J Nut Res (2013) 1(1):1-7
ISSN:2348-1064

Dual burden of malnutrition in mother-child pairs of the same household: Effect of nutrition transition

Meenakshi Garg*, Shradha Jindal

Received: 06 May 2013 / Received in revised form: 18 August 2013, Accepted: 18 August 2013, Published online: 04 November 2013

Abstact

This paper explores the dual form of malnutrition existing in the same household i.e. occurrence of both under-nutrition and over-nutrition together and determining the adequacy of food consumption in mother-child pairs.30 mother-child pairs were included in the study. Nutritional status was assessed by WHO criterion. 50% of mothers were aged between 25-30 years, 36.7% had graduated. The prevalence of overweight mothers-underweight child pair was found to be 23%. Significant difference was reported between the intake adequacy of cereals, vegetables, fats and oils, carbohydrate, invisible fat, visible fat, total fat and fiber, among the mother-child pairs. Also MAR (Mean Adequacy Ratio) of nutrients revealed that mothers had significantly better nutritional adequacy than children (p=0.01). Therefore, mothers had a better nutritional status when compared with children. Dual form of malnutrition exists within the same household and the food intake adequacy of the child is influenced by mother's food intake.

Key words: malnutrition, dual-burden, mother-child pair, nutrient adequacy, nutrition transition

Introduction

Overweight and underweight have long been treated as two separate public health problems, as different underlying factors have been assumed (Barnett, 2011). The paradoxical coexistence of child under-nutrition and maternal overweight within the same household, often described as the 'dual burden of malnutrition', is a relatively new phenomenon that has been described in studies from low- and middle-income countries including Benin, Brazil, China, Haiti, Guatemala, South Africa, Malaysia and Mexico (Steyn & Labadarios 2011; Rodrigues & Taddei 1998; Raphael & Delisle 2005; Khor & Sharif 2003; Barquera et al. 2007; Angeles-Agdeppa & Lana 2003; Deleuze et al. 2005)). Jehn & Brewis (2009) hypothesized that the dual burden might be an integral part of the transitional process and could perhaps be seen as a mere 'by-product' of the rapid increase in maternal overweight due to dietary and lifestyle changes and lack of change in the risk factors for child under nutrition.

Meenakshi Garg*, Shradha Jindal

Dietetics and Applied Nutrition, Dept. of Allied Hospitality Studies, WGSHA, Manipal University, Manipal-576104, Karnataka, India

Email: meenakshi.garg@manipal.edu;

The concept of nutritional transition which was extensively analysed by Popkin & Gordon-Larsen (2004) and Drewnowski & Popkin (1997) covers rapid changes from a traditional, low-fat, high-fibre, plant-based diet combined with physical labour to a Westernized diet high in meat, saturated fats, sugar and energy combined with a sedentary occupation. With increased economic development and urbanization, populations in many developing countries are consuming more processed foods, including more refined grains and foods with higher content of saturated fat, sugar, and salt. Changes in physical activity may accompany these dietary changes, as rural-dwellers move to the city to take on more sedentary jobs and firms and households adopt labor-saving technologies (Doak, Adair, Monteiro & Popkin 2000) (Popkin 1994). The nutritional transition usually occurs in parallel with economic, epidemiological and demographic transitions in a country.

Comparing nationally representative surveys from 42 developing countries, Garrett & Ruel (2005) found the prevalence of dual burden households ranging from as low as 2 per cent in Ethiopia to as high as 71 per cent in Egypt. According to data surveys from NNMB and NFHS-3 , it was shown that over years there has been a steep increase in the proportion of families where adults are getting adequate food but preschool children's energy needs are not met (Technical report of the NNMB 21 : Diet and Nutritional status of the rural population, 2001). In families where mother was over nourished, 31% of under five children were stunted, 20% were underweight and 9% wasted (NFHS-3).

In cruel and ironic contrast to the deprivation associated with poverty, diseases more often associated with excess, such as diabetes, obesity, and heart disease have also emerged as serious concerns in many developing countries (Popkin 2002) (PAHO 2000). These countries now face the worst of two worlds: millions of infants and young children suffer from under nutrition and poor growth while adults contend with over nutrition (Garrett & Ruel 2003). Given rapid urbanization and

growing wealth in India, coupled with changing food availability and prices, it is likely that the trend towards increased consumption of fats and processed foods will continue among wealthier groups in India, so moving towards a diet associated with DRCDs. These diets will become more desirable among lower-income groups (Hawkes 2007). This study aims at pointing such dual form of malnutrition existing in a household i.e. occurrence of both under nutrition and over nutrition together and determining the adequacy of their food consumption.

