IV RESULTS AND DISCUSSION

The results pertaining to the research entitled "Assessment of **Health Status of School Children and the Influence of Demographic and Lifestyle Factors**" are presented and discussed under four phases.

PHASE I: DEMOGRAPHIC, SOCIO-ECONOMIC STATUS AND LIFESTYLE FACTORS OF CHILDREN AND INFLUENCE OF CHILD REARING PRACTICES

A. Demographic and socio economic status of the selected children

B. Lifestyle practices of the selected children

C. Child rearing and weaning practices

D. Familial influence

A. DEMOGRAPHIC AND SOCIO ECONOMIC STATUS OF THE SELECTED CHILDREN

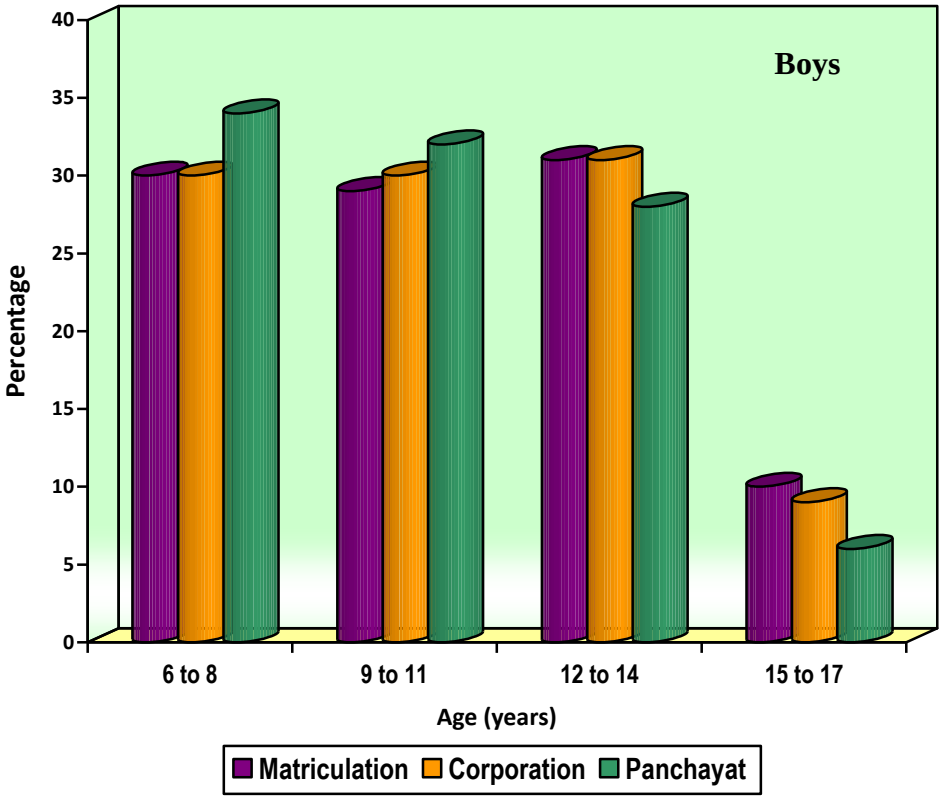
1. Area, type of school, age and gender of the selected children

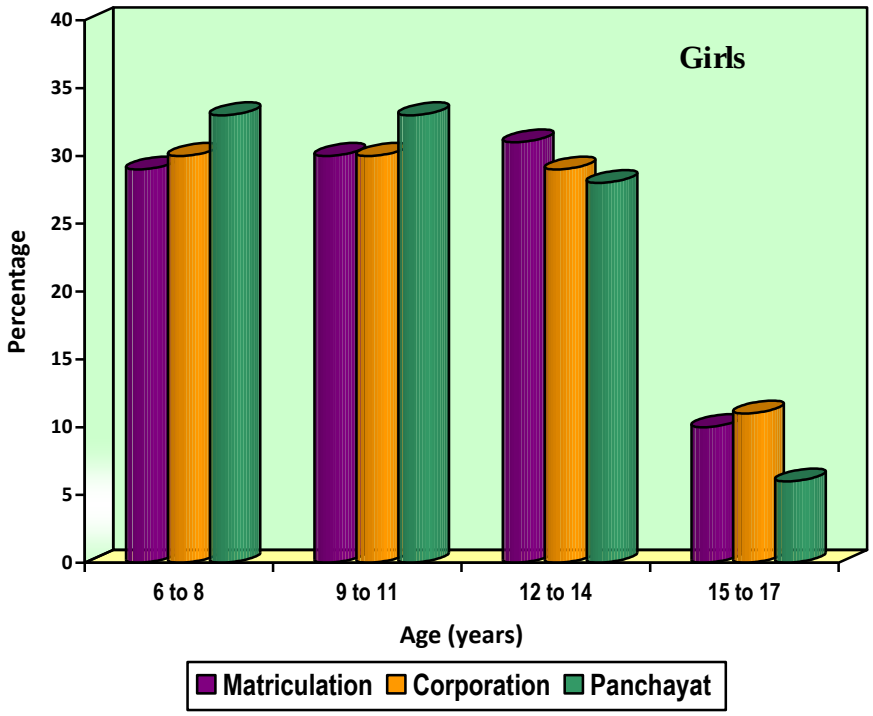
Table I shows the distribution of the selected children according to area to which they belong, type of school, age and gender. Figure 1 depicts the percentage distribution of children according to type of school, age and gender.

TABLE I
DISTRIBUTION OF THE CHILDREN ACCORDING TO AREA, TYPE OF SCHOOL, AGE AND GENDER

(N= 6190)

Age (years)	Urban area N=4302								Rural area N= 1888			
	Matriculation schools N=2180				Corporation schools N=2122				Panchayat schools N = 1888			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
6-8	325	30	320	29	320	30.	315	30	320	34	315	33
9-11	315	29	330	30	315	30	322	30	305	32	310	33
12-14	339	31	334	31	330	31	302	29	266	28	261	28
15-17	111	10	106	10	100	9	118	11	52	6	59	6
Total	1090	100	1090	100	1065	100	1057	100	943	100	945	100





DISTRIBUTION OF THE CHILDREN ACCORDING TYPE OF SCHOOL, AGE AND GENDER
FIGURE 2

As evident from Table I, Matriculation and Corporation schools were located in urban area and Panchayat schools were in rural area. Corporation schools in urban area and Panchayat schools in rural area were run by the Government, while Matriculation schools in urban area were under private management. Children studying in Matriculation schools were from high and middle income families, while children of urban Corporation schools and rural Panchayat schools were comparatively from low socio-economic group.

The age of the selected children ranged from six to fifteen years. They were from classes one to ten. One thousand and ninety each of boys and girls were selected from Matriculation and Corporation schools. There were no drop-outs in Matriculation schools till the study was completed. However, due to drop out of children in Corporation schools, the final number reduced by two percent in the case of boys and three percent in case of girls in Corporation schools, showing an average drop-out rate of 2.5 per cent. Equal numbers of children were selected from each class in Matriculation and Corporation schools while in rural Panchayat schools it was not possible as the enrolment of children was less especially in higher classes. There were also more dropouts in the higher classes.

Hence only 1000 each of boys and girls were selected from Panchayat schools and at the end of the study period there were only 943 boys and 945 girls showing a drop-out rate of six per cent. Thus a total number of 6190 children were selected for the study from all the three types of schools.

Dearth of facilities in terms of electricity, drinking water, toilets, class rooms and library were the reasons for reduction in the enrolment of children in Panchayat schools in comparison with those of the Matriculation and Corporation schools located in urban area. In addition to these, there were inadequate number of teachers and teaching hours.

