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RESEARCH ARTICLE

DIETARY HABITS, PARENTAL HISTORY AND DUAL BURDEN OF MALNUTRITION AMONG AFFLUENT SCHOOL GOING CHILDREN

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ABSTRACT

Background: Rapidly changing physical environment has led to socio-demographic mutilation among populations, increasing the prevalence of dual burden of malnutrition especially among school going children. Objective: The study aimed to assess the effect of dietary habits and parental history of chronic disease on prevalence of dual burden of malnutrition among school children.
Design: Multistage cluster sampling technique was applied to select 10/113 public-private schools. Students of 4th to 9th standard (n= 6472) were enrolled under the study. Standard techniques were used to derive the anthropometric measurements. Information on the dietary habits and parental history of chronic degenerative diseases was elicited using structured questionnaire.
Results: Eating habits were categorized under high, moderate and low risk based on the frequencies. Frequency of eating out of home was at moderate risk among 15% students. Moderately risky eating behavior prevailed among 13% - 21% students. Consumption of maggie noodles was maximum (21%), followed by ice-cream (18%), chips (17%) and soft drink (11%). Moreover consumption of junk food, fried food and sweets have shown a significant co-relation with the nutritional status of children at p value <0.05, 95% CI. Both father and mother of 8.2% children have reported to be suffering from either of the chronic diseases such as obesity, diabetes, hypertension, stroke and heart disease. Parental history of obesity followed by heart disease significantly correlated with the current nutritional status of the children.
Conclusion: Unhealthy eating habits and parental history of diseases determine the shift in nutritional status of children from a young age.

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INTRODUCTION

The Dual Burden of Malnutrition refers to the double burden of under and over nutrition occurring simultaneously within a population. The term malnutrition is explained as the state of not having enough food or not eating enough of right food. Recent studies show that underweight or stunting can coexist with overweight and obesity. Large bodies of evidence have indicated increasing prevalence of Dual Burden of Malnutrition in the Asian countries (Doak *et al*., 2005). Underweight and obesity are both among the top ten leading risk factors for the global burden of disease (Khan and Khoi, 2008). Industrialization and urbanization have augmented rapid socio-economic, demographic, health and nutritional transition in India. Escalating allfluency and existing poverty are behaving like two sides of the coin; the outcome of which has manifested as the dual paradox throwing a challenge at the country's health sector. The market liberalization has immensely affected dietary patterns which has spurred up the "double burden" (Goyal *et al*., 2010). Over the last two decades chronic non-communicable diseases have taken over the communicable diseases; thereby making it as a major public health problem, especially in the urban areas (Ramchandran, 2006).

Physical Environment and the Contributing Factors

A complex interaction of genetic, environmental and behavioral factor has amplified overnutrition (45% overweight and 42% obesity) and related morbidities among children in the developing countries (Hanley *et al*., 2000; Singh, 2010;

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Kumar *et al*., 2007). Reduced physical activity, snacking between the meals, consuming calorie dense and nutrient deficient food, frequently eating out of house are ostensible contributors of childhood obesity especially among affluent families (Hanley *et al*., 2000; Kaneria *et al*., 2006 and Goyal *et al*., 2010). Various other parameters such as birth weight, catch-up growth; (Toschke *et al*., 2005) parental prevalence of Non Communicable Diseases (NCD), have been studied as the "predicators" of childhood obesity. Out of these, "early weight gain" and "obese parents" are reliable set of predictors (Khan and Khoi, 2008; Kaneria *et al*., 2006 and Goyal *et al*, 2010).
With changing physical environment the preferences among young children have also changed. Lack of playing space, inadequate time for sports have increased the inclination towards screen time and simultaneous reduced their involvement in active outdoor sports. Moreover, media marketing, easy accessibility and affordability of unhealthy food choices have influenced the food preferences (Hanley *et al* 2000; Goyal *et al*., 2010); thus increasing pediatric obesity (Jadavji, 2006).

Sustainable Preventive Measures

Wide spreading obesity among young school going children could be best tackled if the risk factors are analyzed well in advance. Childhood obesity increases the risk of obesity and related morbidities during adulthood (Goyal *et al*., 2010). Therefore emphasis needs to be laid on prevention programs targeting behavioral modifications (Singh, 2010). Parents, health professional, teachers and other school officials need to work together to combat this "epidemic" (Wang and Lobstein, 2006). If the present trend of overweight/obesity continues, it may emerge as the single most important public health problem in children (Sidhu *et al*., 2005). The present study was planned with an objective of evaluating the effect of dietary habits and parental history on the nutritional status of school going children and suggest upon sustainable preventive strategies.