Materials and Methods

The study design was descriptive cross-sectional. The data collection was done, tabulated and analyzed over the period of 4 months (August to December 2011). The study was carried out in and around Manipal, Karnataka. Mother-child pairs in the same household with at least one child aged between 1-3 years were the target group. Sample size of 30 households having 1-3 years, children living with their mothers was included in the study. Tools used were interview schedule, modified Kuppuswamy scale (2007), SPSS Package Version 16.0, standard measuring spoons and cups and measuring tape. Demographic profile, anthropometric assessment height, weight and mid-upper arm circumference (MUAC), body mass index of both mother and child were taken and waist- hip ratio (WHR) of the mother was measured. BMI of mother was categorized according to Asian classification for BMI by World health Organization (WHO). And the child's data was compared with WHO BMI for age and MUAC for age classification. Mother's waist to hip ratio was compared to the WHO standards for adult women.

Table 1: Socio-demographic characteristics of mothers in the study

PARAMETER	Frequency n=30	Percent
Current Age		
20-25	4	13.3
25-30	15	50
30-35	8	26.7
35-40	2	6.7
40-45	1	3.3
Educational Qualification		
Illiterate	2	6.7
Middle School Certificate	7	23.3
High School Certificate	6	20
Intermediate Diploma	2	6.7
Graduate/Post Graduate	11	36.7
Profession/Honors	2	6.7
Employment Status		
Non-Working	18	60
Working	12	40
Socioeconomic Status of the family		
Upper Class	4	13.3
Upper Middle Class	14	46.7
Lower Middle Class	6	20
Upper Lower Class	6	20
Type of Family		
Nuclear	18	60
Joint	12	40
Number of Family Members		
<4	7	23.3
4 To 6	16	53.4
6 To 8	3	10
>8	4	13.3

Dietary Assessment was done using 24 hour recall and food frequency, also nutritional adequacy ratio and mean adequacy ratio was calculated and categorized according to cut-off set by Arimond and Ruel 2004. Mean adequacy ratio (MAR) was calculated as the mean of the nutrient adequacy ratios (NARs) for the intake of energy and nutrients and categorized according to given set cut-off.

The cut-off for MAR was <70% : Inadequate and >70% : Adequate

The data collected was coded using statistical analysis tool. McNemar's Test, t-test, Chi-square test, Pearson Correlation and Regression Analysis was used for statistical testing of the data.

General Characteristics

The socio- demographic information of the selected study subjects is depicted in Table 1. The mothers belonged to the reproductive age group, between 20 to 45 years. The majority of the mothers were aged between 25-30 years (50%). This is similar to one of the study which shows that the majority of mothers, 72.6% were aged <39 years (Khor & Sharif 2003). More of the mothers had an educational qualification. 36.7% were graduate and only 6.7 % illiterate. A greater part of the mothers were housewives (60%) and remaining 40% were employed. This is supported by NFHS 3 according to which 47% of mothers are working in Karnataka. 46.7 % of the population belonged to the Upper Middle Class category, 60 % were from nuclear families. The NFHS-3 survey has had reported a presence of 63% of nuclear families in India. More than 50 % of families had four to six members.

Table 2: General Characteristics of the children in the study

Parameter	Frequency (n=30)	Percent
Age		
12 to 18 months	13	43.3
18 to 24 months	7	23.3
24 to 30 months	7	23.3
30 to 36 months	3	10
Gender		
Female	11	36.7
Male	19	63.3
Birth Order		
1	19	63.3
2	10	33.3
5	1	3.3
Birth Weight (In Kg)		
Low 1.5-2.5	4	13.33
Normal2.5-3.5	23	76.67
Overweight >3.5	3	10

As depicted in Table 2, the majority, i.e. 43.3% of the children were of the age group 1 to 1 year 6 months. Most of the children were males with 63.3% and rest were females. 63.3% of children were of first birth order. According to the birth weight in kg 76.67% were normal, 13.33% were low birth weight and 105 were overweight. Current study varies from NFHS-3 India where 23.35% children had low birth weight.

In the present study when classified according to the BMI 50% of the mothers fall in the normal category, followed by 26.7% overweight and 13.3% obese whereas in case of children 53.3% are normal, followed by 33.4% underweight. These findings differ from NHFS-3 data. It is evident from Table 3 that while the percentage of underweight is more in children, overweight and obesity is more in mothers. On applying correlation test between BMI for mother and child, it showed a negative correlation trend (r= -.241), meaning, as the mother's

BMI goes up, the child's BMI is likely to come down. However, this correlation was not significant.

