGY DEFICIENCY (CED) ON CHILDREN'S NUTRITIONAL STATUS IN TAMILNADU: EVIDENCE FROM NFHS-II

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INTRODUCTION

Adequate nutrition, a fundamental cornerstone of any individual's health, is especially critical for women because inadequate nutrition wreaks havoc not only on women's own health but also on the health of their children. Malnutrition poses a variety of threats to women. It weakens women's ability to survive childbirth, makes them more susceptible to infections, and leaves them with fewer reserves to recover from illness. In addition, malnutrition in women undermines their productivity, capacity to generate income, and ability to care for their families. Above all, the malnutrition leads to economic losses for families, communities, and countries.

Women are more likely to suffer from nutritional deficiencies than men are, for reasons including women's reproductive biology, low social status, poverty, and lack of education. Socio-cultural traditions and disparities in household work patterns can also increase women's chances of being malnourished. Several reviews have emphasized the vulnerability of women throughout their life cycle [Leslie, 1991]. In some countries, like India, girls are treated differently in terms of access to health care, food, and education. Also, girls are at risk for early pregnancy, which may affect their own pre-pubertal growth. Women of reproductive age are subject to numerous stresses affecting their health and well-being.

It is difficult to determine exactly what proportion of those losses are due to maternal malnutrition, but recent research indicates that 60 percent of deaths of children under age 5 are associated with malnutrition — and children's malnutrition is strongly correlated with mothers' poor nutritional status (David L. Pelletier and Edward A. Frongillo, 2003). Although malnutrition's effects on this group have been recognized for decades, there has been little measurable progress in addressing the specific nutritional problems of women. Ignorance about the symptoms of malnutrition, such as the lethargy and depression caused by iron deficiency, may be dismissed as "normal" or unimportant, further exacerbating the problem (Rae Galloway, 2002).

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In recent year, dramatic progress has been made globally in tackling malnutrition, especially in reducing vitamin A deficiency and iodine disorders. However, around 800 million people are chronically malnourished, and more than a billion are sick or disabled because of nutrient deficiencies in the world. Each year, chronic malnutrition is a key factor in the deaths of at least 13 million children under five years of age in the developing world. Maternal nutritional status is important for a host of reasons-for the woman herself, for her capacity to reproduce, and for the development of her children, with implications for the health and reproductive capacity of the next generation's mothers. However, for decades, issues in women's nutrition have centered on nutrition during pregnancy and lactation and much of the concern has thus been for the newborn's health and well-being [Shepard et al. 1996]. The nutritional issues of women themselves have rarely been investigated and not many nutritional data are available from non-pregnant women.

In India, malnutrition remains a silent emergency, though the government of India has made significant progress in the past several decades in improving the health and well-being of its people. In India, more than half of all children under the age of four are malnourished, 30 per cent of newborns are significantly underweight, and sixty per cent of women are anaemic. According to the World Bank Report, in the last 40 years in India the mortality has declined by half and fertility by two-fifths, but malnutrition has only come down by about one-fifth. It is obvious that the further progress in human development in India will be difficult to achieve unless malnutrition is tackled with greater vigor and more rapid improvement in the future than in the past.

In recent decades, India has established a framework of programs with the potential to combat malnutrition, including a Public Distribution System (PDS), an Integrated Child Development Services (ICDS) program, a National Mid-day Meals Program (NMMP), and several employment schemes providing food for work. In India, volumes have been written about the nature and cause of adult and child malnutrition and the means of reducing it. But the role of women's 'chronic energy deficiency' in children's nutritional status has gone largely unnoticed until recently.

In Guatemala, in 1987, the term 'chronic energy deficiency' (CED) was being used as a term to indicate an inadequate household food supply. Since then, attempts to define, measure and assess CED have evolved, using the body mass index (BMI or weight/height2) of individuals as the index of CED. Therefore, in this study BMI can be

used to asses the nutritional status of women. Among children, anthropometry is usually used to track growth or failure to grow (wasting and stunting). Anthropometry is the single most non-invasive method of assessing body composition. It reflects both health and nutrition and predicts performance, health and survival.

Tamilnadu is one among of the demographically advanced States in India and it has established a framework of programmes with the potential to combat malnutrition including an ICDS (Integrated Child Development Services) programme, a NMMP (National Mid-day Meals Programme), and a PDS (Public Distribution System)and other some employment schemes providing food for work. Despite these programmes, the state continues to bear a burden of malnutrition – high prevalence of CED and anaemia among mothers and more number of severely undernourished children. These situation calls for an exploration of the relationship between CED and children's nutritional status in Tamilnadu.

The main **objectives** of the study are

- to study the nutritional status of women in the age group of 15-49 years in Tamilnadu
- to present a nutritional (status) profile of the children less than four years of age
- to examines the pattern of food intake practices among ever married women
- to study the degree of 'chronic energy deficiency' and anaemia (severe, mild and moderate) among women by selected background characteristics
- to explore the impact of 'chronic energy deficiency' (BMI) of women on the nutritional status of their children

SUBJECTS AND METHODS

Subjects: The data for the present study were drawn from National Family Health Survey, a nationally represented large scale sample survey conducted in Tamilnadu, India during 1998 – 99. The structure of the survey is similar to that of the DHS conducted in various Asian and African countries. The NFHS in Tamilnadu was conducted in all 29 districts of Tamilnadu based on a representative sample of 4676 eligible women aged 15-49 from 5281 households. A total of 4299 women alone were considered for this study. Women who are all currently pregnant and those who have given birth in the month of interview were excluded. In addition, out of 1359 children born to eligible women in the

three years preceding the survey only 977 were considered for assessing the nutritional status of children (the height and weight measured children alone).

Methods: Anthropometry is the single most portable, easily applied, inexpensive and non-invasive method of assessing body composition. It reflects both health and nutrition and predicts performance, health and survival.

The use of body mass index (BMI) as a measure of obesity has been widespread and has recently been promoted for assessment of chronic energy deficiency (CED) in adults. The Body Mass Index (BMI) is defined as the weight in kilograms divided by the height in meters squared (kg/m^2). A BMI of less than 18.5 indicates chronic energy deficiency (CED). Women were classified as chronically energy deficient or obese as described by James et al. (1998) and the World Health Organization (1995). Chronic energy deficiency grades I, II, and III correspond to body mass index (BMI) 17.0-18.4, 16.0-16.9, and < 16.0, respectively. Women with BMI 18.5-24.9 were classified as normal. Finally, obesity grades I, and II correspond to BMI 25.0-29.9, and >30.0 respectively. The weight of children and women was measured using a solar-powered digital scale, which gives results with an accuracy of $\pm$100grams. Height/length was measured using an adjustable wooden measuring board that provides accurate measurement to the nearest 0.1 cm.