METHODOLOGY

***Area of research*:** Having taken prior permissions, 10 schools, (3 public and 7 private schools) of urban Vadodara, were selected to get a representative sample.

1. Schools should follow English medium of teaching
2. Schools should have coeducation system of education
3. Schools could be using either state or central board of education
4. Schools should be catering to children belonging to Middle Income, Higher Income Group families

Multistage cluster sampling technique was used to select students (n=6472) of 4^{th} to 9^{th} standard (8-16 years) from 10 schools. Blanket coverage for students was undertaken during baseline evaluation of risk factor analysis. Consequent follow up for two days was done to cover up absentees, if recorded.

Limitations: Considering the academic commitments for students of higher standard, they were not enrolled in the study. Moreover the study design involved data collection using a self-administered questionnaire, for which children of lower classes would have been too young; thereby they were excluded.

Lifestyle mapping questionnaire: Self-administered, structured and pre-tested questionnaire was distributed among the students during the school hours. This questionnaire was designed to elicit information on parental history of degenerative morbidities and dietary pattern using a food frequency table for selected foods (junk food, deep fried food, sweets/desserts, fruits and juices). Questionnaires were filled in presence of the investigator and were collected on the same day.

Anthropometric measurements: Anthropometric indices such as height (cm), weight (kg), Waist Circumference (WC) and Hip Circumference (HC) (cm) were measured and indicators such as the Body Mass Index (BMI) and Waist:Hip Ratio (WHR) were calculated from the respective indices to assess the biophysical measurements as indicator of risk factor.

Height: Feet were placed together with heels, buttocks and shoulder blades touched to the wall against the marking and head was positioned in the Frankfurt horizontal plane (Mushtaq *et al*., 2011). The height was measured from front using a non-elastic fiber glass scale.

Weight: Subjects were asked to stand straight with relaxed arms at the sides, feet positioned close together and weight evenly distributed across feet (Mushtaq *et al*., 2011). Bathroom weighing scale was used to weigh the subject, after adjusting it to zero each time before weighing. The reading was taken from the front only.

Waist Circumference (WC): Waist circumference was measured midway between the lowest rib and the superior border of iliac crest at the end of normal expiration using non-elastic, tailor's measuring tape, positioned at a level parallel to the floor (Mushtaq *et al*., 2011; WHO, 2008). Cut-off values of $\geq$ 78 cm for boys and $\geq$ 72 cm for girls (Mushtaq *et al*., 2011) were considered as risk factor.

Hip Circumference (HC): Hip circumference was measured at the level of widest position of buttocks (trochanters) (Mushtaq *et al*., 2011; WHO, 2008). All the measurements were to the nearest 0.1 cm. WHO 2004, classification was used for nutritional status assessment using BMI, while WHR cut-offs used were $\geq$ 0.95 in boys and $\geq$ 0.80 in girls (Kurpad *et al*., 2003).

Statistical analysis: The data was analyzed using SPSS 13 package for appropriate tests.

RESULTS AND DISCUSSION

Dietary habit as risk factor indicator

Foods were categorized as fried food, junk food, soft drinks, sweets and healthy foods. Based on the frequency of consumption the dietary pattern was grouped as high risk

(daily, 4-6 days/week and 2-3 days/week), moderate risk (once/week and once/15 days) and low risk (once/month and never/sometimes) categories. Table 1 shows the average for each listed food in each category. Frequency categorized as "Moderate Risk" had higher average values than "High Risk". Among the list of junk food, chips and maggie was consumed maximum. An average point of 17 and 21 in moderate risk was calculated for chips and maggie respectively. In the list of fried foods, samosa was rated as highest consumed food in moderate category (average point 15). Chocolates (14 points) and ice-cream (18 point) were recorded in category of moderate risk. Pattern of consuming sweet dish with meals or after meals was recorded in moderate risk at average point of 13, while frequency of eating out of home received 15 points in moderate risk category. Unhealthy dietary habits formed and followed at a young age becomes lifelong practices and are responsible for the transition from undernutrition to overnutrition; in which normal nutritional status acts as a intermediate state. Moreover, even moderate risky eating behaviour can cause gradual shift in the nutritional status of children who are at the growing stage; causing an early initiation of the metabolic aberrations. Children belonging to normal, underweight and overweight category showed significant co-relation with consumption of foods listed under the category of junk food, fried food as well as sweets at 0.003 – 0.005 (P value<0.05, 95% CI) Table 2. Hence habit of consuming these foods, is common among children of all three nutritional categories which can easily bring a shift from undernourished and normal to overweight and obese individuals.

