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Prevalence of nutritional and lifestyle disorders among school going children in urban and rural areas of Coimbatore in Tamil Nadu, India

N. Rema and G. Vasanthamani
Dept. of Food Service Management and Dietetics, Avinashilingam Deemed University, Coimbatore-43, TN, India
remabsankar@gmail.com

Abstract

The prevalence of both nutritional as well as lifestyle disorders is common among children as quoted by the World Health Organization (2010) and we studied this in both urban and rural areas of Coimbatore city. The students were selected from 5 schools each of Matriculation, Corporation and Panchayat in the age group of 6-15 years. Background information of the 2180 students from Matriculation schools, 2122 students from Corporation and 1870 from Panchayat schools was obtained using an interview schedule. Nutritional deficiencies among children were recorded using the physical signs and symptoms. Lifestyle disorders, particularly the prevalence of hypertension was observed among the students by measurement of systolic and diastolic blood pressures. Anthropometric measurements like height, weight, mid upper arm circumference were done using standardized procedures. It could be deciphered from the anthropometric measurements that 8.44% of boys and 7.43% of girls from Matriculation schools were obese, while in Corporation schools, 5.73% boys and 4.45 % girls and in Panchayat schools 2.65% boys and 1.59% girls were found to be obese. Common nutritional deficiencies identified among the students include anemia prevalent among 24.22% boys and 21.54% girls in Matriculation schools while it was 35.43% boys and 46% girls in the Corporation schools and 34.4% boys and 41.92% girls from Panchayat schools among the pre-adolescent group. Among the adolescents, 47.11% boys and 66.82% girls in Matriculation schools, 64.65% boys and 69.52% girls in Corporation schools and 58.67% boys and 67.5% girls in Panchayat schools had anemia. Other common nutritional deficiencies identified were vitamin A and skin infections. Thus, the extremities of obesity as well as underweight and nutritional deficiencies are prevalent among the school going children. The common lifestyle disorders prevalent among the children were obesity and hypertension.

Keywords: Obesity, underweight, school going children, nutritional deficiencies, life style disorders, anthropometry.

Introduction

In the words of the 35th President of the United States, John F. Kennedy, “Children are the world’s most valuable resource and its best hope for the future”, it is indeed true that the future is in the hands of the children. Hence the health and well being of children go a long way in nurturing them into better adults. However, considering the present scenario, according to a survey by the FAO (2006), on one side there is still prevalence of malnutrition and other deficiency diseases like anemia, vitamin A and iodine deficiency, improper immunization and food insecurity, while on the other side overweight and obesity are rampant among children in India. This portrays a dismal picture from the point of view of development of children into healthy adults of tomorrow. The consequences of underweight and deficiency diseases as well as overweight and obesity are extensive among children, resulting in reduction in the rate of productivity. According to the WHO/FAO report (2003), the consequence of malnutrition has severe long-term impact for individual educational achievement, labour productivity and economic growth, especially in developing countries like India. The World health report (2002) lists overweight as the fifth most serious risk factor for both developed countries and low mortality developing countries. According to a report from urban South India, 21.4% of boys and 18.5% of girls aged 13-18 years were overweight or obese in 2006. According to the WHO health report (2006) many low and middle income countries are now facing a "double burden" of disease:

- While they continue to deal with the problems of infectious disease and under-nutrition, at the same time they are experiencing a rapid upsurge in chronic disease risk factors such as obesity and overweight, particularly in urban settings.
- It is not uncommon to find under-nutrition and obesity existing side-by-side within the same country, the same community and even within the same household.
- This double burden is caused by inadequate pre-natal, infant and young child nutrition followed by exposure to high-fat, energy-dense, micronutrient-poor foods and lack of physical activity.

The need of the hour is to determine strategies to prevent the occurrence of both underweight as well as overweight and obesity as well as avoid nutritional deficiencies among children in order to increase their capacity in education as well as extracurricular activities to enable them to grow into complete individuals, with mental as well as physical prowess. This requires concentrating both at home and at school where children spend most of their time. Encouraging physical activity and healthy dietary habits, such as increasing fiber intake, reducing the consumption of junk foods and saturated fat, and increasing levels of physical activity

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starting in childhood, may have important effects on public health. With the overall objective of creating awareness and increasing knowledge of the students, parents and teachers on diet and nutritional habits, the present study was conducted among school going children with the objectives of identifying nutritional deficiencies, underweight and overweight among school children, assess their socio economic status, determine the medical history of their family members as well as that of the children, measure their height, weight and other parameters of body dimensions as well as determine their nutritional and lifestyle habits and draw an association between the prevalence of underweight and other deficiency diseases as well as overweight to the above parameters

Table 1. Age & area wise distribution of the students (N= 6190).