Three indices of nutritional status were calculated for children: height-for-age, weight-for-height, and weight-for-age. The height-for-age index examines linear growth retardation and is an indicator of chronic under-nutrition. The weight-for height index compares body mass to body length. This index reflects acute under-nutrition. Weight-for-age is a composite measure of both chronic and acute under-nutrition. Under nourished children on the weight-for-age index are referred to as "underweight" on the height-for-age index as "stunted" and on the weight-for-height index as "wasted". The measurements on these three indices are compared with the international reference population as recommended by WHO (Dibley et al 1987).

RESULTS AND DISCUSSION

Women's Nutritional Status in the study area: BMI are most effectively used as indicators to describe the nutritional status of population and as an expression of the magnitude and distribution of under nutrition and over nutrition. Even though there is a progress in the nutritional status of adults, the incidence of CED remains high in India over

the past two decades, according to the National Nutrition Monitoring Bureau Survey (2000-01) 37.4 percent of adult males and 39.4 percent of adult females suffered from CED in rural areas of nine sample states. The adult malnutrition is largely a result of poor diets and infection during childhood (Gillespie and Mc Neill 1994).

CED: BMI of 4346 married women in the age group15-49 are given in the Table 1. In Tamilnadu, among the 4346 women surveyed, more than one-quarter (26.7 percent) of women have chronic energy deficiency (CED) which is lower than the national average (36 percent). Further, the CED grades III, II and I degree were found among 5.1 percent, 7.2 percent and 14.5 percent of women respectively. At the other end of the spectrum, the women with obesity percentage was higher (16.8 percent) than the country's average (10.6 percent) and the obesity I and II degree were found among 13.2 percent and 3.4 percent of women respectively. On the whole, only 39 percent of the women in the 15-49 age groups were well-nourished in Tamilnadu. The overall picture indicates that overweight (obese) problem overshadowed the underweight (CED) problem in Tamilnadu. Finally, the underweight is largely a result of poor diets and infection during childhood. The causes of obesity epidemic are sedentary lifestyles with a fall in spontaneous and work related physical activity and high-fat, energy-dense diets (Fig 1).

Table No.1
Percentage distribution of ever married women in Tamilnadu by their Nutritional Grade (BMI)

Nutritional Grade	No. of Women	Percent	Nutritional Grade	No. of Women	Percent	INDIA
Severe Thinness (<16.0)	221	5.1	CED (< 18.5)	1160	26.7	36.2
Moderate Thinness (16.0 – 17.0)	311	7.2				
Mild Thinness (17.0 – 18.5)	628	14.5				
Low Normal (18.5 – 20.0)	740	17.0	Normal (18.5 – 25.0)	2416	55.6	53.2
Well-Nourished (20.0 – 25.0)	1676	38.6				
I degree obesity (25.0 – 30.0)	574	13.2	Over weight (25.0 – 30.0)	574	13.2	10.6
II degree obesity (> 30.0)	149	3.4	Obese (>30.0)	149	3.4	
Total				4299	98.9	
Missing				47	1.1	
Grand Total*				4346	100.0	100.0

*Excludes the women who are all currently pregnant and those who given birth in the month interview

Anaemia: Anaemia is characterized by a low level of hemoglobin in the blood. Anaemia usually results from a nutritional deficiency of iron, foliate, vitamin B12, or some other nutrients. This type of anaemia is commonly referred to as iron-deficiency anaemia. Iron deficiency is the most widespread form of malnutrition in the world, affecting more than two billion people. In India, anaemia affects morethan 50 percent of the population. Anaemia may have detrimental effects on the health of women and children and may become an underlying cause of maternal mortality and perinatal mortality. Anaemia results in an increased risk of premature delivery and low birth weight.

Table No.2
Percentage distribution of ever married women in Tamilnadu by their hemoglobin level (G/DL)

Anaemic Nature	Number of women	Percentage of women	Percentage of women	INDIA
Severe Anaemic	110	2.5	any kind of anaemia 54.5	1.9
Moderate Anaemic	615	14.2		14.8
Mild Anaemic	1642	37.8		35.1
Non-Anaemic	1899	43.7	43.7	38.2
Total	4266	98.2	98.2	100.0
Missing	80	1.8	1.8	-
Grant Total	4346	100.0	100.0	100.0

The prevalence of 54.5 percent of anaemia among the ever married women indicates anaemia as a major nutritional problem in Tamilnadu. Further, more than one-third of the women had mild anaemia (37.8 percent) and 14 percent had moderate anaemia. The only state in India with a prevalence of severe anaemia of nearly 3 percent among the non-pregnant women is Tamilnadu. It is comprehensible that these high levels are attributed to diets that are low in iron content, clear absorption of iron due to inhibitors and increased demand due to the physiological requirements of menstruation, pregnancy and lactation (Fig. 2).

Children's Nutritional Status in the study area: Adequate nutrition and health during the first several years of life is fundamental to the attainment of the Millennium Development Goals for child survival and the prevention of malnutrition. Poor nutrition during these critical formative years has both immediate and long-term consequences.

A recent authoritative paper on child survival ranked nutrition interventions among the most effective preventive actions for reducing under-five mortality (Jones 2003). Throughout the world children fail to grow in length and weight in a remarkable similar age-specific pattern, despite vastly different prevalences of low weight-for-age, length-for-age, and weight-for-length between and among regions (Shrimpton 2001). Recent estimates show that about 40 per cent of the undernourished children in the world are in India although India accounts for less than 20 percent of the children in the world.

Table No.3
Percentage distribution of Children less than four years of age classified by their Nutritional Status in Tamilnadu

Age groups (in months)	Anaemia			Anthropometric Indices		
	Severe	Moderate	Mild	Stunting	Under weight	Wasting
<6	-	29.0	21.6	7.8	10.2	16.2
6-11	0.9	40.3	20.4	16.4	25.1	19.6
12-23	8.5	40.6	21.6	38.3	46.5	25.3
24-35	4.2	37.6	23.2	36.9	39.9	12.4
Total	4.4	37.8	21.7	27.8	33.9	19.5

In terms of nutritional status of children, about one-third of children (33.9 percent) are underweight and 27.8 percent of children are stunted in Tamilnadu. Further, the above table shows that the underweight and stunting are relatively low for children less than 6 months old (7.8 percent and 10.2 percent respectively)and this incidence increases more than twice after 6 months and highest of all among children who are 12-23 months (38.3 percent and 46.5 percent). In Tamilnadu about one in five children are too thin (wasting). The overall picture discloses the fact that both the acute and chronic under nutrition are a serious concern in Tamilnadu (Fig 3).