Prevalence of overweight and obesity was found to be highest among children who consumed junk food on weekly basis and had habit of snacking between meals (Goyal *et al*., 2010; Kumar *et al*., 2007). It was found that the risk of overweight increases 5.6 times higher among those who ate chocolates daily (Kotian *et al*., 2010); while the incidence of overweight increases 5 times more, among adolescents consuming soft drinks (21%) at least once a week (Laxmaiah *et al*., 2007). Educating parents and children on habits of healthy eating through well designed programmes could inculcate healthy eating habits among children (Misra *et al*., 2006). Moreover efforts need to be made to curb the effect of aggressive marketing of junk food on food choices of children (Jadavji, 2006).

Parental history as risk factor indicator

Parental heredity contributes between 5 to 25 percent of the risk for obesity and other degenerative diseases. Among parents, highest prevalence of obesity was elicited followed by diabetes and hypertension. Percentage of morbidities was higher among fathers than mothers. Prevalence of obesity was 11% among fathers, 9% among mothers and 5% among both father and mother (Table 3). When compared with the nutritional status of the children, parental history of obesity (0.000***) followed by heart disease (0.002**) showed strong correlation. Prevalence of parental obesity (either of the parent / both the parent) was highest (n=1354) among children belonging to normal category. Either of the parents of 1078 children and both the parents of 276 children were obese. Thus even though the children had normal nutritional status, their risk of becoming overweight and obese adults could not be ignored (Table 4). Coexistence and co-inhabitation between several obese members within a family is very common and suggests the involvement of genetic factors in obesity (Bray and Bouchard, 2004). It has been estimated that 40% of obesity is attributable to independent genetic influences, while cultural and societal factors may explain at least 30% of the variation (Wardle *et al*., 2008). BMI has a strong independent association with family history of diabetes and obesity. Children having family history of obesity are more likely to have high prevalence of obesity (Goyal *et al*., 2010; Kumar *et al*., 2007).

Anthropometric measurements as risk factor indicators

Pre-adolescents and adolescents is a growing stage, when the body dimensions of children attain maximum spurt based on the genetic potential and dietary habits. Anthropometric measurements during this stage can be used as predictor of malnutrition especially, over nutrition. Thus it could be a strong indicator for predicting the risks of developing adulthood chronic degenerative diseases. With regards to the nutritional status, prevalence of dual burden of malnutrition was recorded among the children (Table 5). Under nutrition was present among 7.36% children while 6.17% children were over nourished. Within the gender, 8% boys and 7% girls were undernourished whereas 7% boys and 5% girls were overweight and obese. Thus prevalence of under and over nutrition co-exists in similar proportions, clearly indicating dual burden of malnutrition among the students. The indicators of body measurements such as waist circumference, waist : height ratio and waist : hip ratio significantly correlated between boys and girls (Table 6). Among the various parameters compared between the boys and girls (Table 7), it could be seen clearly that the nutritional status, consumption of junk food, colas and fried foods showed significant correlation. As computed in Table 8, a score card with total score points of "27" was made by giving individual points for the 3 factors viz. dietary pattern, parental history and nutritional status. Doing aggregate of each score, a single value was calculated and furthers its percentage was computed. Based on the percentage value, 3 categories of risk were created. This would give an approximation of risk – Children having score ≥55 were at highest risk, 38 – 54 were at moderate risk and ≤37 were at lowest risk of developing adulthood chronic diseases. The mean ± SD of the calculated sum percentage was 46.4±8 and further based on the categorization, 66.5% were at moderate risk of developing adulthood chronic diseases. India is facing the dubious distinction of having "double burden" of disease; where the prevalence of overweight and obesity is significantly increasing over a period of 3 decades even among rural population (Laxmaiah *et al*., 2007). Studies 10 have revealed 11% prevalence of over nutrition of which 12% girls and 9.9% boys were classified as overweight at school entry.

In Indian scenario 17, 5.74% obesity was found among students of 5^{th} to 10^{th} standard, 8.82% prevalence among girls and 4.4% among boys. Among schools in Punjab, prevalence of overweight ranged from 12% to 14%, while that of obesity was 6% among boys and girls (Mushtaq *et al*., 2011). Prevalence of obesity increased, with increase in age in both boys and Girls.