Similar situation has also been brought out by an UN study (2008) on resource availability which revealed a particularly glaring gap between urban and rural schools, especially in terms of electricity, lavatories and libraries.

Lawless (2009) has also pointed out that rural school students were less likely to have access to computers and the Internet. In today's changing

society, this lack of computer facilities creates a terrible handicap for these students.

2. Type of family

Table II shows the family type of the selected children.

TABLE II

TYPE OF FAMILY

School	Type of family									
	Nuclear		Joint		Level of confidence		Single parent			
							Father		Mother	
	N	%	N	%	Groups compared	'Z' value	N	%	N	%
Matriculation(M)	1867	86	198	9	M vs. C M vs. P	5.78^{NS} 1.28*	23	1	92	4
Corporation(C)	1512	71	454	21	C vs.P	1.55*	55	3	101	5
Panchayat (P)	648	34	1182	63			24	1	34	2

*Significant at 99 per cent confidence level; NS – Not significant

From Table II it is evident that nuclear family system was predominant among the children studying in Matriculation and Corporation schools in urban area with 86 and 71 per cent nuclear families respectively. In Panchayat schools located in rural area, only 34 per cent of children were from nuclear families. Joint family system was predominant (66%) in rural area reflecting the tradition and culture of India that still exist in rural areas. Grand-parents and / or cousins formed part of the joint families.

The difference in the existence of nuclear and joint family system was statistically tested using the Z test. The difference between nuclear and joint families was significant at 99 per cent confidence level between Matriculation and Panchayat schools as well as between Corporation and Panchayat schools. There was no statistically significant difference in the family system between Matriculation and Corporation schools indicating that the difference in type of family existed between urban and rural areas and not between the types of school.

The benefits of joint family system in terms of security, health and stress-free environment compared to nuclear families have been well brought out by Jha (2010).

It was also observed that single parenthood was found both in urban and rural areas, with more percentage of mothers remaining single (11 %). Single parenthood was the result of divorce (2%) or migration of one parent (6%) from rural to urban areas to provide better education and opportunities for their children or due to employment of the spouse (3%).

Dhanyasree (2007) observed in her study that in most cases single parenthood was due to an unforeseen tragedy such as the death of one parent, divorce, or abandonment by one parent.

In the present study, two per cent of the mothers were divorced, widowed or lived separate from their spouse while three per cent lived alone due to employment reasons. Six per cent lived alone to provide better education to their children.

3. Educational status of the parents

Table III brings out the educational status of the parents of the children from urban and rural schools.

TABLE III

EDUCATIONAL STATUS OF THE PARENTS OF THE SELECTED CHILDREN

Educational Status	Father						Mother					
	M N= 2088		C N=2021		P N=1854		M N=2157		C N=2067		P N=1864	
	N	%	N	%	N	%	N	%	N	%	N	%
Graduates and Post- Graduates	2082	98	54	3	15	1	2145	99	104	5	81	4
Higher Sec./Diploma	6	2	133	6	30	2	7	0.5	153	7	58	3
High School	0	0	1712	85	1493	80	5	0.5	1671	81	1512	81
Illiterate	0	0	122	6	316	17	0	0	139	7	213	12
Total	**2088**	**100**	**2021**	**100**	**1854**	**100**	**2157**	**100**	**2067**	**100**	**1864**	**100**

M = Matriculation C = Corporation P = Panchayat

From Table III it can be inferred that 98 per cent fathers and 99 per cent mothers of Matriculation school children were graduates or post

graduates. There were no illiterates or even those with only high school education among the parents of Matriculation school children. This brings out the better educational status of the parents of children in Matriculation schools. These schools insist on education of both parents for enrollment of their wards in their schools. Children of illiterate parents are not admitted in Matriculation schools.

Only one to five per cent of the parents of the children of Corporation and Panchayat schools were graduates and post-graduates. None of them were professionals. Majority (81 -85%) had only high school education. Only a few had attained higher education. Illiteracy was found to be more among the parents of Corporation and Panchayat school children. Six and 17 per cent fathers and seven and 12 per cent mothers of Corporation and Panchayat school children respectively were illiterates.

Maitra and Sharma (2009) have associated the educational levels of parents with the education of their children. Well-educated parents ensured that their children are also well educated.

Chesters (2011) declared that university-educated parents are more likely to take advantage of opportunities to provide higher education for their children. Educated parents were also better placed to provide extra tuition and to assist their children in their studies.

4. Occupational status of parents

Table IV provides data on the occupational status of parents of children from urban and rural schools.

TABLE IV

OCCUPATIONAL STATUS OF PARENTS OF SELECTED CHILDREN

Occupational status*	Father						Mother					
	Matriculation N = 2088		Corporation N = 2021		Panchayat N = 1854		Matriculation N = 2157		Corporation N = 2067		Panchayat N = 1864	
	N	%	N	%	N	%	N	%	N	%	N	%
Highly skilled	1087	52	0	0	0	0	825	38	0	0	0	0
Skilled	815	39	1285	64	496	27	1046	48	655	32	191	10
Semiskilled	186	9	406	20	497	27	58	3	213	10	353	19
Unskilled	0	0	330	16	861	46	228	11	1199	58	1320	71
Total	2088	100	2021	100	1854	100	2157	100	2067	100	1864	100

*Recommended by Indian Institute of Management, Ahmedabad, India (2011).

From Table IV it can be inferred that 52 per cent of fathers of Matriculation school children were highly skilled professionals namely doctors, lawyers, engineers, chartered accountants and professors. It could be observed that 38 and 48 per cent of the mothers fell under the highly skilled and skilled categories respectively with professionals, professors, and computer and marketing jobs.

Parents of children of Corporation schools fell under the skilled as well as unskilled categories with 64 and 16 per cent of fathers and 32 and 58 per cent of mothers respectively. They were school teachers, computer and marketing professionals, building supervisors, carpenters, masons, tailors, self-employed through self-help groups, conservancy workers and home makers.

Parents of Panchayat school children belonged to unskilled category with 46 per cent of fathers being farmers and 71 per cent of mothers were homemakers. Occupational status of the parents well correlated with their level of education. There were no highly skilled or skilled professionals among parents of Corporation and Panchayat school children.

Statistical analysis indicated a high level of significance at 99 per cent confidence level ($Z = 2.14$) between education and occupational status showing that education is directly linked to the type of occupation.

Mirowsky and Ross (2004) contend that learning influences economic prosperity which enables the adoption of a healthy lifestyle (regular exercise, restricting caloric intake etc.) and mitigates the ill effects of personal economic hardship.

It was observed in the present study that high income led to various lifestyle changes like eating calorie rich foods, eating out in hotels and spending more on recreation rather than adapting a healthy lifestyle.

5. Income of the parents

Table V and Figure 3 reveal the details of the annual income of the parents of the selected children.

TABLE V

TOTAL FAMILY INCOME OF THE SELECTED CHILDREN

Income status*	Income (Indian Rupees)	Families					
		Matriculation N=2180		Corporation N=2122		Panchayat N = 1888	
		N	%	N	%	N	%
The Rich	2,15,000 and more	1104	51	533	25	425	23
The Consuming Class	45,000- 2,15,000	692	32	522	25	556	28
The Climbers	22,000-45,000	268	12	326	15	584	31
The Aspirants	16,000-22,000	116	5	463	22	143	8
The Destitute	Below 16,000	0	0	278	13	180	10
Total		2180	100	2122	100	1888	100

*National Council of Applied Economic Research (NCAER), 2010.