The prevalence of anaemia is higher during infancy and early childhood than at any other time in the life cycle (Yip 2002). The state representative data from NFHS-2 shows 63.9 percent of children below 3 years with any kind of anaemia (21.7 percent had mild, 37.8 percent had moderate and 4.4 percent had severe anaemia). The prevalence of anaemia varied from 50.6 percent in the age group of less than 6 months to 70.5 percent in the age group of 12-23 months (table 3) and severe anaemia is highest (8.5 percent) in the age group 12-23 months. Nevertheless, even though the state performing better child health care programmes, the anaemic levels were still high.

Table No.4
Percentage distribution of ever married women by their Nutritional Grade (BMI) with their Background Characteristics

Background Characteristics		Severe Thinness (<16.0)	Moderate Thinness (16.0 – 17.0)	Mild Thinness (17.0 – 18.5)	(<18.5)	Low Normal (18.5 – 20.0)	Well-Nourished (20.0 – 25.0)	I degree obesity (25.0 – 30.0)	II degree obesity (> 30.0)
Age of Women	15-19	6.6	10.5	25.7	42.8	22.4	30.3	3.9	0.7
	20-24	6.5	11.2	17.7	35.4	20.3	35.5	7.7	1.1
	25-29	6.0	7.2	14.9	28.1	18.6	40.7	10.0	2.5
	30-34	3.9	5.8	15.8	25.5	16.7	38.2	15.2	4.3
	35-39	3.6	6.2	12.1	11.9	15.3	41.5	18.4	3.0
	40-44	5.0	5.5	11.8	12.3	16.3	40.0	15.9	5.5
	45-49	5.9	7.1	12.1	25.1	13.9	39.2	15.8	5.9
Type of place of residence	Urban	3.0	3.5	10.3	16.8	12.7	44.8	20.0	5.7
	Rural	**6.9**	**10.4**	**18.2**	**35.5**	**21.0**	34.1	7.8	1.6
Educational level	Illiterate	8.1	10.3	17.9	36.6	21.2	**35.0**	**5.9**	**1.6**
	Primary	5.4	7.1	16.2	28.7	16.9	**37.9**	**12.6**	**3.7**
	Secondary	2.6	5.4	12.6	20.6	15.4	**42.0**	**17.7**	**4.3**
	Higher	2.7	3.1	5.8	11.1	10.5	**45.3**	**26.2**	**6.3**
Religion	Hindu	5.2	7.7	15.3	28.2	18.0	38.7	12.0	3.0
	Muslim	4.3	3.6	8.2	16.1	10.0	40.9	24.7	8.2
	Christian	4.4	4.4	10.5	19.3	13.5	41.0	20.1	6.1
	Other	6.2	-	-	6.2	6.2	56.2	31.3	-
Ethnicity	SC	7.6	8.5	20.2	36.3	19.2	34.5	7.5	2.5
	ST	9.4	25.0	18.8	53.2	12.5	28.1	6.3	-
	OBC	4.5	6.9	13.2	24.6	17.0	40.1	14.6	3.7
Household standard of living index	Low	8.9	10.7	20.2	39.8	22.3	32.5	4.1	1.5
	Medium	3.8	6.9	13.7	24.4	16.6	41.4	14.6	2.8
	High	1.4	1.7	5.8	8.9	9.2	44.9	27.9	9.0
Total		**5.1**	**7.2**	**14.5**	**26.7**	**17.0**	**38.6**	**13.2**	**3.4**

Relationship between Women's Nutritional Status and background factors

Undoubtedly, the socio-cultural and economic characteristics play a significant role in shaping the women's nutritional status. The above table furthermore supports this fact that the disparities in background conditions increase women's chances of being malnourished.

CED: Chronic energy deficiency is more prevalent among women in the age group 15-19 (42.8 percent) followed by 20-24 (35.4 percent). Further, CED is particularly

pronounced for rural women (35.5 percent) and women who are illiterate (36.6 percent), SC (36.3 percent) and women living in low standard of living (39.8 percent). However, chronic energy deficiency was less likely among women who had higher education (11.1 percent), OBC (24.6 percent) and women with high standard of living (8.9 percent). The other important findings drawn from this table was that CED grade II (severe thinness) was doubled among rural and illiterate women and it was more widespread among ST, and women living in households having a low standard of living (Fig. 4).

Table No.5
Odds Ratios from Logistic regression examining the effect of selected SED variables on CED condition of women in Tamil Nadu

SED variables	Coefficients (odds)	Significance	Odds Ratios
Residence			
Rural (Ref)			1.000
Urban	0.582	0.000	1.790
Religion			
Hindu (Ref)			1.000
Muslim	-0.350	0.047	0.705
Christian	-0.082	0.656	0.921
Others	0.774	0.183	2.168
CASTE			
SC (Ref)			1.000
ST	0.547	0.153	1.728
OBC	-0.231	0.007	0.794
Non-of these	-0.538	0.148	0.584
Educational Level			
No Education (Ref)			1.000
Primary Education	-0.150	0.106	0.861
Secondary Education	-0.395	0.000	0.674
Higher Education	-0.563	0.003	0.570
Standard of living index			
Low (Ref)			1.000
Middle	-0.414	0.000	0.661
High	-1.208	0.000	0.299
Current Age			
15-19 (Ref)			1.000
20-24	-0.151	0.435	0.860
25-29	-0.510	0.007	0.600
30-34	-0.659	0.001	0.518
35-39	-0.872	0.000	0.418
40-44	-0.922	0.000	0.398
45-49	-0.751	0.000	0.472
Constant	-0.015	0.940	0.985

-2 Log Likelihood 4515,398 No. of cases: 4346

The logistic regression results are given in above table 5. The odd ratios (Exp (B)) indicate the effect of each of the predictor variables on the prevalence of CED, controlling for other variables included in the model. Almost in each of the variables the odds decrease with the categories of a variable when compared to the respective variable's first category, indicating a decreasing chance for experiencing CED when improving the background conditions of women. The most significant variables are residence, education, and standard of living.

Obesity: According to NFHS-2 16.6 percent of ever married non- pregnant women age 15-49 in Tamilnadu are overweight and obese. But this percentage is considerably higher for some sub-groups of women (women who have better education (32.5 percent), Muslim Community (32.9 percent), and those who have high standard of living (36.9 percent)). Further, the problem of overweight and obesity are also higher among urban (25.7 percent) and OBC women (20.7 percent)). Older age, high standard of living and higher educational attainment are significant risk factor for extreme obesity (grade II). In contrast the obesity is less common in the early ages of ever-married women and women having low standard of living.

On the whole, the table 4 highlights that there is 2-fold difference in underweight and 3-fold difference in overweight between rural and urban women. Among the ethnic groups a two fold difference observed both in CED and in overweight between SC/ST and OBC. The other interesting observation is that the change in food habits and largely sedentary lifestyle may contribute to the current trend of overweight among the high standard of living women and women in urban area.