Age in years	Schools											
	Urban areas (N=4302)								Rural areas (N=1888)			
	Matriculation (N=2180)				Corporation (N=2122)				Panchayat (N=1888)			
	Boys N=1090		Girls N=1090		Boys N=1065		Girls N=1057		Boys N=943		Girls N=945	
	N	%	N	%	N	%	N	%	N	%	N	%
6-8	325	29.82	320	29.36	320	30.05	315	29.8	320	33.93	315	33.33
9-11	315	28.90	330	30.28	315	29.58	322	30.46	305	32.34	310	32.8
12-15	450	41.28	440	40.37	430	40.38	420	39.74	318	33.72	320	33.86
Total	1090	100	1090	100	1065	100	1057	100	943	100	945	100

Materials and methods

The study entitled prevalence of nutritional and lifestyle disorders among school going children in urban and rural areas of Coimbatore city was carried out in the following manner.

Selection of area & samples: For obtaining information about the prevalence of underweight and overweight as well as obesity, both rural and urban areas of Coimbatore were the target areas, with five each of Matriculation and Corporation schools in urban areas and five Panchayat schools in rural areas were selected. About 20 each of boys and girls were selected from each class in each of the schools totaling to about 2180 students from Matriculation, 2122 students from Corporation and 1870 students from Panchayat schools respectively. In Matriculation and Corporation schools, more number of students was chosen due to availability when compared to Panchayat schools. This selection was based on random sampling technique with the teachers allotting the students as per the roll order on a random basis.

Study of the profile of the sample: Background information such as socio-economic status and medical history was obtained through administering a well framed interview schedule. The information on parental annual income was verified from school records. Information on the medical records of the students obtained from each school served as a valuable tool for assessing the medical history of the students.

Measurement of body dimensions: The nutritional status of the children was analyzed by measuring their body dimensions such as height, weight and mid upper arm circumference. These measurements were carried out by using standardized procedures. The following methods were adopted:

a) *Height:* Height was recorded to the nearest 0.1 cm using a stadiometer, the student standing barefoot with his or her heels against the upright bar of the scale while standing erect.
b) *Weight:* Weight was recorded using a portable spring balance checking for accuracy with standard weights prior to taking the weight. The students were in their school uniform and were made to stand barefoot at the time of measurement. Overweight and Obese children were then identified using the IOTF (2009) cut-off values.
c) *Mid upper arm circumference:* The mid-point between the elbow and the shoulder (acromion & olecranon) was determined. The tape measure was placed around the left arm (the arm should be relaxed and hang down the side of the body). The MUAC was measured while ensuring that the tape neither pinches the arm nor is left loose. The MUAC value was recorded to the nearest 0.1 cm or 1 mm. (MCN 2010)

Measurement of blood pressure: Using the standardized procedure suggested from the National high blood pressure education program working group on high blood pressure in children and adolescents the systolic and the diastolic blood pressure of the selected children were measured (US Dept. of Health & Human Services, 2007).

Results and discussion

Background information of the subjects

a. *Distribution of the selected subjects according to the area:* Table 1 shows the distribution of students according to area from where they were selected. From Table 1 the distribution of the students according to their age is obvious. In the urban area five matriculation schools and 5 corporation schools were selected; whereas in rural areas, five Panchayat schools were selected. This selection was done based on random sampling method by which the teachers randomly allotted the students from each section of the classes. Compared to Matriculation and Corporation schools, the number of children in each class of Panchayat schools was less due to less demand for these schools as many children in rural areas preferred to go to Corporation schools for higher studies. This might also be due to less availability of resources in rural areas. A UN study (2010) on the resource gap in between rural and urban schools reveal that a particularly glaring gap is present between urban and rural schools, especially in terms of electricity, lavatories and libraries.

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Table 2. Order of birth of the subjects (N=6190).

Age in years	Sex	Order of birth								
		Urban N= 4302						Rural N=1888		
		Matriculation schools (N=2180)			Corporation schools (N=2122)			Panchayat schools		
		First	Second	Third	First	Second	Third	First	Second	Third
6	Boys	25	76	7	12	73	10	8	82	15
	Girls	31	70	5	11	90	7	5	83	16
7	Boys	36	63	9	22	76	11	18	76	13
	Girls	27	75	5	26	70	9	15	79	12
8	Boys	37	67	5	29	79	8	23	64	21
	Girls	40	61	6	26	66	10	20	68	17
9	Boys	43	54	8	33	61	12	35	49	20
	Girls	52	56	6	36	61	9	37	50	13
10	Boys	45	59	2	38	52	13	37	45	20
	Girls	47	56	3	45	44	17	42	42	22
11	Boys	58	43	3	49	46	11	39	41	19
	Girls	52	52	6	50	49	11	45	43	16
12	Boys	55	50	7	35	60	17	37	40	21
	Girls	59	39	9	42	42	16	39	42	19
13	Boys	53	56	4	47	49	9	42	37	15
	Girls	58	53	1	45	48	7	40	46	12
14	Boys	59	52	3	53	52	8	38	24	12
	Girls	62	48	5	56	39	7	30	22	11
15	Boys	65	42	4	57	36	7	22	18	12
	Girls	59	45	2	58	55	5	25	24	10
	Total	963	1117	100	770	1148	204	597	975	316

Table 3. Family type (N=6190).