From Table V, it is evident that 51 per cent of families of Matriculation school children were categorized as the rich while only 25 and 23 per cent of the Corporation and Panchayat school families were in the rich category.

The next category of consuming class families was also high in Matriculation schools with 32 per cent followed by 25 and 28 per cent of Corporation and Panchayat school children belonging to the category of climbers.

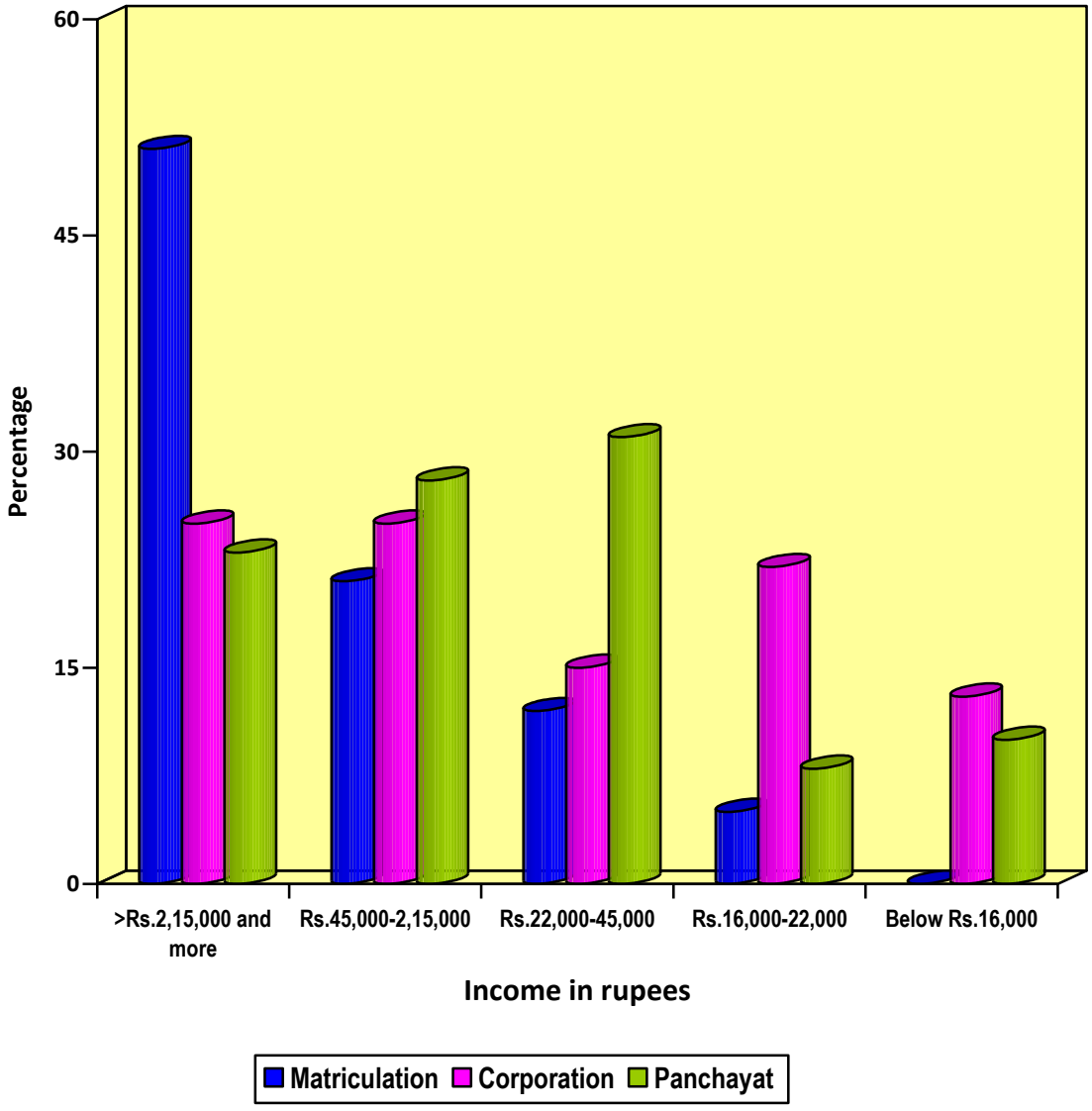
A low annual income of less than Rs.22,000 (aspirants) and below 16,000 (destitute) were observed only among families of Corporation and Panchayat school children (22% and 13% and 8% and 10% respectively).

More than 50 per cent of families of Corporation and Panchayat school children earned less than Rs.45,000 per year while in Matriculation school families more than 80 per cent earned more than Rs.45,000 per year.

As the income decreases, the money spent for foods decreases leading to inadequate quality and quantity of foods purchased for the family. NCAER (2010) survey confirms that 62 per cent of Indian households belong

to the middle class comprising of those earning between Rs.45,000 to Rs.1.80 lakh per annum.

The World Development Report (2007) points out that as the level of urbanization increases better economic development occurs. In other words



TOTAL FAMILY INCOME OF THE SELECTED CHILDREN

FIGURE 3

urbanization and economic development seem to go hand in hand within Indian states over time. This has resulted in better annual income among elite urban households than among disadvantaged urban and rural households.

It is evident in the present study that the annual income of families of urban Matriculation school children was better in comparison with those of Corporation and Panchayat school children.

B. LIFESTYLE PRACTICES OF THE SELECTED CHILDREN

1. Leisure time activities

Table VI brings out the activities performed by the selected children during their leisure time.

TABLE VI

LEISURE TIME ACTIVITIES OF THE SELECTED CHILDREN

Type of Activity	Matriculation schools				Corporation schools				Panchayat schools			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Television Viewing	903	83	1043	96	992	93	1037	98	876	93	910	96
Computer Games	798	73	681	62	576	54	446	42	275	29	138	15
Outdoor games	218	20	104	10	268	25	98	9	520	55	230	24
Indoor games	605	56	827	76	497	47	727	69	347	37	545	58
Singing/Listening to music	346	32	644	59	448	42	545	52	410	43	446	47
Reading books	84	8	114	11	60	6	61	6	39	4	38	4

As depicted in Table VI, the common recreational activity of all the children of all ages in both urban and rural schools was television viewing. In both urban and rural areas, the percentage of girls viewing television was more than boys. Nearly 96 to 98 per cent of girls were involved in television viewing. These girls stated that watching television by the elders at home was the important influencing factor.

Television viewing was followed by computer games. Computer games and computer related activities were more popular among Matriculation school children as it was more accessible and affordable for them compared to Corporation and Panchayat school children. Computer games were more popular among boys compared to girls. The recent advent of even roadside shops offering computer games on payment was one of the influencing factors in urban area.

In rural area, computer related games and computer activities were not very popular. But, more children were involved in outdoor games which was very much less in urban areas. Lack of space for outdoor games was the restricting factor in urban area.

Indoor games and singing and listening to music were equally popular among both urban and rural school children.

There was a difference in the activities performed by urban and rural children as could be envisaged from Table VI. Outdoor activities were more popular among rural children while indoor activities were popular among urban children. Computer related activities have not yet fully reached the rural school children.

As obvious from Table VI, television, computer and the internet as well as school home-work have usurped the available time and hence the habit of reading books had declined among the children. However, urban children showed a better interest towards reading books in comparison to rural children.

McDonough (2009) opines that the trend of increased viewing of television, playing Internet games and involvement in mobile phones have occupied much of the time of school children.

The advancement in Information and Communication Technology (ICT) in urban area was evident while it had not reached the rural children.