Anaemia: More than half of the women in age 15-49 in Tamilnadu have some degree of anaemia (39 percent have mild anaemia, 14 percent have moderate anaemia and 3 percent have severe anaemia). The prevalence of incidence of anaemia is highly prominent among women living in household with low standard of living (63.7 percent), SC category (61.6 percent) and illiterates (61.1 percent). Muslim women, low standard of living and illiteracy are significant risk factor for prevalence of extreme anaemia (severe) in Tamilnadu (Table 7). On the whole, the incidence of anaemia among the ever married women in Tamilnadu by their background condition also shows the similar pattern as what observed in CED and obesity condition.

Table No.6
Odds Ratios from Logistic regression examining the effect of selected SED variables on Obesity condition of women in Tamil Nadu

SED variables	Coefficients (odds)	Significance	Odds Ratios
Residence			
Rural (Ref)			1.000
Urban	-0.582	0.000	0.559
Religion			
Hindu (Ref)			1.000
Muslim	0.784	0.000	2.191
Christian	0.208	0.225	1.232
Others	-0.233	0.674	0.792
Caste			
SC (Ref)			1.000
ST	-0.560	0.488	0.571
OBC	0.119	0.357	1.126
Non-of these	-0.082	0.744	0.922
Educational Level			
No Education (Ref)			1.000
Primary Education	0.617	0.000	1.853
Secondary Education	0.728	0.000	2.070
Higher Education	0.847	0.000	2.333
Standard of living index			
Low (Ref)			1.000
Middle	0.889	0.000	2.433
High	1.563	0.000	4.774
Current Age			
15-19 (Ref)			1.000
20-24	0.486	0.252	1.625
25-29	0.876	0.034	2.401
30-34	1.472	0.000	4.357
35-39	1.606	0.000	4.981
40-44	1742	0.000	5.711
45-49	1.808	0000	6.096
Constant	-4.217	0.000	0.015

-2 Log Likelihood 3273.217 No. of cases: 4346

The above logistic regression results undoubtedly confirms that in general the probability of obesity enhances with improving their positions in each of the socio-economic variables. The most significant variables are residence, education, standard of living and current age.

Table No.7
Percentage of ever married women by their anaemic level with their Background Characteristics

Background Characteristics		Severe Anaemia	Moderate Anaemia	Mild Anaemia	Non Anaemia
Age of Women	15-19	-	17.2	43.7	39.1
	20-24	1.9	16.2	39.3	42.5
	25-29	2.3	15.0	39.4	43.3
	30-34	2.7	11.5	36.3	49.6
	35-39	4.0	14.3	38.2	43.4
	40-44	2.5	15.5	38.8	43.2
	45-49	2.6	13.8	37.7	45.9
Type of place of residence	Urban	1.4	11.8	38.9	47.9
	Rural	3.6	16.6	38.2	41.7
Educational level	Illiterate	4.1	17.1	40.0	38.9
	Primary	2.7	14.2	39.6	43.5
	Secondary	1.6	14.3	37.3	46.8
	Higher	0.5	6.8	34.4	58.4
Religion	Hindu	2.4	14.4	39.1	44.1
	Muslim	5.0	16.2	37.4	41.4
	Christian	3.1	11.0	31.6	54.4
	Other	-	26.7	20.0	53.3
Ethnicity	SC	3.3	16.5	41.8	38.4
	ST	-	15.6	43.8	40.6
	OBC	2.5	13.9	37.2	46.4
Household standard of living index	Low	4.2	18.3	41.2	36.3
	Medium	2.1	13.1	37.1	47.7
	High	0.7	10.5	36.9	52.0
Total		**2.6**	**14.4**	**38.5**	**44.5**

Food Intake Practices: Malnutrition reflects an imbalance of both macro and micro-nutrients that may be due to inappropriate intake and/or inefficient biological utilization. Gross imbalance of macro nutrients results in body weight and height that deviate from normal population standards. Latest studies show that in spite of being the world's largest producer of fruits, vegetables and milk and achieving self- sufficiency in cereals, Indians are not eating enough of their own produce to be normally healthy.

Tamilnadu find to be a superfluous state for sugar, fruits, vegetables and milk and a deficit state for cereals, pulse and eggs in respect to percapita net production vis-à-vis percapita requirement. Thus the food production in Tamilnadu is well diversified.

Table No.8
Percentage of ever married women in Tamilnadu by Food intake Practices

Food intake Practices	Mild or curd	Pulses or beans	Green leafy vegetables	Other vegetables	Fruits	Eggs	Chicken/meat/fish
Daily	50.1	42.1	10.2	71.8	13.7	6.1	2.4
Weekly	17.9	53.1	69.3	27.1	35.5	50.0	54.0
Occasionally	28.8	4.7	20.3	1.1	50.6	37.6	38.1
Never	3.2	0.1	0.1	-	0.2	6.4	5.5

Table 8 shows about the food practice of ever married women in Tamilnadu. Only half of the women were consuming milk/curd every day and more than one-fourth (28.8 percent) were consuming milk/curd on occasionally, though the Tamilnadu is self-sufficient in the milk production. Further, more than 50 percent were having the practice of eating egg and chicken/meat/fish on weekly basis, at the same time a considerable proportion (37 percent) took egg and chicken/meat/fish very occasionally. The fruits eating pattern was also not sufficient among the women in Tamilnadu. On the other hand, around 72 percent of the women used to take vegetables in their daily diet as a result of surplus vegetable production in Tamilnadu. In general, the food consumption pattern among the ever married women in Tamilnadu is not satisfactory but not worsening.

Consumption of a variety of nutritious foods that provide adequate amounts of protein, fat, carbohydrates, vitamins, and minerals is important for women's health. Empirical nutrition studies (Seckler 1982) show that increase in food energy intake would reduce malnutrition while the other variables are controlled. The relationship between BMI and percent food intake has been examined and the results are given in table 9.

In Tamilnadu, morethan one-fourth of women (26.7 percent) have a chronic energy deficiency. Women who consume milk/curd every day in the study area are less likely than other to have CED. The eating pattern of green leafy vegetables on daily clearly establishes the low prevalence of CED (6.3 percent) and high prevalence of obesity (18 percent for >25.0 nutritional grade). The women who took fruits on daily are less likely to have CED than others. Further, nearly half of the women who have less than 18.5 BMI eat eggs and chicken/fish/meat occasionally and those who eat chicken/fish/meat foods weekly have the high prevalence of obesity (64.8 percent in

I degree and 69.8 percent in II degree). Therefore, an undoubtedly established fact is a strong association between BMI and food intake practice.