Table 1. Frequency (in percentages) of eating foods in different categories among students under study (n=6472)

Categories		High risk				Moderate risk			Low risk		
Food groups		**Daily**	**4-6 days/ week**	**2-3 days/week**	**AVG**	**Once/week**	**Once/ 15 days**	**AVG**	**Once/ month**	**Never/ sometimes**	**AVG**
Junk Food	**Chips**	4.4	14.2	3.9	**8**	19.9	14.1	**17**	16.7	26.9	22
	Burger	0.6	3.8	1.9	2	9.2	9.7	9	22.7	52	37
	Pizza	0.7	4	2.2	2	8.4	9.9	9	27.5	47.2	37
	French Fries	1.8	5.5	3.3	4	10.6	10.7	11	18.4	49.8	34
	Noodles	3.9	14.8	6.4	**8**	24.5	18.1	**21**	16.7	10.6	14
Soft Drinks		2.7	7.1	4.1	5	10.8	10.5	**11**	14.2	50.5	32
Fried	Samosa	2.3	7.7	4.3	5	14.1	15.3	**15**	20.1	36.1	28
	Puri	16.2	15.5	7.9	**13**	16.1	12.5	14	11.9	19.9	16
	Bhatura	1.9	6.1	3.7	4	10.1	11.5	11	16.8	50	33
Sweets	Ice-cream	5	11.7	8.6	8	18.5	16.5	**18**	16.7	23	20
	Chocolate	13.2	17.1	11.7	**14**	16.6	11.8	**14**	10.1	19.5	15
	Sweet dish during or after meal	7.9	9.7	6.8	8	13.9	11.3	**13**	12.1	38.2	25
Healthy	Whole fruits	37.8	12.3	10.4	**20**	11.2	9.8	11	6.8	11.7	9
	Packed fruit juices	10	10.8	7	9	14.3	11.3	13	13.1	33.4	23
Frequency of eating out of home		6.6	3.3	6.2	5	16	13	**15**	23.3	31.5	27

**Note: AVG=Average. For each frequency and each food listed, the percentage was calculated first and then the average of the percentages have been computed for each category of risk*

Table 2. Correlation between the dietary patter of children and their nutritional status (n=6472)

Foods	Nutritional Status of Children	High Risk	Moderate Risk	Low Risk	Chi-Square
Junk Food	Undernourished	223	257	35	0.005**
	Normal	2103	2981	305	
	Overnourished	191	333	44	
Colas	Undernourished	75	177	263	0.901^{NS}
	Normal	755	1918	2716	
	Overnourished	73	201	294	
Fried Food	Undernourished	255	210	50	0.005**
	Normal	2548	2300	541	
	Overnourished	223	279	66	
Sweet Food	Undernourished	317	159	39	0.003**
	Normal	3035	2008	346	
	Overnourished	295	222	51	
Healthy Food	Undernourished	377	95	43	0.002**
	Normal	3616	1417	356	
	Overnourished	383	140	45	

**Note: The significance is tested at 95% CI, **P value<0.05. NS stands for "Non-Significant" relation*

Table 3. Prevalence of chronic degenerative disorders among parents of subjects under study (n=6472)

Diseased condition	Father	Mother	Both	None
Obesity	739 (11.4)	591 (9)	350 (5.4)	4792 (74)
Diabetes	503 (7.8)	164 (2.5)	57 (0.9)	5748 (88.8)
Heart Disease	299 (4.6)	201 (3.1)	50 (0.8)	5922 (91.5)
Stroke	54 (0.8)	47 (0.7)	19 (0.3)	6352 (98)
Hypertension	326 (5)	234 (3.6)	52 (0.8)	5860 (90.5)

**Note: Values in parenthesis are the percentages*

Table 4. Correlation between the parental history of degenerative diseases and nutritional status of children (n=6472)

Disease	Nutritional Status of Children	Either of the parents	Both the parents	Chi-Square
Obesity	Undernourished	93	14	0.000***
	Normal	1078	276	
	Overnourished	159	60	
Diabetes	Undernourished	34	5	0.011^{NS}
	Normal	558	46	
	Overnourished	75	6	
Heart Disease	Undernourished	19	1	0.002**
	Normal	427	45	
	Overnourished	54	4	
Hypertension	Undernourished	46	2	0.45^{NS}
	Normal	456	44	
	Overnourished	58	6	
Stroke	Undernourished	8	2	0.86^{NS}
	Normal	87	15	
	Overnourished	6	2	