Table 3: BMI classification of Mother and the child

Parameter	Mother		Parameter	Child	
	n= 30	%		n= 30	%
BMI (kg/m2)			BMI (kg/m2)		
Underweight <18.5	3	10	<15th Percentile (Underweight)	10	33.4
Normal 18.51-22.99	15	50	15th - 85th Percentile (Normal)	16	53.3
Overweight 23-27.49	8	26.7	85th - 97th Percentile (Overweight)	1	3.3
Obese I 27.50-32.49	4	13.3	>97th Percentile (Obese)	3	10

Nutritional Adequacy: As seen in Table 4, in the present study when the nutritional adequacy ratio of mother and child was compared, it was observed that majority of the mothers (83.3%) were consuming marginally inadequate cereals and children (50%) had marginally adequate amounts of cereals. The adequacy of pulse intake was marginally inadequate for both majority of mothers (70%) and children (93.3%). The vegetable consumption adequacy was different for mother and the child, 70% of mothers and only 36.7% of children, were consuming marginally inadequate amount of vegetables. Both the mother (86.7%) and child (76.7%) were consuming marginally inadequate amounts of fruits majorly Out of the people consuming meat and its products majority were consuming inadequate amounts, 60% mother and 57.9% children 56.7% mothers and 73.3% of children were consuming mainly marginally inadequate amounts of milk and its products. The fat and oils consumption was marginally inadequate for 26.7% of mothers and 96.7% of children.76.7% of mothers and 73.3% of children were consuming marginally inadequate amounts of sugars.

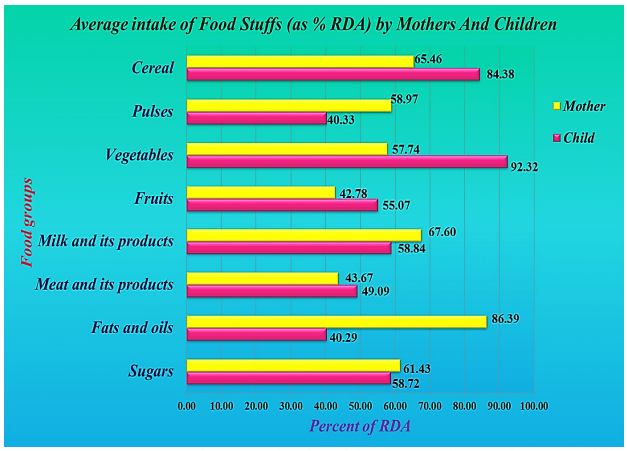

Figure 1: Comparison of average intake of food groups by mother and child

The average intake of food stuffs for both mothers and children when compared with their respective ICMR RDA's indicated that mothers had better intake of pulses, milk and its products, fats and oils and sugars which are the important food groups responsible for gaining weight. The current study was supported by NNMB survey (Brahmam, 2001-02) where higher percent of RDA was met by the women than the children of age 1-3 yrs (Figure 1).

The t-test was done for the monthly intake of food stuffs with their respective monthly RDA for the mother. The mean cereal intake 6.77 ± 0.95 kg for the mother for a month differed from the RDA significantly indicating inadequate consumption of cereals by the mother (Table 5). The intake of women in Karnataka state by NSSO was found to be 10 kg which is closer to the current study. Similar findings were seen in the case of the child were the intake was 3.04 kg with a standard deviation being 0.725 kg showed significant difference from the RDA. The mean intake of pulses, oils, vegetables, fruits, milk and its products, meat and its products, and sugars also showed

Table 4: Comparison of Nutritional Adequacies of mother and child in the same household (based on food groups)

Nutritional adequacy ratio of food stuffs	Mother		Child	
n=30	Freq.	Percent	Freq.	Percent
Cereal				
Marginally Inadequate <75	25	83.3	5	16.7
Marginally Adequate 75-90	4	13.3	15	50
Adequate 90-110	1	3.3	8	26.7
Excess >110	0	0	2	6.7
Pulses				
Marginally Inadequate <75	21	70	28	93.3
Marginally Adequate 75-90	2	6.7	0	0
Adequate 90-110	4	13.3	2	6.7
Excess >110	3	10	0	0
Vegetables				
Marginally Inadequate <75	21	70	11	36.7
Marginally Adequate 75-90	7	23.3	2	6.7
Adequate 90-110	2	6.7	6	20
Excess >110	0	0	11	36.7
Fruits				
Marginally Inadequate <75	26	86.7	23	76.7
Marginally Adequate 75-90	0	0.0	1	3.3
Adequate 90-110	4	13.3	2	6.7
Excess >110	0	0.0	4	13.3
Meat And Its Products				
Marginally Inadequate <75	12	60.0	11	57.9
Marginally Adequate 75-90	2	10.0	0	0.0
Adequate 90-110	5	25.0	3	15.8
Excess >110	1	5.0	5	26.3
Milk And Its Products				
Marginally Inadequate <75	17	56.7	22	73.3
Marginally Adequate 75-90	6	20	3	10
Adequate 90-110	5	16.7	4	13.3
Excess >110	2	6.7	1	3.3
Fats And Oils				
Marginally Inadequate <75	8	26.7	29	96.7
Marginally Adequate 75-90	8	26.7	0	0
Adequate 90-110	6	20	1	3.3
Excess >110	8	26.7	0	0
Sugars				
Marginally Inadequate <75	23	76.7	22	73.3
Marginally Adequate 75-90	2	6.7	2	6.7
Adequate 90-110	3	10	2	6.7
Excess >110	2	6.7	4	13.3