Age in years	Sex	Urban (N=4302)						Rural (N=1888)		
		Matriculation schools (N =2180)			Corporation Schools (N=2122)			Panchayat schools (N=1888)		
		Nuclear	Joint	Single parent	Nuclear	Joint	Single parent	Nuclear	Joint	Single parent
6	Boys	91	13	4	67	20	8	38	66	1
	Girls	85	12	9	76	21	9	40	61	3
7	Boys	87	16	5	71	32	5	37	67	3
	Girls	85	13	9	69	32	9	31	70	5
8	Boys	96	7	6	75	27	7	31	73	4
	Girls	96	5	6	80	24	8	33	70	2
9	Boys	87	12	6	76	20	9	35	64	5
	Girls	99	10	5	78	13	9	29	68	3
10	Boys	85	13	8	79	28	9	35	62	5
	Girls	88	11	7	72	25	8	40	62	4
11	Boys	91	6	7	79	15	8	34	62	3
	Girls	95	9	6	67	26	7	39	64	1
12	Boys	93	11	8	79	18	9	36	59	3
	Girls	94	7	6	73	32	8	40	56	4
13	Boys	99	9	5	77	20	9	34	58	2
	Girls	99	7	6	79	16	7	35	60	3
14	Boys	98	11	5	74	21	8	16	56	2
	Girls	101	10	4	77	15	8	20	42	1
15	Boys	100	9	2	80	21	5	21	30	1
	Girls	98	7	1	84	28	6	24	32	3
	Total	1867	198	115	1512	454	156	648	1182	58

b. *Birth order of the selected students:* Table 2 shows the order of birth of the selected children in urban areas. From Table 2 it is clear that 3 children norm was prevalent in both urban and rural areas. However, third order birth was to a greater extent prevalent in Corporation schools than in Matriculation and even more in Panchayat schools. This shows a trend of larger family norm in rural areas than in the urban areas. A higher proportion of urban married women (51%) than rural married women (37%) use contraceptives (Adlakha, 1997). This might be a contributory factor for the higher number of children in rural areas compared to urban areas.

c. *Type of family of the subjects:* Table 3 shows the pattern of nuclear and joint families among the selected urban and rural students. From Table 3 it can be deciphered that in urban areas, the prevalence of nuclear family was predominant while in rural areas the trend was towards joint family with either grandparents or cousins staying together. Also there was a tendency towards single parenthood observed both in urban and rural areas. Single parenthood in India may be the result of many things. In most cases it is an unforeseeable tragedy as in the death of one parent, divorce, or abandonment by one parent (Dhanyasree, 2007).

d. *Educational status of the parents of the school going children:* Table 4 shows the distribution of parents of the school going children according to their educational qualification. From Table 4 it can be inferred that the parents of Corporation and Panchayat schools were not professionally qualified while

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Table 4. Educational status of the parents in urban & rural areas (N = 6190).

Educational Status	Mother						Father					
	M (N= 2093)		C (N=2022)		P(N=1828)		M (N=2152)		C (N=2068)		P(N=1854)	
	N	%	N	%	N	%	N	%	N	%	N	%
Professional degrees	525	25.1	0	0	0	0	900	41.82	0	0	0	0
Post graduates	649	31.2	9	0.45	3	0.16	756	35.13	7	0.34	5	0.27
Graduates	913	43.8	45	2.23	12	0.66	489	22.72	97	4.69	76	4.11
Higher secondary/diploma	6	0.29	134	6.63	28	1.53	7	0.33	154	7.45	58	3.13
High school	0	0	265	13.11	1085	59.35	0	0	612	29.59	1198	64.62
Middle school	0	0	935	46.24	272	14.88	0	0	800	38.68	212	11.43
Primary education	0	0	512	25.32	112	6.13	0	0	259	12.52	92	4.96
Illiterate	0	0	122	6.03	316	17.29	0	0	139	6.72	213	11.49
Total	2093	100	2022	100	1828	100	2152	100	2068	100	1854	100

M = Matriculation, C = Corporation, P = Panchayat.

Table 5. Occupational status of parents of urban & rural students (N=6190).

Occupation	Mother						Father					
	M (N=2093)		C (N=2022)		P (N=1828)		M (N=2152)		C (N=2068)		P (N=1854)	
	N	%	N	%	N	%	N	%	N	%	N	%
Professionals (Engineers, doctors, chartered accountants & lawyers)	189	9.03	0	0	0	0	615	28.58	0	0	0	0
Professors /Lecturers	336	16.05	0	0	0	0	472	21.93	0	0	0	0
School teachers	500	23.89	121	5.98	89	4.87	342	15.89	552	26.69	252	13.6
Medical profession (Nurse, paramedical, pharmacy)	527	25.18	191	9.45	112	6.13	237	11.01	241	11.65	158	8.52
IT/Computer professionals	258	12.33	0	0	0	0	259	12.04	12	0.58	0	0
Drivers	2	0.095	5	0.25	7	0.38	2	0.09	565	27.32	79	4.26
Marketing professionals	53	2.53	57	2.82	52	2.84	163	7.57	159	7.69	162	8.74
Electricians /Plumbers & construction workers	--	0	156	7.72	189	10.34	62	2.88	309	14.94	294	15.9
Sanitary workers	--	0	229	11.33	512	28.01	0	0	178	8.61	59	3.18
Household /farm workers	--	0	632	31.26	456	24.95	0	0	52	2.51	850	45.9
Housewife	228	10.89	631	31.21	411	22.48	0	0	0	0	0	0
Total	2093	100	2022	100	1828	100	2152	100	2068	100	1854	100