Table No.9 Percentage of ever married women by their Nutritional Grade (BMI) with their Food Intake Practices

Mother's Nutritional Grade (BMI)		Milk or curd*			
		Daily	Weekly	Occasionally	Never
I degree	(< 18.5)	37.8	20.9	36.5	4.8
Normal	(18.5 – 25.0)	50.7	18.1	28.6	2.6
I degree obesity	(25.0 – 30.0)	67.4	13.3	16.2	3.1
II degree obesity	(>30.0)	73.2	9.4	17.4	-
		Pulses or beans			
I degree	(< 18.5)	40.9	52.3	6.7	-
Normal	(18.5 – 25.0)	43.4	52.3	4.2	0.1
I degree obesity	(25.0 – 30.0)	39.9	57.3	2.6	0.2
II degree obesity	(>30.0)	42.3	54.4	3.4	-
		Green leafy vegetables*			
I degree	(< 18.5)	6.3	66.1	27.4	0.2
Normal	(18.5 – 25.0)	9.9	71.0	19.0	0.1
I degree obesity	(25.0 – 30.0)	18.1	70.0	11.8	-
II degree obesity	(>30.0)	16.8	68.5	14.8	-
		Other vegetables			
I degree	(< 18.5)	67.8	30.3	2.0	-
Normal	(18.5 – 25.0)	71.7	27.3	1.0	-
I degree obesity	(25.0 – 30.0)	79.3	20.4	0.2	0.2
II degree obesity	(>30.0)	76.5	23.5	-	-
		Fruits*			
I degree	(< 18.5)	8.6	29.6	61.5	0.3
Normal	(18.5 – 25.0)	13.2	36.9	49.7	0.2
I degree obesity	(25.0 – 30.0)	22.5	41.2	36.3	-
II degree obesity	(>30.0)	30.4	41.9	27.7	-
		Eggs*			
I degree	(< 18.5)	4.2	43.1	48.3	4.3
Normal	(18.5 – 25.0)	5.8	51.2	36.9	6.1
I degree obesity	(25.0 – 30.0)	10.3	58.0	21.3	10.5
II degree obesity	(>30.0)	9.4	59.7	21.5	9.4
		Chicken/meat/fish*			
I degree	(< 18.5)	2.3	44.4	50.2	3.1
Normal	(18.5 – 25.0)	2.4	55.3	37.1	5.3
I degree obesity	(25.0 – 30.0)	3.0	64.8	22.6	9.6
II degree obesity	(>30.0)	2.7	69.8	16.8	10.7

*refers to significant at 5% level (chi-square results – Nutritional level and Food intake practices

Table No.10. Percentage distribution of women by their BMI with their anaemic condition

Anaemic condition	Severe Thinness	Moderate Thinness	Mild Thinness	I degree <18.5	Normal	Obesity
Severe	11.8	13.6	31.8	57.2	37.3	5.5
Moderate	8.1	8.9	17.9	34.9	55.3	9.8
Mild	4.8	7.6	15.1	27.5	58.4	14.2
Non Anaemic	4.2	5.9	12.2	22.3	55.7	22.1
Total	5.2	7.2	14.6	27.0	56.2	16.8

The importance of nutrition as a foundation for healthy development is often underestimated. Poor nutrition leads to high prevalence of CED and it contributes to further deterioration in their nutritional status. The above table clearly shows that women with BMI less than 18.5 have higher incidence of anaemia (57.2 percent) and this percentage declines with their declining anaemic level. Severe and moderate thinness was more pronounced among women who are suffered from severe anaemia. The non-anaemic women are found to have high degree of obesity. Hence, it is well clear that the body mass index seems to be highly correlated factor with anaemia.

Table No.11. Percentage distribution of Children's Nutritional Status with the their mother's Nutritional Grade (BMI)

Children's Status		Severe Thinness (<16.0)	Moderate Thinness (16.0 – 17.0)	Mild Thinness (17.0 – 18.5)	I degree <18.5	Low Normal (18.5 – 20.0)	Well-Nourished (20.0 – 25.0)	I degree obesity (25.0 – 30.0)	II degree obesity (> 30.0)
*Anaemic level (G/DL, 1 decimal)	Severe	14.3	4.8	16.7	35.8	23.8	33.3	7.1	-
	Moderate	7.1	9.8	20.8	37.7	22.4	31.1	8.2	.5
	Mild	7.1	9.5	17.5	34.1	16.1	37.4	10.9	1.4
	Non Anaemic	4.3	6.3	12.3	22.9	19.8	43.3	12.0	2.0
*Wt/A Standard deviations	Severe underweight	14.6	9.0	20.2	43.8	21.3	31.5	3.4	-
	Moderateunderweigh	9.5	9.9	24.0	43.4	18.2	32.2	6.2	-
	Well Nourished	4.0	7.2	13.5	24.7	19.5	40.6	13.6	1.5
*Ht/A Standard deviations	Severe Stunted	8.5	8.5	16.0	33.0	26.4	38.7	1.9	-
	Moderate stunted	4.8	9.6	18.1	32.5	25.3	33.7	7.2	1.2
	Mild Stunted	10.0	9.2	20.9	40.5	16.5	34.1	9.2	
	Well- nourished	4.5	6.9	15.1	26.5	16.9	39.4	16.1	1.1
	Above Normal	3.8	3.8	-	7.6	15.4	61.5	3.8	11.5
*Wt/Ht Standard deviations	Severe wasting	18.4	5.3	15.8	39.5	28.9	28.9	2.6	-
	Moderate wasting	10.5	7.2	19.1	36.8	16.4	38.2	8.6	-
	Mild wasting	6.0	9.5	21.0	36.5	20.3	34.3	8.3	0.6
	Well- nourished	4.5	7.5	13.5	25.5	19.0	39.1	14.8	1.5
	Above normal	-	9.5	4.8	14.3	14.3	66.7	-	4.8

*refers to significant at 5% level (chi-square results – Children's Nutritional status and Mother's BMI

The table11 highlights the close correlation between mothers's BMI with incidence of anaemia among children. The women with BMI less than 18.5 (CED) had 35.8 percent of severe anaemic children, it includes 14.3 percent of severe anaemic children among women with severe thinness (BMI <16.0). Further, the table shows that the moderate and mild anaemic children are closely associated with CED. Where as, the severe anaemic nature among children were less common women with I degree obesity (7.1 percent) in Tamilnadu. It is note that the well nourished (and obesity) women have about 57 percent of non-anaemic children.

Environmental and socio-economic factors influence childhood growth in height and weight more than genetic factors [Habicht et al. 1974]. The table 11 shows linkage between women's BMI and children's anthropometric indices (Fig.5, 6.1, 6.2, 6.3).

As expected, women with poorer nutritional status, as indicated by the CED condition, have registered higher risk of severe wasting and severe underweight children (18.4 and 14.6 percent respectively). Further, the severe stunted children are also associated with women's BMI. A similar relationship (which witnessed CED with anaemic condition) is also observed in anthropometric indices and, among the well-nourished (and obesity) women who have less significant risk of underweight, stunting and wasting children.

So it is clear that the severe underweight children were predominant among low BMI women in Tamilnadu (around 44 percent), and a significant percentage was also noticed among severe wasting, of around 40 percent.