Similar results have been pointed out by Nayak (2011) who observe that more than half of television viewers in India today are children below 15 years.

2. Exercise

Table VII brings out the type and duration of physical exercise performed by the selected children.

TABLE VII

TYPE AND DURATION OF EXERCISE PERFORMED AT SCHOOL

Type of physical exercise	Matriculation				Corporation				Panchayat			
	Boys N= 1090		Girls N= 1090		Boys N= 1065		Girls N= 1057		Boys N= 943		Girls N= 945	
	N	%	N	%	N	%	N	%	N	%	N	%
Outdoor games	512	47	431	40	324	30	282	27	213	23	167	18
Athletics	362	33	85	8	123	12	97	9	74	8	43	5
Aerobics	69	6	32	3	20	2	14	1	17	2	15	2
Yoga	417	38	334	31	512	48	581	55	523	56	480	51

From Table VII, it is evident that 47 per cent boys and 40 per cent girls were involved in outdoor games in Matriculation schools. In Corporation and Panchayat schools, learning of yoga was emphasized with weekly classes of yoga. It could be observed that 48 and 56 per cent boys and 55 and 51 per cent girls from Corporation and Panchayat schools respectively were involved in the yoga classes during school hours during the physical training period, the duration of which was forty minutes per week for each class. Due to space constraint in certain urban Corporation schools, yoga was found to be a better alternative compared to games.

In Corporation and Panchayat schools, the infrastructure available for the conduct of outdoor games like tennis, badminton, volley ball and basketball was not available and along with lack of trainers, these games were not pursued. Cricket, kabaddi and kho-kho were popular among Corporation and Panchayat school children.

In Matriculation schools, the students could volunteer for games, other than during the physical training hour. Special coaching was given for basketball, volleyball, throw ball and tennis after school hours for those interested in these games.

Generally, playing outdoor games and involvement in athletic events were limited after eighth standard because of age factor in case of girls and due to concentration on studies from standard nine onwards. This had brought down the percentage of those involved in games and athletics in higher classes among boys and still less among girls. Girls were not allowed to play outdoor games after attainment of puberty. Hence these children did not reap the health benefits of regular exercise. Basile (2011) stresses that regular exercise helps kids handle the physical and emotional challenges that a typical day presents such as feel less stressed, be more attentive in school, keep a healthy weight, build and keep healthy bones, muscles and joints and sleep better at night.

C. CHILD REARING AND WEANING PRACTICES

A subsample of 600 children each from the three types of schools was selected to study the impact of child rearing and weaning practices on the present health status.

1. Term of birth and birth weight

Table VIII reveals the term of birth and birth weight of the selected subsample of children.

TABLE VIII

TERM OF BIRTH AND BIRTH WEIGHT OF SELECTED SUBSAMPLE OF CHILDREN

(N = 1800)

Criteria	Values	Matriculation(M) N = 600		Corporation(C) N = 600		Panchayat(P) N = 600		Groups compared	Z value
Term of birth		**N**	**%**	**N**	**%**	**N**	**%**	**Pre-term birth**	
Pre Term	< 35 weeks	63	11	88	15	128	21	M vs. P	4.89^{NS}
Full Term	36 – 39 weeks	537	89	512	85	472	79	C vs. P	4.39^{NS}
Birth weight									
Low	< 2500 g	86	14	101	17	126	21	**Low birth weight**	
Normal	2500 -3500 g	492	82	476	79	459	77	M vs. P	5.12^{NS}
High	> 3500g	22	4	23	4	15	2	C vs. P	4.23^{NS}

NS- Not Significant

It could be observed from Table VIII that there were more pre-term babies (21%) among Panchayat school children while it was less in Matriculation (11%) and Corporation schools (15%).

Teenage pregnancy and poor health of the mother were seen more among rural households compared to urban mothers. However, statistical analysis did not indicate significant difference in the term of birth between the three schools.

Mukherjee and Mukherjee (2010) have recorded a prevalence of 8.73 per cent premature birth among Indian children. Young age of the mother and birth order of the child were the causative factors. Children born in the order of first to third were more susceptible to premature births.

With regard to birth weight of children, it was observed that low birth weight was found more among rural children (21%) compared to urban school children. But the confidence level tested for low birth weight between the three types of schools did not show any significant difference.

The World Health Organization (2011) has estimated the prevalence of low birth weight among children to be 23.8 per cent (globally) and 30 per cent in developing countries.

The results of the present study indicate the percentage of low birth weight to be 14 to 17 per cent in urban area and 21 per cent in rural area which were lower than the global and developing countries' averages published by WHO (2011).

Low birth weight is regarded as a major determinant of morbidity and disability in infancy and childhood and also has a long-term impact on health outcomes in adult life.

2. Correlation of term of birth and birth weight with BMI values

Table IX brings out the distribution of pre-term and full term children as well as children with low medium and high birth weights according to their BMI percentiles. Fig 4 shows the distribution of children according to their BMI percentiles as influenced by their birth weight.

TABLE IX

DISTRIBUTION OF CHILDREN ACCORDING TO TERM OF BIRTH AND BIRTH WEIGHT AND BODY MASS INDEX

(N = 1800)

Variables	No.	Body Mass Index Classification*								r values
		Underweight		Normal		Overweight		Obesity		
		N	%	N	%	N	%	N	%	vs. BMI
Term of birth										
Preterm	279	41	15	135	48	89	32	14	5	r = 0.9
Full term	1521	86	5	1180	78	223	15	32	2	r = 0.4
Birth weight										
Low	313	21	7	265	84	15	5	12	4	r = -0.8
Normal	1427	54	5	1321	92	33	2	19	1	r = 0.3
High	60	0	0	36	60	15	25	9	15	r = 0.9

*Centers for Disease Control and Prevention (CDC) (2010)

It could be concluded from Table IX that compared to full term infants, a greater percentage of preterm infants showed underweight, overweight and obesity. While underweight prevalence was only five per cent among full term infants, it was 15 per cent among preterm infants. This could be due to failure to have good growth potential in these children.