Table 5: Paired Samples Test for food intake (food group wise) for mother and child

Food stuff intake vs. RDA monthly	Paired Differences Mother				Paired Differences Child			
	Mean Intake	Std. Deviation	t value	Sig. (2-tailed)	Mean Intake	Std. Deviation	t value	Sig. (2-ailed)
Cereals (g)	6770	954.5015	-16.143**	0.000	3040	725.4829	-4.247**	0.000
Pulses (g)	825	552.2465	-5.626**	0.000	218	140.7647	-8.779**	0.000
Vegetables(g)	4240	1872.342	-9.545**	0.000	4150	2482.904	-0.763^{NS}	0.000
Fruits(g)	1280	837.0034	8.391^{NS}	0.000	165	2110.784	-3.498**	0.002
Milk And Its Products (ml)	6200	2820.887	-5.707**	0.000	8770	4059.19	-8.402**	0.000
Meat And Its Products (g)	702	460.0381	-4.147**	0.000	368	424.0801	-1.703^{NS}	0.099
Fats & Oils(ml)	663	157.6703	-3.278**	0.003	302	133.4275	-18.384**	0.000
Sugars (g)	432	209.2892	-6.334**	0.000	526	371.616	-5.515**	0.000

NS- Not significant, *Significant at 5%, **Significant at 1%

significant differences from the RDA for both the mother and the child except the meat & its products intake was adequate for the child.

This means that the basic food groups were not adequate in the diet of the mother and child and they are taking lower amounts than what is recommended for them.

Table 6: Correlation Test between Nutritional Adequacy Ratios (NARs) of Food Group Consumption of Mothers and the children

Parameter	Pearson Correlation value	p value
NAR Cereal	0.233^{NS}	0.216
NAR Pulses	0.488**	0.006
NAR Vegetables	0.804**	0.000
NAR Fruits	0.704**	0.000
NAR Meat and its products	0.470**	0.009
NAR Milk and its products	0.480**	0.007
NAR Sugars	0.045^{NS}	0.813
NAR Fats and oils	0.344^{NS}	0.063

NS- Not significant, *Significant at 5%, **Significant at 1%

Pearson correlation test was applied to the NARs of various food groups of mother and child. Significant positive associations was obtained between NAR of pulse, vegetables, fruits, meat and its products, milk and its products, indicating if the mothers are consuming in deficit amounts so will the child and therefore both of them will suffer. Also, an inverse relationship was seen for NAR of cereals, sugars and fats& oils indicating an opposite trend of intake of mother and child. If the mother will consume excess of a particular food the child will have a deficit intake and vice-versa (Table 6).

Table 7: McNemar's test for association between Nutritional Adequacy Ratios (NARs) of food groups consumption between Mother- Child pairs

Paired parameter	McNemar $\chi 2$ test value							
	Cereal	Pulses	Veg.	Fruits	Meats	Milk	Sugars	Oils
Marginally Inadequate -Marginally Inadequate	11*	2^{NS}	11^{NS}	1^{NS}	0^{NS}	1^{NS}	8*	8*
Marginally Adequate - Marginally Adequate	0^{NS}	0^{NS}	0^{NS}	0^{NS}	0.33^{NS}	1^{NS}	0^{NS}	0^{NS}
Adequate - Adequate	7*	1^{NS}	6*	2^{NS}	0^{NS}	1^{NS}	5*	5*
Excess - Excess	2^{NS}	3^{NS}	7*	1^{NS}	0^{NS}	1^{NS}	8*	8*

NS- Not significant, *Significant at 5%

Table 7: Comparison of Nutritional Adequacy Ratio of Nutrient Intake by Mother and the child