**Note: The significance is tested at 95% CI, ***P value <0.001 and **P value<0.05. NS stands for "Non-Significant" relation*

Table 5. Comparison of the nutritional status among boys and girls (n=6472)

Nutritional status (baz – z score)	Boys (%) (n=3758)	Girls (%) (n=2714)	Total (%) (n=6472)
Sever Under Nutrition (< -3)	112 (2.98)	52 (1.91)	164 (2.53)
Moderate Under Nutrition (≥ -3 to < -2)	182 (4.84)	131 (4.82)	313 (4.83)
Normal (≥ -2 to ≤ +2)	3193 (84.96)	2402 (88.50)	5595 (86.44)
Moderate Over Nutrition (> +2 to ≤ +3)	233 (6.20)	116 (4.27)	349 (5.39)
Sever Over Nutrition (> +3)	38 (1.0)	13 (0.47)	51 (0.78)

**Note: Calculated using WHO AnthroPlus software*

Table 6. Comparing the anthropometric indicators among boys and girls using ANOVA test (n=6472)

Parameters	Calculated f-value
Waist Circumference	1.96***
Waist Circumference : Height Ratio	2.21***
Waist : Hip Ratio	1.38***

**Note: The significance is tested at 95% CI, ***P value <0.001*

Table 7. One way ANOVA between boys and girls for various parameters affecting the prevalence of dual burden of malnutrition

S.No.	Parameters	F-Value
1.	Nutritional status of children	15.9***
2.	Parental history of obesity	2.94
3.	Parental history of diabetes	0.28
4.	Parental history of heart disease	0.56
5.	Parental history of hypertension	0.64
6.	Parental history of stroke	2.03
7.	Frequency of eating junk food	22***
8.	Frequency of consuming colas	59***
9	Frequency of eating fried food	11**
10.	Frequency of consuming sweets	3.4
11	Frequency of consuming healthy food	1.7

**Note: The significance is tested at 95% CI, ***P value <0.001 and **P value<0.05*

Table 8. Cumulative risk assessment among the study subjects (n=6472)

Risk Category	Frequency (%)
High Risk	1141 (17.6)
Moderate risk	4303 (66.5)
Low Risk	1028 (15.9)

**Note: A Score card with total score points of "27" was made by giving individual points for the 3 factors viz. dietary pattern, parental history and nutritional status. Doing aggregate of each score, a single value was calculated and furthers its percentage was computed. Based on the percentage value, 3 categories of risk were created.*
This would give an approximation of risk – Children having score ≥55 were at highest risk, 38 – 54 were at moderate risk and ≤37 were at lowest risk of developing adulthood chronic diseases.

Several investigators have used Body Mass Index, Waist and Hip Circumference and Waist : Hip Ratio (WHR) to assess the risk for developing chronic morbidities, and these indicators have shown significant association with abdominal obesity, diabetes and cardiovascular diseases (WHO, 2008; Kurpad *et al*., 2003). Waist:Hip Ratio have proven as a stronger indicator of risk factors than BMI, which is a simple and general measure used to characterize the persons nutritional well-being (Kurpad *et al*., 2003; Wardle *et al*., 2008).

These indicators could be measured more precisely than other anthropometric measurements and they help in understanding the body fat distribution up to a great extent. As per WHO (2008), WHR should be used among Asian population as they are predisposed to develop metabolic syndrome.

Conclusion

Anthropometric measurements could be best utilized for screening across nutritional status, however just body measurements alone are insufficient to identify future risk. Combining lifestyle parameters would better predict the future risk among school going children. Unhealthy lifestyle and habits developed at young age are responsible for predisposition to adulthood chronic diseases. It is the cumulative effect of several factors existing in the physical environment that are responsible for bringing in vitro changes. Therefore awareness combined with behavioural adaptations could greatly reduce the likelihood of developing chronic diseases and may also delay the onset of the same. Thus a holistic intervention that addresses lifestyle modification and

behavioural changes could reduce the risk parameters among school going children.

Pertaining to the fast changing dietary and lifestyle habits coupled with parental history of diseases, nutrition transitions occur in no time. Rising picture of Dual Burden of Malnutrition would soon change to endemic obesity among school children and future adults projecting huge figures of chronic morbidity and mortality unless preventive measures are taken at budding age.

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Conflict of Interest

No conflict of interest is involved in the study.

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