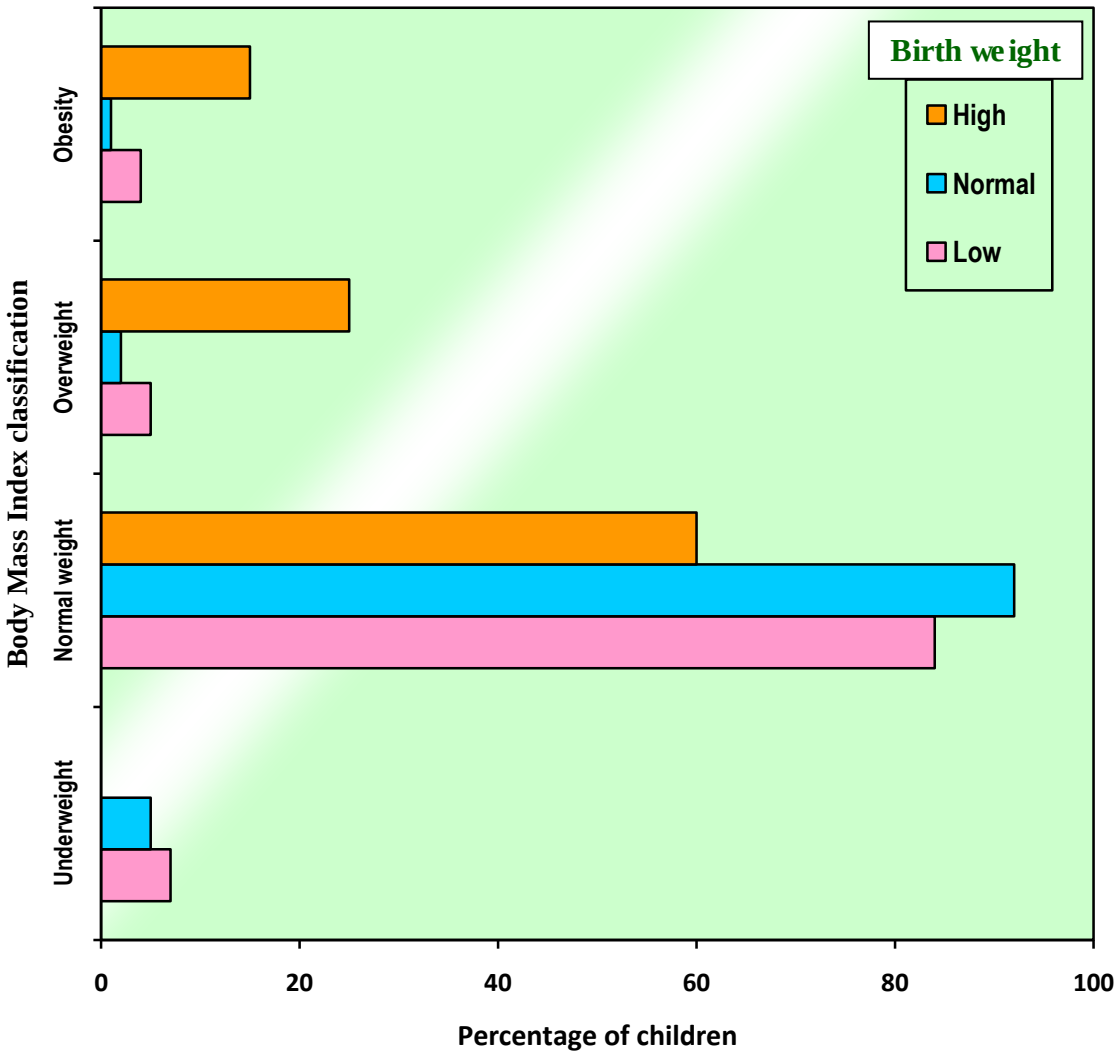
Also the percentage of overweight and obesity prevalence doubled in case of preterm infants. This might be due to overfeeding of preterm children by mothers leading to later development of overweight and obesity.

Gaskins et al. (2010) found that preterm birth was an independent risk factor for increased risk of childhood adiposity, leading to overweight and obesity among children.

Considering the influence of birth weight on Body Mass Index, greater percentage of low birth weight infants belonged to underweight category (7%). None of the children who had high birth weight showed underweight in later years. But they depicted overweight and obesity. Forty per cent of high birth

weight children were overweight or obese. Similar results have been observed by Apfelbacher et al. (2008), Dubois and Girard (2006) and Rossi et al. (2010).

Overweight and obesity were prevalent among a small percentage of low birth weight children. Those children who had normal weight at birth were normal in their later ages also.



DISTRIBUTION OF CHILDREN ACCORDING TO BIRTH WEIGHT AND BODY MASS INDEX

FIGURE 4

2. Duration of breast feeding

Table X brings out the duration for which the subsample of children were breast fed.

TABLE X

DURATION OF BREAST FEEDING OF THE SUBSAMPLE OF CHILDREN

(N = 1800)

Duration	Matriculation N = 600		Corporation N = 600		Panchayat N = 600		Groups compared	Z value
	N	%	N	%	N	%		
< 1 month	192	32	212	35	72	12	Breastfeeding >6 months	
Up to 6 months	325	54	313	53	334	56	M vs. P	1.93*
>6 months	31	5	38	6	173	28	C vs. P	1.92*
Not breastfed	52	9	37	6	21	4		

*Significant at 90 per cent confidence level

Table X brings out the duration of breastfeeding among the subsample of children of the three different schools. It could be observed that breast feeding for longer period was observed in rural Panchayat school children compared to urban children. In urban area 32 and 35 per cent of children were breastfed only for less than a month. In Panchayat schools, the unique feature was that breast feeding was done even after six months, along with the introduction of supplementary foods. It was encouraging to find that 28 per cent of the Panchayat school children were breast fed even after six months.

A significant difference (90% confidence level) was found with regard to the period of breast feeding for greater than six months among children of Matriculation and Panchayat schools and between Corporation and Panchayat schools.

This showed that breastfeeding was more effectively done for children of Panchayat schools when compared to Matriculation and Corporation school children. The main reasons for better breastfeeding practice observed in rural area were: mothers were housewives, community co-operation and presence of elders at home due to joint family system, which acted as impetus and the elders supported the mothers in breast feeding the children.

WHO (2010) confers several benefits for both mothers and infants including reduction in mortality and morbidity due to exclusive breastfeeding for duration of 6 months.

Early weaning was initiated among urban children either due to illness of the mother, inability to continue breast feeding due to nature of work or inadequacy of breast milk for the infant.

3. Correlation of duration of breastfeeding and Body Mass Index

Table XI and Figure 5 bring out the distribution of children according to duration of breast feeding and Body Mass Index classification.

TABLE XI

DISTRIBUTION OF CHILDREN ACCORDING TO DURATION OF BREAST FEEDING AND CLASSIFICATION OF BODY MASS INDEX

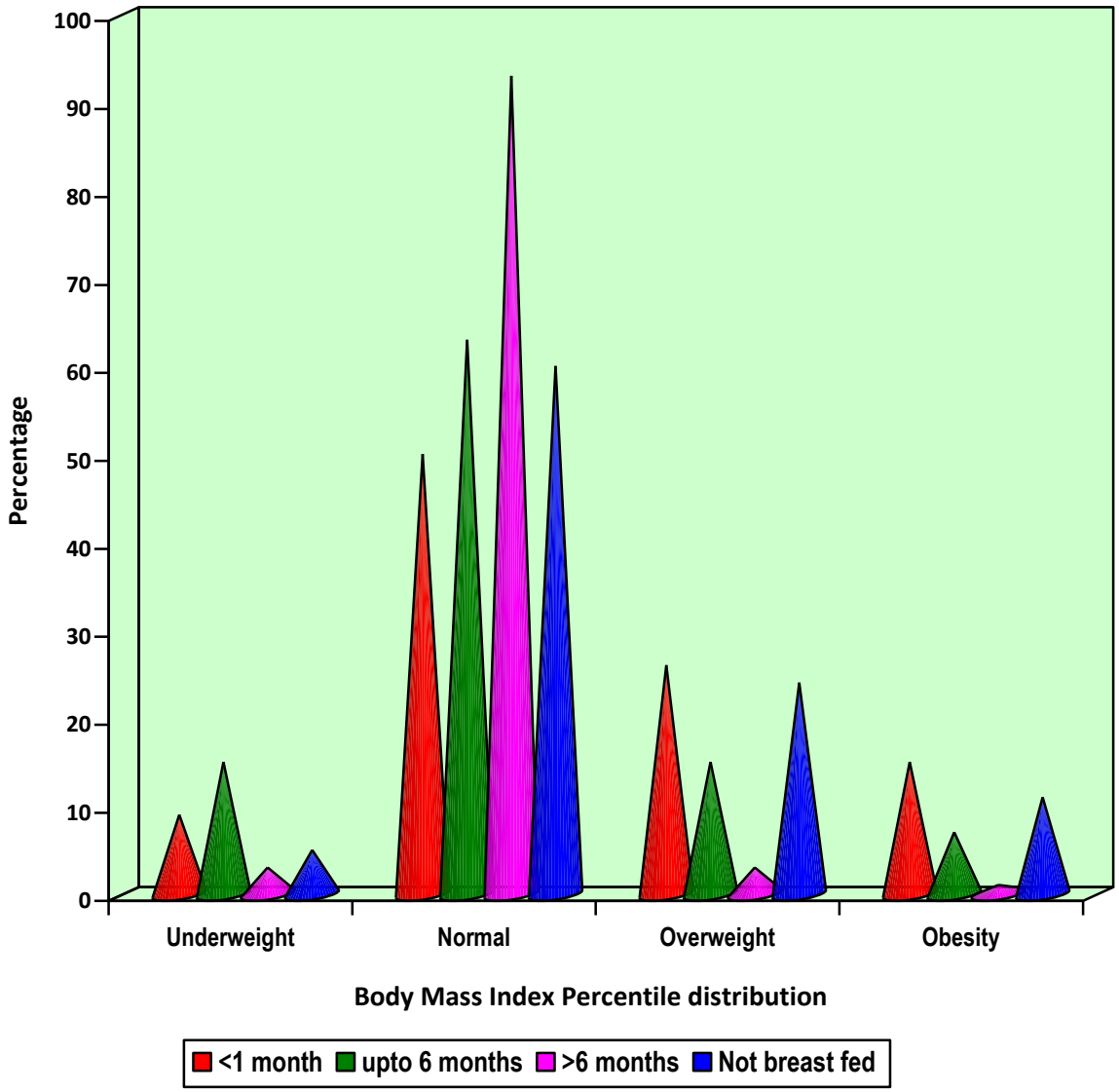
(N = 1800)