Nutritional Adequacy Ratio of Nutrient Intake	Mother		Child	
n=30	Freq	%	Freq	%
Energy				
Marginally inadequate <75	15	50	18	60
Marginally adequate 90-75	9	30	9	30
Adequate 100-110	6	20	3	10
Carbohydrate				
Marginally inadequate <75	18	60	12	40
Marginally adequate 75-90	6	20	13	43.3
Adequate 90-110	6	20	5	16.7
Protein				
Marginally inadequate <75	11	36.7	3	10
Marginally adequate 75-90	9	30	8	26.7
Adequate 90-110	10	33.3	10	33.3
Excess >110	0	0	9	30
Invisible fat				
Marginally inadequate <75	5	16.7	1	3.3
Marginally adequate 75-90	4	13.3	2	6.7
Adequate 90-110	6	20	7	23.3
Excess >110	12	40	20	66.7
Visible fat				
Marginally inadequate <75	3	10	29	96.7
Marginally adequate 75-90	4	13.3	0	0
Adequate 90-110	6	20	1	3.3
Excess >110	17	56.7	0	0
Total fat				
Marginally inadequate <75	2	6.7	15	50
Marginally adequate 75-99	6	20	8	26.7
Adequate 90-110	12	40	5	16.7
Excess >110	10	33.3	2	6.7
Iron				
Marginally inadequate <75	30	100	29	96.7
Marginally adequate 75-99	0	0	1	3.3

The McNemar Test for different food groups intake adequacy of mother and child showed significant discordance for cereal, vegetable, sugar and fats & oils intake as chi-square value was more than 3.8, thereby indicating that there is a difference in the intake between the pairs (Table 7). A marginally inadequate and adequate cereal consuming mother is not likely to have a marginally inadequate cereal consuming child. The child may be consuming adequate, inadequate or excess amounts of cereals. But for marginally adequate and excess pair there is no difference in cereal intake adequacy between the mother the child and they are likely to follow the same trend. Similar trends can be seen for other food groups as well.

Table 8: Comparison of nutritional adequacy ratio of nutrient intake by mother and the child

Nutritional Adequacy Ratio of Nutrient Intake	Mother		Child	
n=30	Freq	%	Freq	%
Calcium				
Marginally inadequate <75	8	26.7	9	30
Marginally adequate 75-90	8	26.7	2	6.7
Adequate 90-110	3	10	6	20
Excess >110	11	36.7	13	43.3
Beta-carotene				
Marginally inadequate 50-74	27	90	27	90
Marginally adequate 75-90	0	0	3	10
Adequate 100-110	1	3.3	0	0
Excess >110	2	6.7	0	0
Fiber				
Marginally inadequate <75	17	56.7	26	86.7
Marginally adequate 75-90	5	16.7	4	13.3
Adequate 90-110	6	20	0	0
Excess >110	2	6.7	0	0

The nutritional adequacies for both majority of mother 50% and child 60% for energy intake is marginally inadequate. Protein consumption is marginally adequate for majority of the mothers (36.7%) but excess for 30% of the children. 60% of mothers and 40% of the children were found to be consuming marginally inadequate carbohydrates. The consumption of invisible fat is in excess for both the mothers (40%) and the child (66.7%) mainly. Visible fat consumption shows opposite trend where majority of children (96.7%) are consuming marginally inadequate amounts and majority of the mothers (56.7%) are consuming in excess. Total fat consumption varies, as 40% of mothers consume adequate amounts and half of the children took marginally inadequate amount. Majority of mothers 100% and the children 96.7% are consuming marginally inadequate amount of iron. 90% of mothers and children were consuming marginally inadequate amounts of beta-carotene. 56.7% of mothers and 86.7% of children were consuming marginally inadequate amounts of fiber (Table 8).

A highly significant difference was seen in the RDA of energy for the child and the intake. According to NFHS -1 the mean energy intake of 1-3 year old children was found to be 807 kcal which is similar to the present study, and differs from the recommended RDA. Similarly there was a significant difference obtained between the intake of carbohydrate, invisible fat, visible fat, total fat, iron, beta-carotene and fiber. The intake varied considerably from the recommended amounts of the above nutrient.

Table 10: Test for correlation between nutritional adequacy ratios of nutrient consumption of mothers and the children

Parameter	Pearson Correlation value	p value
NAR Energy	0.487**	0.006
NAR Carbohydrates	0.312^{NS}	0.093
NAR Proteins	0.320**	0.003
NAR Total Fat	0.320^{NS}	0.085
NAR Invisible fat	0.222^{NS}	0.238
NAR Visible fat	0.149^{NS}	0.431
NAR Iron	0.611**	0.000
NAR Calcium	0.537**	0.002
NAR Beta-Carotene	0.535**	0.002
NAR Fibre	0.496 **	0.005

NS- Not significant, *Significant at 5%, **Significant at 1%

Pearson Correlation was applied to the NARs of various nutrients of mother and child. Significant positive associations was obtained between NAR of energy, proteins, iron, calcium, beta-carotene and fibre indicating if the mothers are consuming in deficit amounts so will the child and therefore both of them will suffer. Also, an inverse relationship was seen for NAR of carbohydrates, total fat, invisible fat and visible fat indicating an opposite trend of intake of mother and child. If the mother will consume excess of a particular food the child will have a deficit intake and vice-versa (Table 10).