BIRTH WEIGHT: It is well accepted that the mother's nutritional status can significantly influence the course and outcome of pregnancy. Low birth weight can result from inadequate body reserves and deficient dietary intake (Prema 1978, Prentice, 1987), have shown that prenatal dietary supplementation is correlated with birth weight and have concluded that such a programme could decrease the infant mortality rates in many poor countries around the world.

Ghosh's (1979) study on the low birth weight infants for 18 years reveals that the growth performance of these infants was poor compared with other infants and children

of the same socio economic groups born with normal birth weight. Apparently children suffering from intra-uterine growth retardation are programmed to grow and develop in a substandard growth trajectory, thus swelling the numbers of stunted and under weight children with low learning capacity and adults with low body mass index with low productivity, Women with CED in the reproductive age will in all probability deliver low birth weight infants.

Table No.12 Percentage distribution of Children's weight at birth with the their mother's Nutritional Grade (BMI)

Children's Characters		Body mass index for respondent							
		Severe Thinness (<16.0)	Moderate Thinness (16.0 – 17.0)	Mild Thinness (17.0 – 18.5)	<18.5	Low Normal (18.5 – 20.0)	Well-Nourished (20.0 – 25.0)	I degree obesity (25.0 – 30.0)	II degree obesity (> 30.0)
Weight at Birth	<2000	10.3	10.3	13.8	34.4	13.8	44.8	6.9	-
	2000-2499	10.9	10.9	19.8	41.6	20.8	29.7	6.9	1.0
	2500-2999	6.4	6.4	16.0	28.8	21.6	41.6	6.8	1.2
	3000+	2.8	5.6	12.5	20.9	17.6	41.2	18.2	2.0
	Not weighed at birth	7.8	13.5	21.7	42.9	22.6	29.6	4.3	.4
	DK	15.6	12.5	25.0	53.1	12.5	31.3	3.1	-
	Total	6.2	8.4	16.6	31.2	19.7	37.4	10.5	1.3

The percentage distribution of Children's weight at birth with their mother's Nutritional Grade (BMI) is given in table 12. Women with low BMI (<20.0) had the 70 percent low weight infants (2000-2499g). On the other hand, the over weight infants (3000+g) were born to women in I degree and II degree obesity condition (20.2 percent). Therefore, it is very clear from the above table that the severe thinness nature of mother had more probability of giving low weight babies. Hence, it is well documented from this analysis that the mother's nutritional status certainly has exercised its influence on the outcome of pregnancies.

CONCLUSIONS

Conclusion: The study's overall goal is to understand the links between women's nutritional status specifically chronic energy deficiency and child's nutrition status in Tamilnadu.

The prevalence of CED rate was less in Tamilnadu (26.7 percent) as compared to national average. Although the incidence of this CED was higher among SC women (53.2 percent), rural women (35.5 percent), uneducated women (36.6 percent), and

women with low standard of living condition (39.8 percent). A contrast trend was observed in the high standard of living group (36.9 percent), Muslim women (32.9 percent), highly educated women (32.5 percent), and urban women (25.7 percent), had high degree of obesity (I degree and II degree). It is therefore concluded that the Tamilnadu state facing the burden of both the nutritional disorders. On the one side, it has the high incidence of CED among the poor people and on the other side the people who have the new changing lifestyles and dietary habits suffer from obesity. Therefore the state should take appropriate steps to tackle these two extreme crises.

Although, the Tamilnadu state is self-sufficient in fruits, vegetables and milk production, the food consumptions were not adequate. The data show that the women who took vegetables and fruits on everyday are less likely to have CED and the obesity prevalence rates are high among those who used to eat chicken/mutton/fish in their diet weekly once. Hence the results confirm that there is a strong association between BMI and food intake practices. It is also evident that the mother's BMI has a positive association with children's anaemic condition. This risk of anemic among children is more women with BMI less than 18.5. In addition, the well nourished and obesity women have non-anaemic children. Similarly, the women with poorer nutritional status have infants of severe chronic and acute under nutrition.

The study strongly supports that the mother's nutritional status can significantly influence the weight of the baby at birth. Low birth weight infant (2000-2499g) was more likely to occur (70 percent) among the women with low BMI (<20.0) and over weight baby was more common among I and II degree obesity women. Therefore, it is well established that the mother's nutritional status had bearing on the weight of the baby.

In general, under and malnutrition starts in the womb and may extend throughout the life cycle. Malnutrition remains a silent emergency in Tamilnadu, though the state government had made significant progress in the past several decades in improving the health and well-being of its people particularly women and children.

The overall nutritional status in Tamilnadu is at reasonable level through the various nutritional intervention programmes, though the most vulnerable groups - women and children suffer from various form of malnutrition.

The risk of malnutrition is higher among the children whose mothers suffer from chronic energy deficiency. Mother's present nutritional status in turn depends on her childhood nutritional status. Concerted efforts are needed to break the vicious circle (mother-child-mother) of malnutrition among poor. It is emphasized that reduction of child malnutrition would greatly depend on delivery of effective and sustainable interventions to children and their mothers. At present, too few children and mothers are receiving effective nutrition interventions that could significantly reduce the risk of their malnutrition.

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Fig 1 Percentage distribution of women by Nutritional Grade in Tamilnadu