Breast feeding	No.	Underweight		Normal		Overweight		Obesity		r values
		N	%	N	%	N	%	N	%	vs. BMI
< 1 month	476	45	9	237	50	123	26	71	15	r = -1
Up to 6 months	972	150	15	621	65	139	14	62	6	r = -0.4
>6 months	242	9	4	223	92	7	3	3	1	r = -0.9
No breast feeding	110	5	5	66	60	27	24	12	11	

From Table XI it could be comprehended that as the duration of breastfeeding increased the extent of overweight and obesity decreased. Children who were breastfed for less than one month and those who were not breast fed at all had greater percentage of overweight (26% and 24% respectively) and obesity (15% and 11% respectively). Among children who were breastfed for six months, only 20 per cent overweight and obesity were observed while those who were breastfed for more than six months, along

with supplementary feeding were least overweight (4%). Statistical analysis of the duration of breast feeding with Body Mass Index brought out a negative correlation. As the duration of breast feeding decreased, it was found that Body Mass Index increased in children.

It was also observed that 10 per cent each of Matriculation and Corporation school children as well as 43 per cent of Panchayat school



DISTRIBUTION OF CHILDREN ACCORDING TO DURATION OF BREAST FEEDING AND BODY MASS INDEX

FIGURE 5

children were exclusively breastfed for six months (not represented in the Table). None of these children were found to have overweight or obesity.

A meta-analysis reported significant protective effects of breastfeeding against overweight in later life, due to the properties of human milk. A possible mechanism for a protective effect of breastfeeding has been found in human milk compared with early formula feeding with respect to later overweight (Beyerlein and Kries , 2011 and Weyermann et al., 2006).

Harder et al. (2005) analyze that for each additional month of breastfeeding, the risk of overweight in children would be reduced by 4 per cent.

4. Time of introduction of weaning foods

Among Matriculation and Corporation school children weaning foods were introduced between four and six months of age (48% and 40 % respectively). Early withdrawal of breastfeeding was observed among urban school children. Among Panchayat school children, only 22 per cent were weaned between four and six months of age, while breastfeeding was continued for more than six months for the rest of the children.

Breastfed infants were introduced weaning foods between 4 and 6 months. This is supported by Norris et al. (2002) who found that breast fed children were weaned later (11.9 ± 4.9 weeks) when compared to formula fed infants (10.2 ± 0.47 weeks).

When the difference between the time of introduction of weaning foods was analyzed between urban and rural children, it was found that urban children were introduced weaning foods at an earlier age (1 month onwards)

compared to rural children (4 months onwards). This difference was statistically significant (Z = 1.99) at 90 per cent confidence level.

Guldan et al. (2011) point out that appropriate weaning practices are associated with better growth pattern among infants. They associated the nutrition knowledge of mothers as major determinants in the choice of weaning foods.

D. FAMILIAL INFLUENCE

Table XII depicts the prevalence of health problems among the family members of the selected children in urban and rural areas.

TABLE XII

PREVALENCE OF HEALTH PROBLEMS AMONG THE FAMILY MEMBERS OF THE SELECTED CHILDREN

(N = 6190)

Type of disease	Matriculation N = 2180		Corporation N = 2122		Panchayat N = 1888	
	N	%	N	%	N	%
Diabetes						
Father	50	2	31	1	17	1
Mother	36	2	27	1	19	1
Uncle/Aunt	39	2	34	1	26	1
Grand parents	546	25	267	13	160	9
Total	671	31	359	17	222	12
Cardio-vascular diseases						
Father	234	11	212	10	134	7
Mother	124	6	126	6	91	5
Uncle/Aunt	134	6	173	8	121	6
Grand parents	878	40	803	38	545	29
Total	1370	63	1314	62	891	47
Cancer						
Father	11	1	11	1	7	0.4
Mother	4	0.18	7	1	6	0.3
Uncle/Aunt	7	0.32	13	1	9	0.5
Grand parents	79	4	101	5	106	6
Total	101	6	132	8	128	7
Osteoporosis						
Father	101	5	98	5	70	4
Mother	93	4	89	4	70	4
Uncle/Aunt	85	4	104	5	75	4
Grand parents	1844	85	1610	76	969	51

Total	2123	98	1901	90	1184	63

From Table XII it can be seen that 25, 13 and nine per cent of grandparents of Matriculation, Corporation and Panchayat school children had diabetes mellitus, while the incidence was 40, 38 and 29 per cent for cardiovascular diseases. There was a significant difference between urban and rural areas with respect to prevalence of diabetes mellitus. The difference was significant at 90 per cent confidence level (Z = 1.12) but in the case of cardio vascular diseases, no difference in prevalence was observed between the areas (Z = 4.23).

The incidence of cancer among parents was however very less. No significant difference was found between the urban and rural prevalence in the case of cancer.

The prevalence of osteoporosis was more (85%, 76% and 51% respectively) among the grandparents of all the three school children. However, the difference between urban and rural areas was significant with rural grandparents having relatively lesser prevalence compared to urban grandparents. The difference was found to be statistically significant at 100 per cent confidence (Z=0.58) level.

The incidence of all diseases among parents, uncle and aunt followed a similar trend in both urban and rural areas. This revealed that the risk factors for diseases, especially lifestyle changes are similar in both rural and urban areas as endorsed by Singh (2010).

The low prevalence of the non-communicable diseases among parents, uncle and aunts compared to grandparents may be due to age factor. Higher the age, greater was the incidence of diseases.