The McNemar Test for different food stuffs intake adequacy of mother and child showed significant discordancy for proteins, total fat, invisible fat, visible fat and fibre intake as chi-square value was more than 3.8. Indicating there is difference in the intake between the pairs. A marginally adequate and adequate protein consuming mother is not likely to have a marginally adequate protein consuming child. The child may be consuming adequate, inadequate or excess amounts of proteins. But for marginally inadequate pair there is no difference in cereal intake adequacy between the mother the child and they are likely to follow the same trend. Similar trends can be seen for other food groups as well (Table 11).

Table 9: Paired sample t-test between mean nutrient intake and its RDA for the mothers and the children

Nutrient Intake v/s RDA Comparison	Mother				Child			
	Mean	Std. Deviation	t value	Significance (2-tailed)	Mean	Std. Deviation	t-value	Significance (2-tailed)
Energy intake in kcal	1590	219.64	-9.27**	0.000	908	166.17	-10.958**	0.000
Carbohydrate intake in g	238	36.71	-8.513**	0.000	131	25.85	19**	0.000
protein intake in g	40.72	8.50	-5.683**	0.000	22.33	6.22	0.292^{NS}	0.772
Invisible fat intake in g	23.98	7.24	0.394^{NS}	0.696	19.47	6.74	4.627**	0.000
Visible fat intake in g	22.41	6.07	0.81NS	0.425	9.33	4.77	-17.979**	0.000
Total fat intake in g.	46.40	10.40	0.844^{NS}	0.405	28.82	8.24	-6.616**	0.000
Iron intake in mg	7.64	3.34	-34.015**	0.000	3.56	1.99	-23.192**	0.000
Calcium intake in mg	413	147.93	-0.739^{NS}	0.466	413	181.93	0.398^{NS}	0.693
Beta-carotene in mcg	793	1148.5	-8.366**	0.000	421	312.90	-20.646**	0.000
Fiber intake in g	22.96	10.61	-4.333**	0.000	8.24	3.714	-15.275**	0.000

NS- Not significant, *Significant at 5%, **Significant at 1%

T- test was done for the comparison of nutrient intake of the mother with RDA. It was observed that mean energy intake for the mother was 1590 ± 219.65 kcal. A highly significant difference was seen in the RDA of energy for the mother and her actual intake (Table 9). The nutrient intake for urban Indian population according to NNMB (2004-05) per C.U. was 1834 kcal which is higher than the mean intake of mothers in the present study. Similarly there was a significant difference obtained between the intake of carbohydrates, protein, iron, beta-carotene and fiber for the mother.

The t-test for comparison of nutrient intake of the child with the respective RDA showed mean energy intake of the child was 908 ± 166.17 kcal.

Table 11: McNemar's test for association between nutritional adequacy ratios of nutrients consumption between Mother- Child pairs

Paired parameter	McNemar χ2 test value									
	Energy	Carbohydrates	Proteins	Total Fat	Invisible-Fat	Visible-Fat	Iron	Calcium	Beta-Carotene	Fiber
Marginally Inadequate-Marginally Inadequate	0.66 NS	3.56 NS	1.8 NS	4 *	0 NS	0 NS	1 NS	1 NS	2 NS	5 *
Marginally Adequate - Marginally Adequate	0.33 NS	0 NS	5*	1 NS	1 NS	4*	1 NS	0 NS	1 NS	1 NS
Adequate-Adequate	1 NS	0.33 NS	4*	5.4 *	0.2 NS	5*		1 NS	1 NS	3 NS
Excess-Excess			0 NS	2 NS	5*	17*		1 NS	1 NS	3 NS

NS- Not significant, *Significant at 5%

Table 12: Chi-square test of association between mean adequacy ratio of nutrients of mother and child

MAR classification for the mother	n=30	MAR classification for the child		χ2 test of significance	Pearson's Correlation
		Inadequate <70	Adequate >70		
Inadequate <70	%	80%	20%	6.652* p = 0.010	0.0574** p = 0.01
Adequate >70	%	33.3%	66.7%		

*Significant at 5%, **Significant at 1%

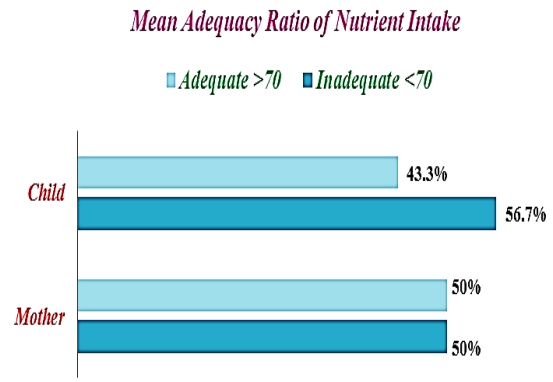

Figure 2: Comparison of Mean Adequacy Ratio of Nutrient Intake of Mother and Child