M = Matriculation, C = Corporation, P = Panchayat.

525 mothers and 900 fathers of Matriculation students were doctors, lawyers, engineers or chartered accountants. This brings out that greater exposure to professional studies and affordability is found among the elite of the urban class, while the urban poor and rural people do not have access to such education. Also the rate of illiteracy was more among rural Panchayat schools and was also present among parents of corporation school children but there were no illiterates among the parents of matriculation school children. This is mainly due to the private schools insisting on both parents being educated to enroll their wards in the schools. Maitra and Sharma (2009) associate the educational levels of mothers with the education of their children with well educated mothers ensuring that their children are also well educated.

e. Occupational status of parents of the selected subjects: Table 5 provides information on the occupational status of parents of the students from urban and rural schools. From Table 5 it can be inferred that the parents of matriculation school children were involved in more white-collar jobs than the parents of those in corporation and Panchayat schools. This is mainly due to the influence of education. There were no professionals among the parents of Corporation and Panchayat schools exposing the trend among professionals to send their children only to matriculation schools. Martin and Shehan (2006) suggest that education is an important variable in conditioning the kinds of expectations workers bring to the workplace. The match between expected and actual job conditions has long been recognized as one determinate of job satisfaction which in turn is influenced by education.

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Table 6. Distribution of families according to the annual income (N=6172).

Source of income	No. of families					
	Urban (N=4302)				Rural (N=1888)	
	M (N=2180)		C (N=2122)		P (N=1888)	
	N	%	N	%	N	%
Rich (Rs. 215,000 & more)	304	13.94	-	-	-	-
Consuming class (Rs. 45,000- 215,000)	892	40.92	178	8.39	255	13.51
Climbers (Rs. 22,000-45,000)	468	21.47	726	34.21	788	41.74
Aspirants (Rs. 16,000-22,000)	516	23.67	322	15.17	243	12.87
Destitute below (Rs. 16,000)	-	-	896	42.22	602	31.89
Total	2180	100	2122	100	1888	100

M = Matriculation, C = Corporation, P = Panchayat.

f. *Distribution of families as per the annual income of the parents:* Table 6 gives details of the annual family income. From Table 6 the family income of the urban and rural school children is evident. It is obvious from the table that the annual income of parents of matriculation school children reached the topmost category while none among the corporation and rural school children had high earning parents. A maximum of 892 parents among the matriculation school children belonged to the consuming class, while 726 and 788 parents of Corporation and Panchayat schools belonged to the class of the climbers. The National Center for Children in Poverty gives the view that higher education is one of the most effective ways that parents can raise their families' incomes. There is clear evidence that higher educational attainment is associated with better jobs and higher earnings.

Medical history of the parents and the selected school children

a. Prevalence of diseases among the family members

Table 7 depicts the prevalence of diseases among the family members of the students in urban and rural areas. Table 7 depicts the disease pattern among the parents of the pre adolescent and adolescent school going children. It can be observed that when compared with pre adolescent's parents, the parents of adolescents had greater prevalence of all the 4 diseases mentioned. The incidence of diseases among parents was more in case of urban areas when compared to rural areas which might be contributed to the lifestyle. It can also be deciphered that the prevalence of diabetes was greater among parents of Matriculation school children, while that of CVD was more among parents of adolescents in Corporation schools. This might be contributed to affluence (diabetes) and ignorance (CVD). Pancholia (2009) infers that life style changes in families are related with physical activity, food habits and tobacco consumption / smoking. These are mainly due to affluence, urbanization and mechanization.

Table 7. Prevalence of disease in the family members of the selected students (N=6190).