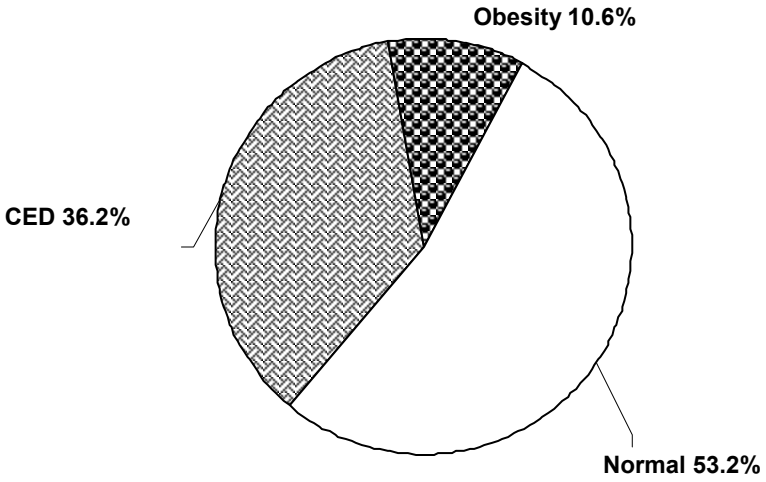


Fig 2 Percentage distribution of women by Anaemic Level in Tamilnadu

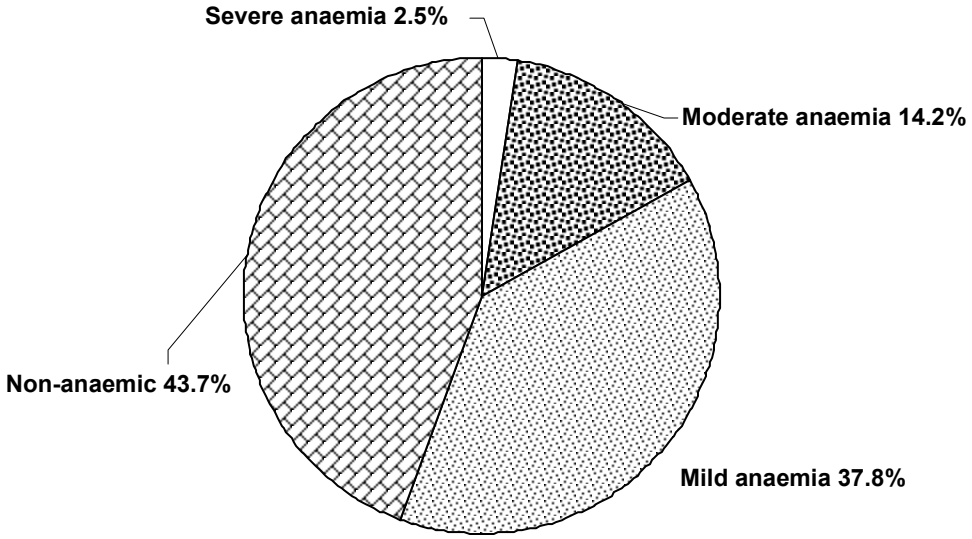


Fig 3 Percentage distribution of children <4yrs by Nutritional Status

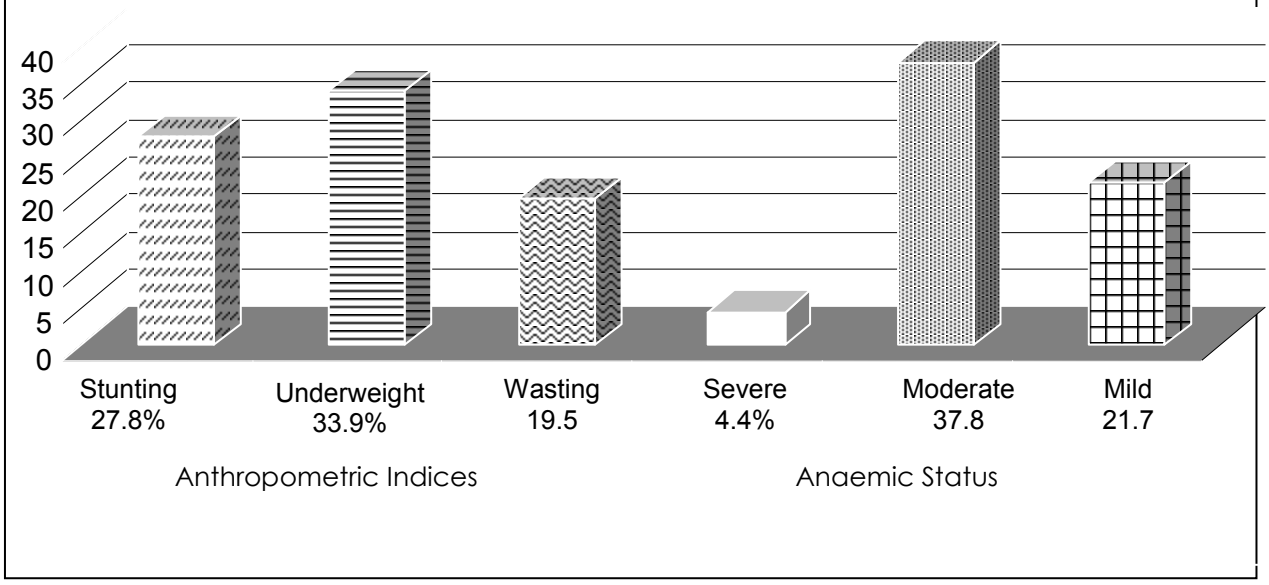


Fig 5 Percentage distribution of Children's Anaemic Level with the their Mother's Nutritional Grade (BMI)

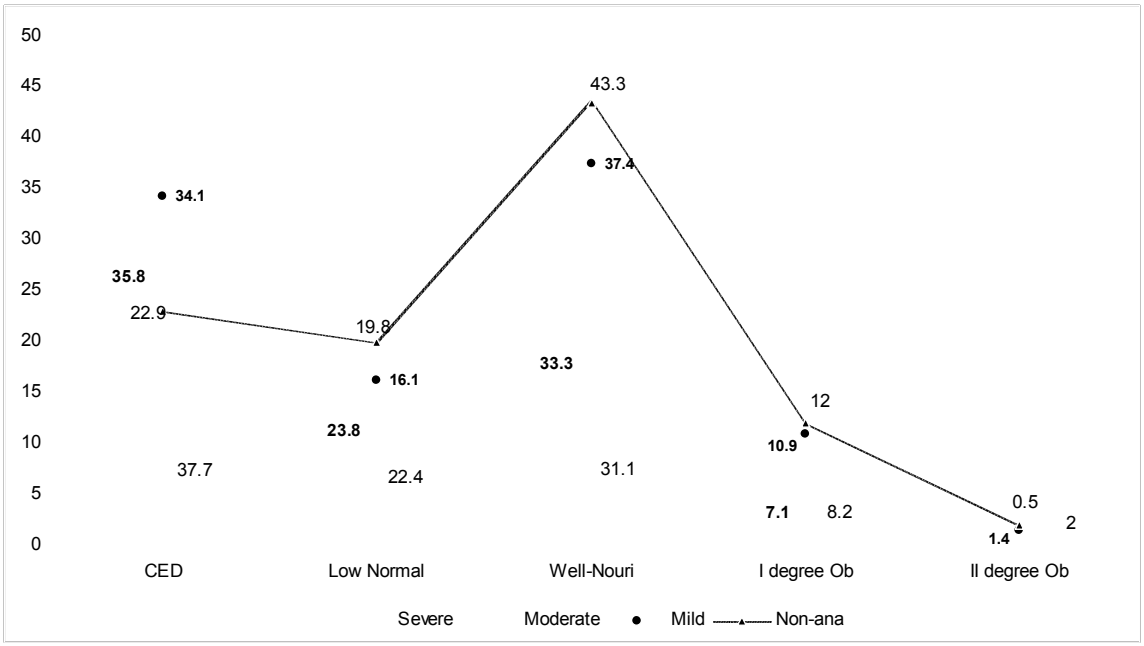


Fig 6.1 Percentage distribution of Underweight Children (Wt/A) with the their Mother's Nutritional Grade (BMI)