Mean Adequacy Ratio (MAR)

Figure 2 represents the mean adequacy ratio of nutrient intake for both mother and child, set a cut-off of 70%. According to this 43.3% of the children consume adequate amounts of nutrients whereas 50% of mothers consume adequately. Thus it can be reported that the nutritional status of the mothers is better than that of their respective children.

A chi square test between MAR of nutrients between the mother and child gave a significant association. It means that the mean adequacy ratio of the nutrients for the mother and the child is associated with each other and influences one another. Though it has been observed that nutritional status of mother is better than that of the child but, they are correlated with each other. A highly positive correlation has been obtained between the two values as p=0.001<0.05. This indicates that the nutritional status of mother and child go parallel and if the mother's nutritional status is good the child will follow a similar trend and vice-versa (Table 12).

Table 13: Dual form of malnutrition in mother-child pairs belonging to the same household on the basis of BMI

Child- Mother Pairs in the Same Household	Frequency (n=30)	%
Underweight child-Normal Mother	3	10
Underweight child-Overweight Mother	7	23.33
Normal child- Normal Mother	9	30
Normal child- Underweight Mother	3	10
Normal child-Overweight Mother	3	10
Overweight Child-Normal Mother	3	10
Overweight Child-Overweight Mother	2	6.67

Dual form of malnutrition was reported among the mother-child pairs belonging to the same household in the current study. When the mother child pairs were compared it was seen that majority (30%) were normal pair, 23.3% were overweight mother-underweight child pair, 10% were normal mother-underweight child pair and 10% were overweight mother-normal child pair. This indicates the disparity that exists within

Table 14:McNemar's test for association between nutritional status of various mother-child pairs

Parameter	χ 2 Test of Significance	df	Inference
Underweight mother and underweight child pair	0 NS	1	Not Significant
Normal mother and child pair	0 NS	1	Not significant
Overweight mother and overweight child	7*	1	Significant

NS- Not Significant, *Significant at 0.05 (2-tailed)

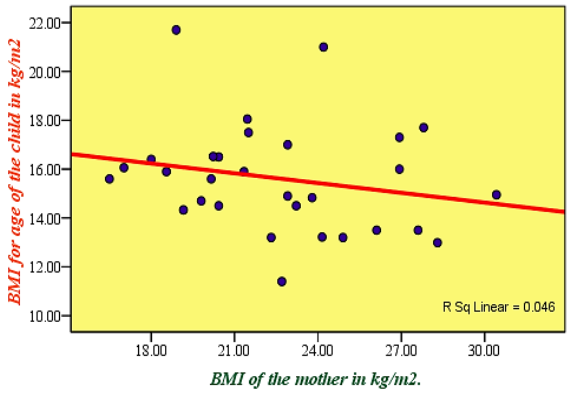

Figure 3: Scatter Plot for the BMI of the child and the mother; Linear Regression Analysis equation: y=18.635-0.133x; where y = BMI of the child, x = BMI of the mother

a household and dual-burden of malnutrition is prevalent (Table 13). The current study is supported by NFHS-3 (2005-06) data, were 20% of mother-child pair were overweight/obese mother with an underweight child. According to another study done by (Barnett, 2011) the prevalence of overweight mothers and underweight child was

found to be 5.3% in urban areas and 2.2% in the total study area of Andhra Pradesh, this is lower as compared to the present study.

On application of McNemar's test between the pairs of mother and child it was observed that an overweight mother is not likely to have an overweight child as the there is significant discordancy between the mother and child ($\chi 2 > 3.8$) (Table 14).

On application of regression analysis, a slight negative relationship between the BMI of mother and the child was obtained but it was not statistically significant p value.256 >0.05. This can be attributed to the fact that the BMI of mothers and that of their corresponding children are varied over the plot and are not concentrated around the line. With the obtained equation we can predict the BMI of the child, when we change the BMI of the mother. This indicates a dependence of both the variables on one another. Also the r square value is 0.046 i.e. BMI of the mother has a 4.6% influence on the BMI of the child (Figure 3).