Type of disease	Age group of the students											
	Pre-adolescents 6-11 years (N=3812)						Adolescents 12-15 years (N=2378)					
	Urban				Rural		Urban				Rural	
	M (N=1290)		C (N=1272)		P (N = 1250)		M (N=890)		C (N=850)		P (N=638)	
	N	%	N	%	N	%	N	%	N	%	N	%
Diabetes												
Father	15	1.16	5	0.39	4	0.32	35	3.92	26	3.06	13	2.04
Mother	9	0.69	2	0.16	3	0.24	27	3.02	25	2.95	16	2.51
Uncle/Aunt	17	1.31	6	0.47	5	0.4	22	2.46	28	3.3	21	3.28
Grand parents	25	1.93	78	6.08	45	3.6	289	32.37	189	22.3	115	18.06
Cardio vascular diseases												
Father	89	6.85	54	4.21	36	2.88	145	16.24	158	18.64	98	15.39
Mother	9	0.69	6	0.47	2	0.16	115	12.88	120	14.16	89	13.97
Uncle/Aunt	22	1.69	58	4.52	26	2.08	112	12.54	115	13.57	95	14.92
Grand parents	28	2.16	178	1.33	124	9.92	589	65.97	625	73.75	421	66.10
Cancer												
Father	2	0.15	3	0.23	2	0.16	9	1.01	8	0.94	5	0.79
Mother	1	0.006	1	0.08	3	0.24	3	0.34	6	0.71	3	0.47
Uncle/Aunt	1	0.006	6	0.47	5	0.4	6	0.67	7	0.83	4	0.63
Grand parents	54	4.16	69	5.38	78	6.24	25	2.8	32	3.78	28	4.40
Osteoporosis												
Father	5	0.39	9	0.70	14	1.12	96	10.75	89	10.5	56	8.79
Mother	4	0.31	7	0.55	11	0.88	89	9.97	82	9.76	59	9.26
Uncle/Aunt	6	0.46	18	1.40	17	1.36	79	8.85	86	10.15	58	9.11
Grand parents	85	6.55	695	5.38	421	33.7	592	66.30	556	65.61	415	65.16

M = Matriculation, C = Corporation, P = Panchayat.

b. Prevalence of lifestyle diseases among children

Among the selected subjects, the incidence of hypertension was the only lifestyle disorder other than

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Table 8. Nutrient deficiency in children (N=6190).

Age group	Deficiency diseases					
	Anemia		Vitamin A deficiency		Skin infections	
	N	%	N	%	N	%
Pre-adolescents (6-11 years) N= 3812						
Boys						
M N=640	155	24.22	36	5.63	12	1.88
C N=635	225	35.43	29	4.57	69	10.87
P N=625	215	34.4	19	3.04	73	11.68
Girls						
M N=650	140	21.54	43	6.62	17	2.62
C N=637	293	46.00	39	6.12	58	19.80
P N=625	262	41.92	26	4.16	62	9.92
Total	1290	203.51	192	30.14	291	56.77
Adolescents (12-16 years) N= 2378						
Boys						
M N=450	212	47.11	28	6.22	9	2
C N=430	278	64.65	32	7.44	27	6.28
P N=318	176	58.67	21	7.00	32	10.67
Girls						
M N=440	294	66.82	47	10.68	13	2.95
C N=420	292	69.52	41	9.76	31	7.38
P N=320	216	67.5	34	15.74	35	16.20
Total	1468	374.27	203	56.84	147	45.48

M = Matriculation, C = Corporation, P = Panchayat.

obesity seen in children. The prevalence of hypertension was among the obese children. In the pre adolescent group of 6-12 years, none were found to have hypertension, while in the adolescent age group of 12-16 years, 12 boys from Matriculation schools were found to have elevated blood pressure, both systolic and diastolic, while among girls six from Matriculation schools were found to have high blood pressure. An association between blood pressure and body mass index (BMI) suggesting that obesity is a strong risk factor for developing childhood hypertension has been brought out by Luma and Spiotta (2006).

c. Nutritional deficiency among children

Table 8 brings out a picture of the prevalence of nutritional deficiencies among the pre-adolescents and the adolescents. From Table 8 it is obvious that the 3 common deficiency diseases prevalent among the school going children were Vitamin A deficiency, anemia and skin infections. Among the deficiency symptoms, as diagnosed through clinical examination by a physician, anemia was predominant in 293 pre adolescent girls of Corporation schools while 294 adolescent girls from Matriculation and 292 adolescent girls from Corporation schools had anemia. The main symptoms presented were brittle nails, pale tongue and eyes, easy fatigue and hair loss. The chief cause of anemia could be contributed to the lack of proper iron, vitamin B12 and folic acid in the diets of these children. Vitamin A deficiency was presented in the form of poor adaptation to darkness, dry skin and dry hair. From the table it is evident that 43 pre-adolescent girls and 47 adolescent girls from Matriculation schools had the highest prevalence compared to Corporation and Panchayat schools. This might be due to their diets lacking the essential vitamin due to less consumption of vitamin A and beta carotene rich diet. According to Ansstas *et al.* (2010) sub clinical forms of VAD may not cause any symptoms, but the risk of developing respiratory and diarrheal infections is increased, the growth rate is decreased, and bone development is slowed. Skin infections pertaining to pellagra was seen among 73 boys and 62 girls in rural areas among the pre-adolescent age group while it was pertinent in 32 boys and 35 girls in rural areas in the adolescent group too. This might be contributed to deficiency of niacin in their diets and also due to frequent infections. Pellagra can be prevented through eating

Table 9a. Distribution of matriculation school children according to their BMI values (N=2180).