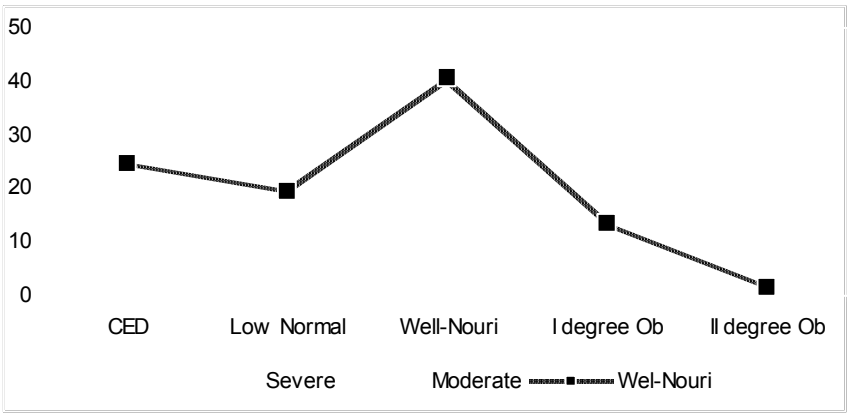


Fig 6.2 Percentage distribution of Stunted Children (Ht/A) with the their Mother's Nutritional Grade (BMI)

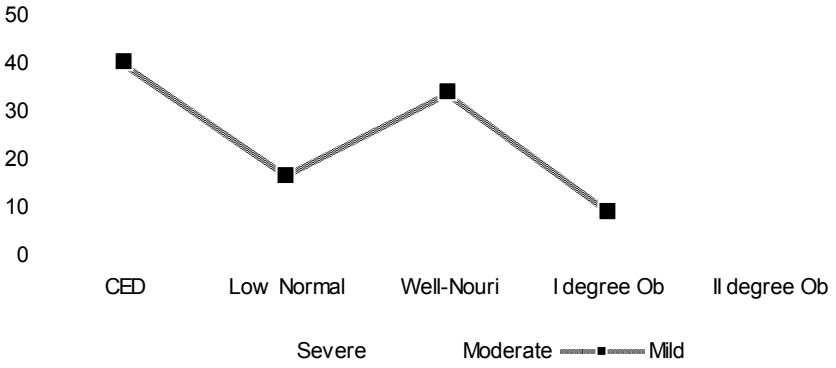
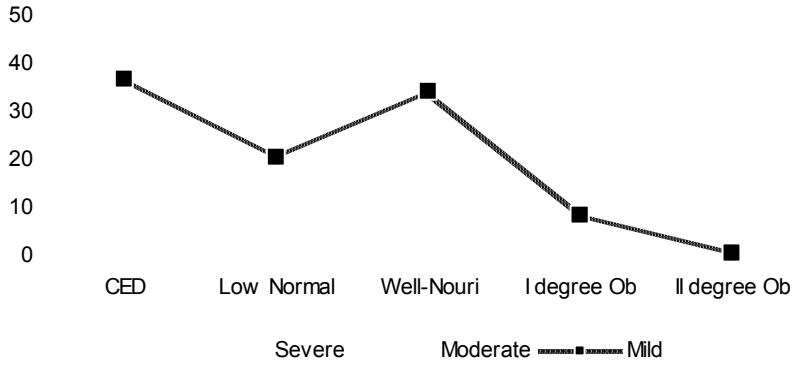
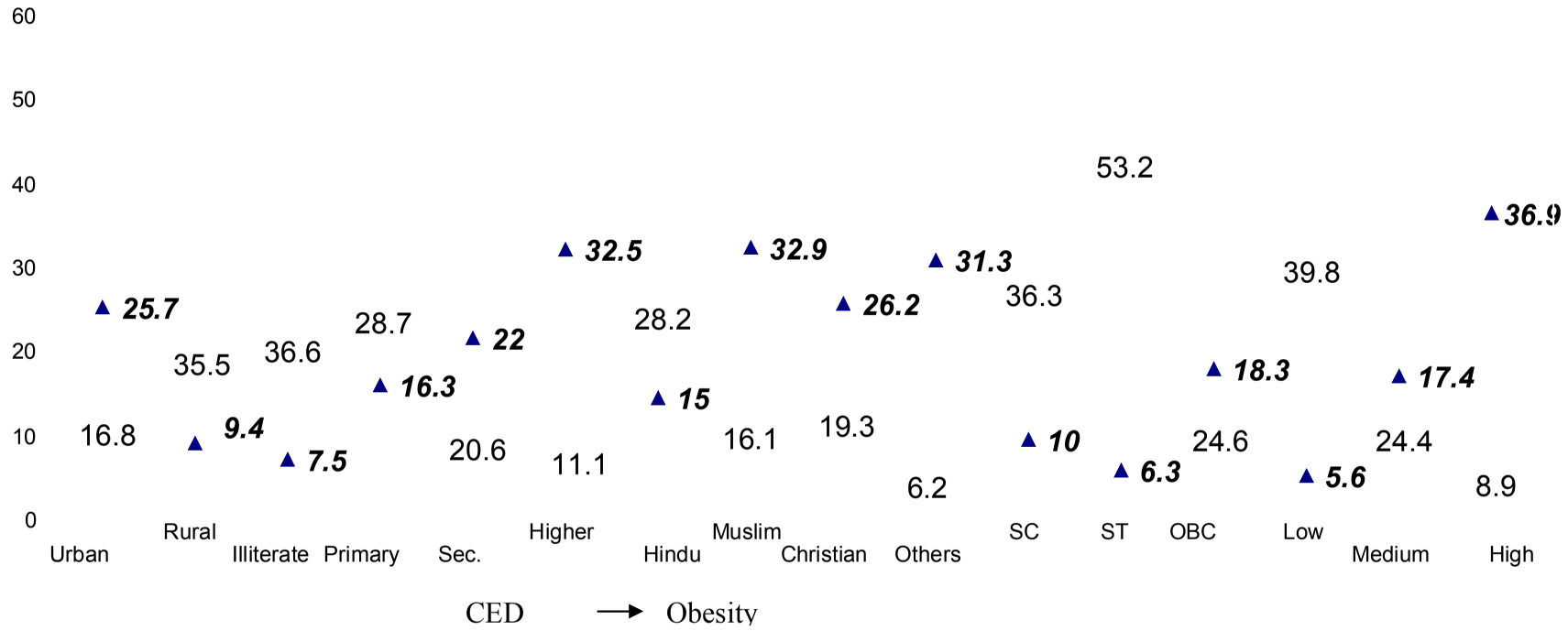


Fig 6.3 Percentage distribution of Wasted Children (wt/Ht) with the their Mother's Nutritional Grade (BMI)

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8.9
Urban
Rural
Illiterate
Primary
Sec.
Higher
Hindu
Muslim
Christian
Others
SC
ST
OBC
Low
Medium
High
CED → Obesity