PHASE II: ASSESSMENT OF NUTRITIONAL STATUS OF CHILDREN IN TERMS OF ANTHROPOMETRY, CLINICAL EXAMINATION, BIO CHEMICAL PARAMETERS AND FOOD AND NUTRIENT INTAKE

A. Anthropometric measurements of the selected children

B. Deficiency diseases prevalent among the selected children

C. Biochemical profile of the selected sub sample

D. Prevalence of lifestyle disorders among the selected children

E. Food and nutrient intake of the selected children

A. ANTHROPOMETRIC MEASUREMENTS OF THE SELECTED CHILDREN

1. Mean height of boys

Tables XIII and Figure 6 show the age-wise mean height of the selected boys in comparison with the Indian Council of Medical Research (2010), India and Centers for Disease Control and Prevention, (2010) U.S.A. values for the respective ages. The individual values of height for all the 3098 boys are given in Appendix VII.

TABLE XIII

MEAN HEIGHT OF BOYS SELECTED FROM THE THREE TYPES OF SCHOOLS

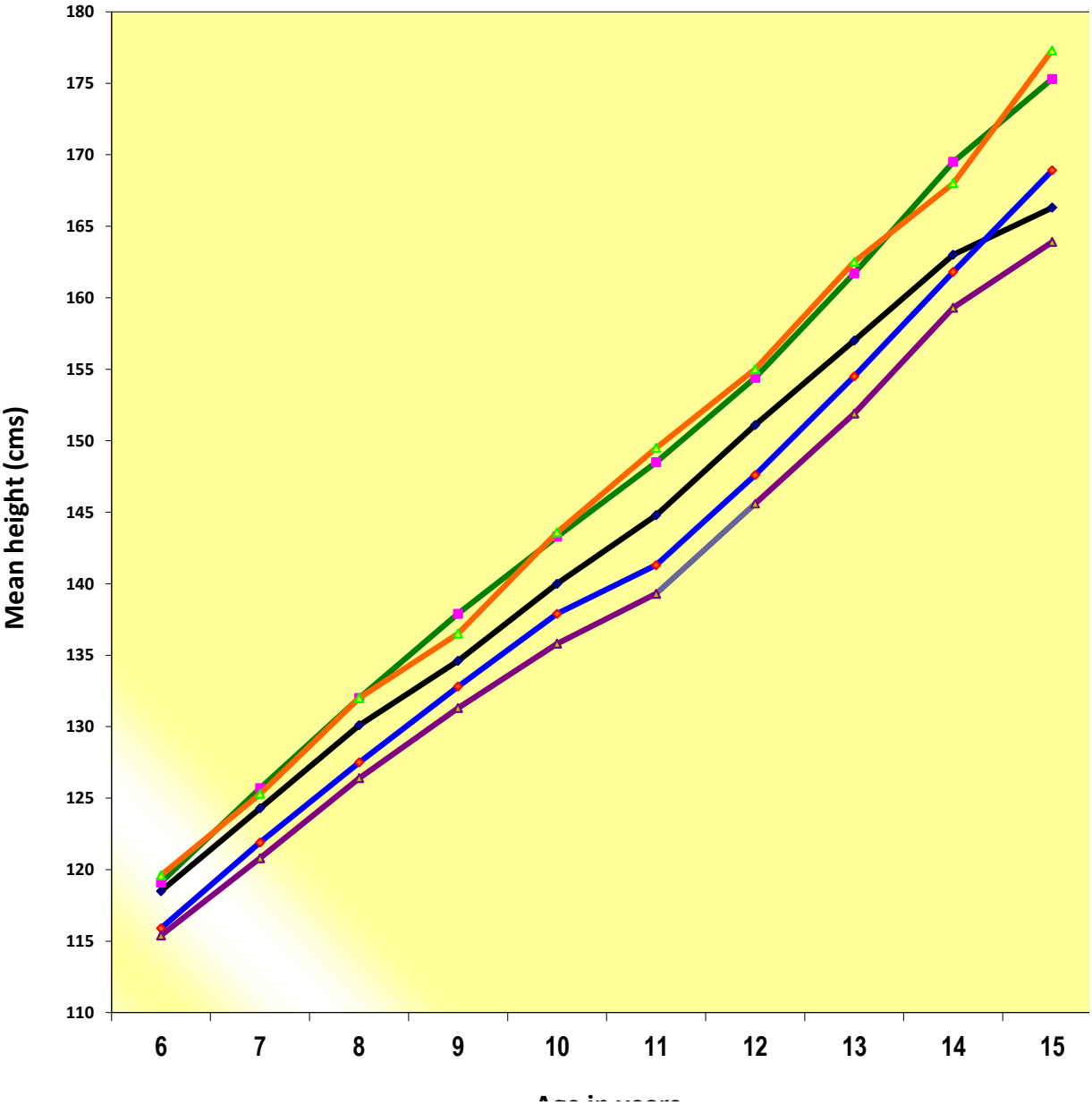
(N = 3098)

Age (years)	ICMR standard#	CDC standard*	Mean height (cm.) ± SD			ANOVA	
			Matriculation	Corporation	Panchayat	F	P
6	118.5	119.1	119.6±2.7	115.9±3.1	115.4±3.3	15.8	<0.0001
7	124.3	125.7	125.3±2.9	121.9±3.1	120.8±2.8	271.2	<0.0001
8	130.1	132.0	132.0±3.5	127.5±2.8	126.4±3.4	25.3	<0.0001
9	134.6	137.9	136.5±3.2	132.8±3.6	131.3±2.4	603.3	<0.0001
10	140.0	143.3	143.6±3.7	137.9±3.9	135.8±2.8	564.4	<0.0001
11	144.8	148.5	149.5±4.2	141.3±3.4	139.3±3.4	563.7	<0.0001
12	151.1	154.4	155.0±2.1	147.6±3.1	145.6±3.5	487.8	<0.0001
13	157.0	161.7	162.5±3.8	154.5±2.4	151.9±2.3	132.9	<0.0001
14	163.0	169.5	168.0±3.4	161.8±2.8	159.3±3.2	569.8	<0.0001
15	166.3	175.3	177.3±2.5	168.9±3.0	163.9±3.4	498.2	<0.0001

95th percentile values of Indian Council of Medical Research (ICMR, 2010)

*75th percentile values of Center for Disease Control and Prevention (CDC, 2010)

From Table XIII it could be observed that the mean heights of the Matriculation school boys at all age groups were greater than the Corporation and Panchayat school boys. The mean heights of the Matriculation school boys



MEAN HEIGHT OF BOYS SELECTED FROM THE THREE TYPES OF SCHOOLS COMPARED WITH THE STANDARD VALUES

FIGURE 6

in the present study were higher than that of the Indian standard values (95th percentile values) published by ICMR (2010). ICMR has indicated that all values of children greater than the 95th percentile values indicate overweight or obesity.

The mean heights of the Matriculation school boys were comparable to the 75th percentile values published by the CDC (2010) for U.S. children. According to CDC (2010), values from the 85th percentile indicate overweight and 95th percentile indicate obesity. Hence values in the 75th percentile were considered for comparison.

Thus the mean heights of boys from Matriculation school represented higher values than that of ICMR (2010) standard values. An increased growth spurt among Indian children comparable to U.S. children was observed. This may be due to environmental factors to which these high income children were exposed to, which are similar to that of Western lifestyles. Thus a secular trend with increasing heights was noticed among the children.

Marwaha et al. (2006) found in Delhi, India, that children from upper socio economic status were taller and heavier than their counterparts were 15 years ago. However, a difference existed between the children from upper and lower socio economic status.

The mean heights of Corporation and Panchayat school children were lesser than both ICMR and CDC values. However, a comparison between the heights of urban and rural children revealed that urban Matriculation and Corporation school children showed better values for mean height compared to their rural counterparts in all age categories. However, a comparison between the urban Matriculation and Corporation school children showed higher values for Matriculation school children. In the same urban environment, the impact of socio-economic status was evident from these results.