Group	Age	No.	Obese		Overweight		Normal		Under weight		Severe under weight	
			N	%	N	%	N	%	N	%	N	%
Boys	6	108	9	8.33	21	19.44	63	58.33	13	12.04	2	1.85
	7	108	8	7.40	19	17.59	65	60.18	15	8.35	1	0.93
	8	109	11	10.09	24	22.02	58	53.21	14	12.84	2	1.83
	9	105	9	8.57	26	24.76	55	52.38	13	12.38	2	1.90
	10	106	9	8.49	22	20.75	59	55.66	15	14.15	1	0.94
	11	104	7	6.73	23	22.12	56	53.85	15	14.42	3	2.88
	12	112	11	9.82	13	11.61	64	57.14	21	18.75	3	2.68
	13	113	10	8.85	13	11.50	70	61.95	19	16.81	1	0.88
	14	114	9	7.89	12	10.53	73	64.04	19	16.67	1	0.88
	15	111	9	8.11	10	9.01	75	67.57	17	15.32	0	0
Total		1090	92	8.44	183	16.79	638	58.53	161	14.77	16	1.47
Girls	6	106	8	7.55	18	16.98	65	61.32	13	12.26	2	1.89
	7	107	7	6.54	18	16.82	69	64.49	12	11.21	1	0.93
	8	107	10	9.35	27	25.23	55	51.40	13	12.15	2	1.87
	9	114	9	7.89	30	26.32	60	52.63	12	10.53	3	2.63
	10	106	8	7.55	23	21.70	55	51.89	18	16.98	2	1.89
	11	110	10	9.09	25	22.72	53	48.18	21	19.09	1	0.91
	12	107	8	7.48	17	15.89	59	55.14	21	19.63	1	0.93
	13	112	9	8.04	16	14.29	63	56.25	23	20.54	1	0.89
	14	115	7	6.08	16	13.91	69	60.00	22	19.13	1	0.87
	15	106	5	4.72	14	13.21	71	66.98	15	14.15	1	0.94
Total		1090	81	7.43	204	18.72	619	56.79	170	15.6	15	1.38

Reference- CDC (2010).

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Table 9b. Distribution of corporation school children according to their BMI values (N=2122).

Group	Age	No.	Obese		Overweight		Normal		Underweight		Severe underweight	
			N	%	N	%	N	%	N	%	N	%
Boys	6	95	5	5.26	18	18.95	64	67.37	7	7.37	1	1.05
	7	109	6	5.50	25	23.94	68	62.39	9	8.26	1	0.92
	8	116	8	6.90	25	21.55	67	57.76	15	12.93	1	0.86
	9	106	8	7.55	22	20.75	58	54.72	16	15.09	2	1.89
	10	103	6	5.83	18	17.48	65	63.11	13	12.62	1	0.97
	11	106	7	6.60	16	15.09	60	56.60	21	19.81	2	1.89
	12	112	8	7.14	18	16.07	61	54.47	23	20.54	2	1.79
	13	105	5	4.76	14	13.33	58	55.24	25	23.81	3	2.86
	14	113	5	4.42	13	11.50	66	58.41	27	23.89	2	1.77
	15	100	3	3.77	6	6.60	69	67.92	20	19.81	2	1.89
Total		1065	61	5.73	175	16.43	636	59.72	176	16.53	17	1.60
Girls	6	108	6	5.56	21	19.44	72	66.67	8	7.41	1	0.93
	7	105	5	4.76	22	20.95	66	62.86	10	9.52	2	1.90
	8	102	4	3.92	20	19.61	66	64.71	11	10.78	1	0.98
	9	106	5	4.72	19	17.92	66	62.26	15	14.15	1	0.94
	10	106	5	4.72	20	18.87	64	60.38	15	14.15	2	1.89
	11	110	8	7.27	21	19.09	66	60.00	14	12.73	1	0.91
	12	100	4	4.00	11	11.00	66	66.00	18	18.00	1	1.00
	13	100	5	5.00	10	10.00	66	66.00	18	18.00	1	1.00
	14	102	3	2.94	10	9.80	70	68.63	18	17.65	1	0.98
	15	118	2	1.69	9	9.06	85	72.03	21	17.80	1	0.85
Total		1057	47	4.45	163	15.42	687	64.99	148	14.00	12	1.14

Reference- CDC (2010).

almost any protein-rich foods (Encyclopedia of Mental Disorders, 2010).

Measurement of body dimensions

a. Distribution of children according to their BMI values

Table 9a shows the distribution of Matriculation school children according to their BMI values. Table 9a brings out the prevalence of obesity, overweight, underweight and severe underweight among the Matriculation school children. It can be inferred from the table that the prevalence of overweight among the boys is 16.79% while among girls it is 18.72%. However, the trend is reversed in underweight category with 15.6% girls remaining underweight in comparison with 14.77% boys. The rate of obesity however is more in boys, with 8.44% being obese, compared to 7.43% girls. The prevalence of overweight was greater among the pre adolescents (6-11 years) than among adolescents (12-15 years). A trend of increasing overweight was seen till the age of 11 years for boys, after which the percentage of overweight reduced such that at 11 years of age 22.12% of boys were overweight while at 15 years of age it reduced to 9.01%. Among the girls, a similar trend was observed with regards to overweight, with 22.72% of girls remaining overweight at 11 years while at 15 years

Table 9c. Distribution of panchayat school children according to their BMI values (N=1888).