Summary and conclusion

In the current study 30 mother-child pairs were interviewed to assess their nutritional status and to seek the existence of dual form of malnutrition existing in a household i.e. occurrence of both undernutrition and overnutrition together and determining the adequacy of food consumption in mother-child pairs .It was revealed that mothers had a better nutritional status when compared to the children when their mean adequacy ratios for nutrient intake were compared. Also the food intake adequacy of the child was seen to be influenced by mother's food intake. The dual form of malnutrition exists within a household. The prevalence of overweight mothers and underweight child pair was found to be 23% in and around Manipal. Poverty does cause under nutrition in a child partially but other socio-demographic factors and child rearing practices also lead to under nutrition in a child to a certain extent and can be considered as some of the reasons for the disparity between the nutritional adequacy of the diet of the child and the mother. The most limiting feature of the present study was the small sample size, which was a hindrance when the variables were subjected to statistical analysis.

Recommendations

1. Informal education should be imparted to mothers about the right child rearing, feeding and hygiene practices that should be followed by the mother and her family.

2. Larger scale studies in various parts of the country can be carried out to identify the determinants of this trend. Understanding why these two extremes of malnutrition occur in households is necessary for policy and programs to target both effectively.

Acknowledgement

The authors wish to acknowledge the support of all the mothers & children who participated wholeheartedly in this study and also the Department of Nutrition & Dietetics, Manipal University, Karnataka, India.

References

Angeles-Agdeppa I, RD Lana, CVC Barba (2003) A Case Study on Dual Forms of Malnutrition Among Selected Households in District 1, Tondo, Manila. Asia Pacific Journal of Clinical Nutrition, 438-46.

Arimond M, Ruel M (2004) Dietary Diversity, Dietary Quality, and Child Nutritional Status: Evidence from Eleven Demographic and Health Surveys. Washington D.C.: Academy for Educational Development (AED).

Barnett I (2011) Is the Dual Burden of Over- and Under-nutrition a Concern for Poor Households in Ethiopia, India, Peru and Vietnam? Oxford: Young Lives.

Barquera S, K Peterson A, Must et al (2007) Coexistence of Maternal Central Adiposity and Child Stunting inMexico, International Journal of Obesity 31.4: 601–7

Brahmam DG (2001-02) Hyderabad: National Nutrition Monitoring Bureau.

Deleuze et al N (2005) Child Malnutrition and Maternal Overweight in Same Households in Poor Urban Areas of Benin. Santé (Montrouge, France), 263-270.

Doak C, Adair L, Monteiro C, Popkin B (2000) Overweight and underweight coexist within households in Brazil, China and Russia. Journal of Nutrition, 2965-2971.

Drewnowski A, Popkin B (1997) The Nutrition Transition: New Trends in the Global Diet. Nutrition Reviews, 31-43.

Gopalan C, Rama Shastri B, Balasubramaniam S (2009) Nutritive Value Of Indian Foods. Hyderabad: NIN, ICMR.

Hawkes C (2007) Globalization, Food and Nutrition Transitions. Ottawa: Globalization Knowledge Network.

Jehn M, Brewis A (2009) Paradoxical Malnutrition in Mother–Child Pairs: Untangling the Phenomenon of Over- and Under-Nutrition in Underdeveloped Economies. Economics and Human Biology, 28-35.

Khor G, Sharif Z (2003) Dual Forms of Malnutrition in the Same Households in Malaysia – A Case Study Among Malay Rural Households. Asia Pacific Journal of Clinical Nutrition 427-37.

L. Garrett J, T Ruel M (2003) Stunted child-overweight mother pairs: an emerging policy concern? Washington D.C.: FCND.

Lakshman DA (2010). Nutrition, Health and the role of micronutrients. Delhi: ICAR.

Garrett J, Ruel M (2005) Stunted Child – Overweight Mother Pairs: Prevalence and Association with Economic Development and Urbanization. Food and Nutrition Bulletin 209-21.

Paho (2000) Obesity and poverty: A new public health challenge.

Popkin B (1994) The nutrition transition in low-income countries: An emerging crisis. Nutrition Reviews 285-298.

Popkin B (2002) An overview on the nutrition transition and its health implications:The Bellagio Meeting. Public Health Nutrition 5:93-103.

Popkin B, Gordon-Larsen P (2004) The Nutrition Transition: Worldwide Obesity Dynamics and Their Determinants. International Journal Of Obesity 2-9.

Raphael D, HL Delisle, C Vilgrain (2005) Households with Undernourished Childrenand Overweight Mothers: Is This a Concern for Haiti?. Ecology of Food and Nutrition 44(2):147–65

Rodrigues EM, JAAC Taddei, DM Sigulem (1998) Overweight and Obesity Among Mothers of Malnourished Children-Brazil-PNSN-1989. Sao Paulo Medical Journal, 1766-1773.

Steyn NP, D Labadarios J, Nel HS Kruger et al (2011) What is the Nutritional Status of Children of Obese Mothers in South Africa? Nutrition.