Group	Age	No.	Obese		Over weight		Normal		Under weight		Severe under weight	
			N	%	N	%	N	%	N	%	N	%
Boys	6	105	1	0.95	9	8.57	69	65.71	21	20	5	4.76
	7	107	3	2.80	12	11.21	70	65.42	19	17.76	3	2.80
	8	108	3	2.78	12	11.11	71	65.74	19	17.60	3	2.78
	9	104	2	1.92	12	11.54	70	67.31	19	18.27	1	0.96
	10	102	3	2.94	9	8.82	69	67.65	20	19.61	1	0.98
	11	99	3	3.03	12	12.12	57	57.58	23	23.23	4	4.04
	12	98	5	5.10	7	7.14	60	61.22	24	24.49	2	2.04
	13	94	2	2.13	5	5.32	62	65.96	24	25.53	1	1.06
	14	74	2	2.70	3	4.05	47	63.5	20	27.01	2	2.70
	15	52	1	1.92	2	3.85	42	80.77	6	11.54	1	1.92
Total		943	25	2.65	83	8.80	617	65.43	195	20.68	23	2.44
Girls	6	104	2	1.92	12	11.54	67	64.42	21	20.19	2	1.92
	7	106	3	2.83	11	10.38	71	66.98	19	17.92	2	1.89
	8	105	1	0.95	10	9.52	74	71.43	19	18.10	1	0.95
	9	100	3	3.00	11	11.00	70	70.00	15	15.00	1	0.95
	10	106	1	0.94	14	13.20	67	63.21	22	20.75	2	1.89
	11	104	2	1.92	9	8.65	71	68.27	21	20.19	1	0.96
	12	100	2	2.00	7	7.00	75	75.00	15	15.00	1	1.35
	13	98	1	1.59	5	6.35	76	76.19	15	14.29	1	1.59
	14	63	0	0	3	4.76	49	77.78	10	15.87	1	1.59
	15	59	0	0	2	3.39	48	81.36	8	13.56	1	1.69
Total		945	15	1.59	84	8.89	668	70.69	165	17.78	13	1.38

Reference- CDC (2010).

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of age it stood at 13.21%. With regard to obesity, there was no correlation with age observed in case of boys

Table 10a. Distribution of corporation school children according to their MUAC (N=2124).

Group	Age	No.	Normal		At risk	
			N	%	N	%
Boys (N=1065)	6	95	90	94.74	5	5.26
	7	109	103	94.5	6	5.5
	8	116	113	97.41	3	2.59
	9	106	104	98.11	2	1.92
	10	103	102	99.01	1	0.97
	11	106	105	99.06	1	0.94
	12	112	112	100	0	0
	13	105	105	100	0	0
	14	113	113	100	0	0
	15	100	100	100	0	0
Girls (N=1057)	6	108	105	97.22	3	2.78
	7	105	104	99.05	1	0.95
	8	102	100	98.04	2	1.96
	9	106	104	98.11	2	1.87
	10	106	105	99.06	1	0.94
	11	110	110	100	0	0
	12	100	100	100	0	0
	13	100	100	100	0	0
	14	102	102	100	0	0
	15	118	118	100	0	0

Reference values for MUAC: <110 mm-Severe malnutrition, 110-124 mm-Moderate malnutrition, 125-134-risk, >135 mm-Normal, MCN (2009).

Table 10b. Distribution of panchayat school children according to their MUAC (N=1888).

Group	Age	No.	Normal		At risk	
			N	%	N	%
Boys (N= 943)	6	105	97	92.38	8	7.62
	7	107	100	93.46	7	6.54
	8	108	101	93.52	7	6.48
	9	104	98	94.23	6	5.77
	10	102	96	94.12	6	5.88
	11	99	93	93.94	6	6.45
	12	98	95	96.94	3	3.06
	13	94	91	96.81	3	3.19
	14	74	73	98.65	1	1.35
	15	52	52	100	0	0
Girls (N=945)	6	104	99	95.19	5	4.81
	7	106	102	96.23	4	3.77
	8	105	99	94.29	6	5.71
	9	100	95	95	5	5
	10	106	102	96.23	4	3.77
	11	104	102	98.08	2	1.96
	12	100	100	100	0	0
	13	98	98	100	0	0
	14	63	63	100	0	0
	15	59	59	100	0	0

Reference values for MUAC: <110 mm-Severe malnutrition, 110-124 mm-Moderate malnutrition, 125-134-risk, >135 mm-Normal, MCN (2009).

while in girls, a decreasing trend was observed from 13 years of age, with 8.04% obese girls at 13 while at 15 years of age only 4.72% were obese. This shows the increased awareness among the adolescents to reduce their body weights, mostly influenced by the media which has created an increased awareness about ideal body weights.

Table 9b shows the distribution of Corporation school children according to their BMI values. From Table 9b it can be deciphered that the prevalence of overweight and underweight among boys follows a similar trend with 175 (16.43%) and 176 (16.53%) being overweight and underweight respectively. The prevalence of obesity is at 5.73% while that of underweight at 1.60% among the boys. As the age of the boys increased from 12 years onwards, a decreasing trend in obesity was observed with 7.14% being obese at 12 years while only 3.77% being obese at 15 years of age. Considering the trend among girls, it could be seen that while 163 (15.42%) were overweight, 148 (14%) were underweight. The prevalence of obesity was less than that of the boys with 47 (4.45%) being obese while the prevalence of underweight was also less than that in boys with 12 (1.14%) falling under the severe underweight category. Table 9c illustrates the distribution of Panchayat school children according to their BMI values. From Table 9c it can be seen that there is greater prevalence of underweight (195) than overweight (83) among the boys while among girls a similar trend was observed with 165 (17.78%) falling under the underweight category while 84 (8.89%) of them being overweight. The prevalence of obesity and severe underweight was almost similar among both boys and girls with 25 (2.65%) obese and 23 (2.44%) severe underweight among boys, while 15 (1.59%) obese and 13 (1.38%) severe underweight among the girls.

Lazzarie et al. (2008) opine that the trend in the prevalence of overweight (including obesity) among girls from 9-15 year old strongly decreased, while the prevalence of thinness increased. In boys, this decrease was less marked and the prevalence of thinness displayed an irregular trend, with an increment from 9-11 year old and a decrease from 13-15 year old. The trend in the prevalence of normal weight increased with age, with a higher prevalence among boys than girls.

Biro and Wien (2010) bring out the consequences of childhood and adolescent obesity as earlier puberty and menarche in girls, type 2 diabetes and increased incidence of the metabolic syndrome in youth and adults, and obesity in adulthood. These changes are associated with cardiovascular disease as well as with several cancers in adults, likely through insulin resistance and production of inflammatory cytokines. In addition, the sex difference in overweight trends may relate to the emerging body image (preference of thinness) among adolescent females (Wang *et al.,* 2002).

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b. Distribution of children according to their mid upper arm circumference

a) *Distribution of Matriculation children according to MUAC values*: All the boys (1090) and all the girls (1090) of the Matriculation schools had normal mid upper arm circumference of greater than 135 mm. This shows that malnutrition was not prevalent among students of Matriculation schools.

b) *Distribution of Corporation School children according to MUAC values:* Table 10a brings out the distribution of the Corporation school students according to the mid upper arm circumference. From Table 10a it can be inferred that among 7 years old boys 6 of them fell in the risk category for malnutrition as they had less than 135 mm mid upper arm circumference. In girls the situation was better as only 3 children in the age group of 6 years showed risk for developing malnutrition. This could be mainly contributed to lack of resources, inadequate food intake and frequent infections in children.

c) *Distribution of Panchayat school children according to MUAC values:* Table 10b depicts the distribution of Panchayat school children according to their mid upper arm circumference.

Among the Panchayat school children, eight were at risk for malnutrition considering their mid upper arm circumference among the boys in the age group of 6 years, while among the girls, six fell in the risk category among the eight years age group. The trend for rise in those who fell in the risk category in Panchayat schools when compared to Corporation schools showed that the dietary intake was not adequate among school children in Panchayat schools when compared to Corporation schools. In Corporation schools, from the age of 12 years in boys and from the age of 11 years in girls, incidence of risk was not found, while in Panchayat schools, only the 15 year old boys and girls from 12 years onwards had normal mid upper arm circumference. This shows a better trend in nutrition in the urban areas when compared to rural areas due to inadequate knowledge on foods to be consumed and also less household income. Roy (2000) points out MUAC as a potential anthropometric indicator of child nutrition. Education of mothers, housing space, family size, religion and sex of children had significant effects on the nutritional status of children.

Conclusions

Compared to the parents of pre adolescents, the parents of adolescents had greater incidence of diabetes mellitus, cardio vascular diseases, cancer and osteoporosis. The incidence of diabetes mellitus was greater in urban areas, while the incidence of cardiovascular diseases was predominant in rural areas. Obesity was linked to the incidence of hypertension among the selected school children. Among the nutritional deficiencies, anemia was more prevalent among pre adolescents and adolescents. Obesity was found in 8.44% boys and 7.43% girls from Matriculation schools. Underweight was prevalent among 20.68% boys and 17.78% girls from Panchayat schools. Among the Corporation school children 5.26% boys and 2.78% girls in the age group of 6 years had low mid upper arm circumference, while among the Panchayat school children 7.62% boys from 6 years and 5.71% girls from 8 years had low levels of mid upper arm circumference.

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