Analysis of variance revealed that there was a significant difference in the heights of the children from the three schools in comparison with the reference values. Comparison between the mean heights of children from the three types of schools also brought out a significant difference.

The reasons for better mean height among Matriculation school boys could be attributed to better quantity and quality of foods that were provided during the growth spurt due to better socio-economic conditions of these families. Availability of conducive environmental conditions, small family size, better nutritional value of diet (particularly protein and calcium), housing, personal hygiene, health habits and medical care facility were the factors observed. These views are endorsed by Freedman et al. (2000) in their Bogalusa Heart study conducted among U.S. children and by Zhao et al. (2010) among European American children.

Growth spurt began earlier in Matriculation school boys, with mean age of 13±1.5 years while in Corporation and Panchayat school children, there was a delayed growth spurt with mean age of 14±1.8 years. Earlier onset of growth spurt could be due to better nutritional status, right from birth of Matriculation school children compared to the other two schools.

In the present study the deficit of height in Corporation and Panchayat school children could be due to inadequate food consumption and frequent infections and illnesses because of unhygienic environmental conditions of these children which might have hindered proper utilization of nutrients.

The height for age of children is used as an indicator for the prevalence of under nutrition, i.e., 'stunting' according to Borooah (2005). Stunting is a cumulative indicator of nutritional deprivation from birth (or rather, conception) onwards. It is relatively independent of immediate circumstances, since height does not change much in the short term (Deaton and Dreeze, 2009).

2. Mean height of girls

Tables XIV and Figure 7 show the age-wise mean height of the selected girls in comparison with values published by ICMR (2010) for Indian girls and Centers for Disease Control and Prevention (CDC) (2010) for U.S. girls. The individual values of height for all the 3092 girls are given in Appendix VII.

TABLE XIV

MEAN HEIGHT OF GIRLS SELECTED FROM THE THREE TYPES OF SCHOOLS

(N = 3092)

Age (years)	ICMR value#	CDC value*	Mean height (cm.) ± SD			ANOVA	
			Matriculation	Corporation	Panchayat	F	P
6	117.5	118.6	117.0± 2.5	114.9± 4.0	113.6± 2.6	314.4	<0.0001
7	123.6	125.6	123.5± 3.0	120.9± 3.3	118.5± 3.4	379.8	<0.0001
8	129.2	131.8	128.3± 3.2	127.2±3.9	124.4± 3.3	403.1	<0.0001
9	135.0	137.4	135.7± 2.7	132.8± 3.7	130.4± 3.2	379.0	<0.0001
10	140.0	142.8	141.6± 2.5	138.1±2.9	136.4± 3.4	284.4	<0.0001
11	145.3	149.2	145.4± 2.2	143.6± 2.9	140.5± 3.6	460.0	<0.0001
12	150.2	156.4	151.9± 2.3	149.6± 2.2	146.2± 3.4	675.8	<0.0001
13	153.8	162.0	158.9± 3.0	155.6± 2.6	148.4± 2.8	181.6	<0.0001
14	157.0	164.9	161.3± 3.4	158.9± 2.9	153.3± 2.6	8.7	<0.0002
15	158.8	166.3	162.5± 3.4	161.3±3.4	158.2± 3.1	375.0	<0.0001

95th per centile of ICMR (2010)

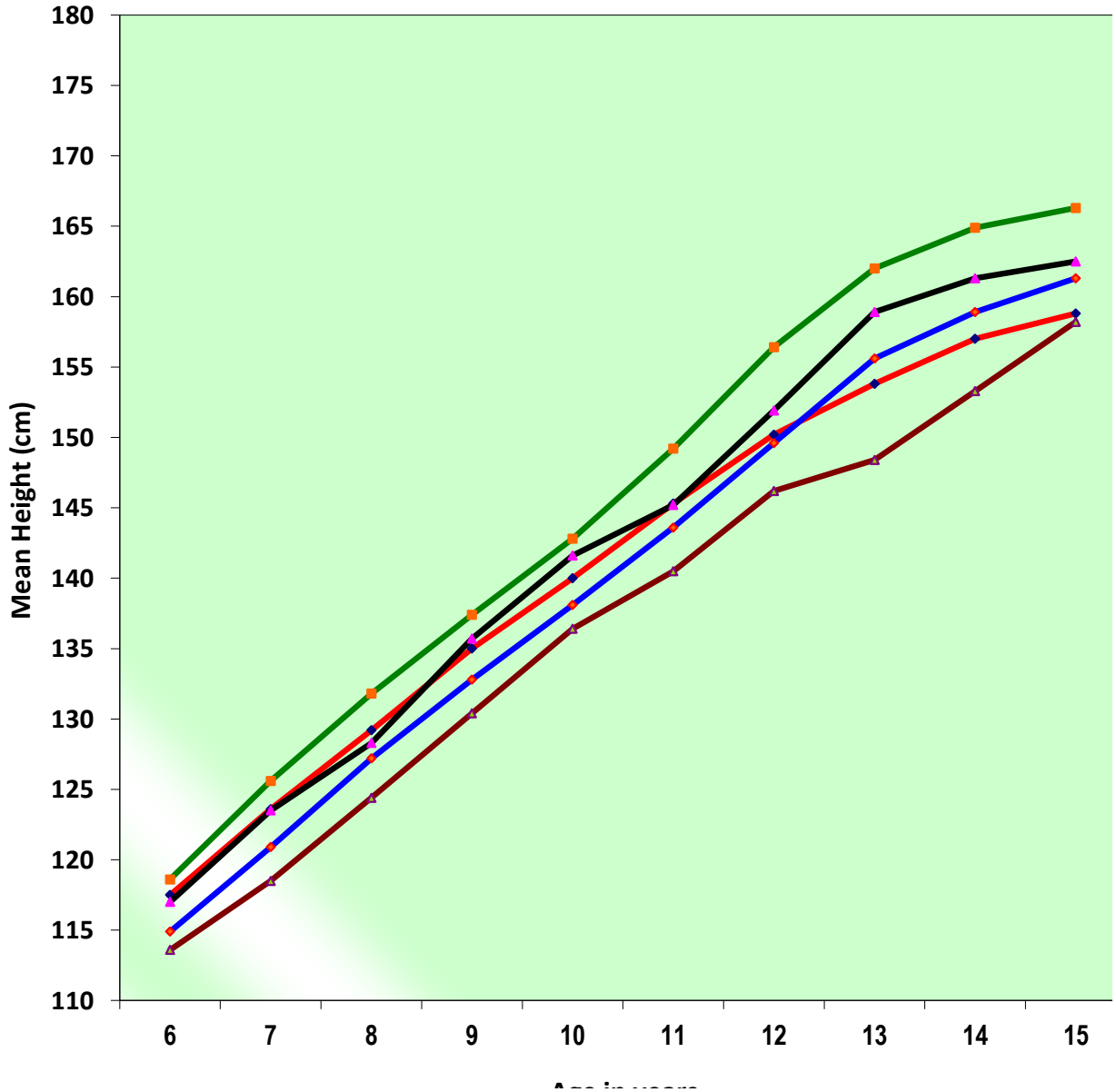
*75th percentile of CDC (2010)

From Table XIV it is evident that the mean height of Matriculation school girls was comparable with that of ICMR values. It was found out that Matriculation school girls showed lower mean height up to the age of eight years, beyond which the values were higher than the ICMR values. After the age of 12 in case of Matriculation school girls, when growth spurt occurred as evidenced by the onset of menarche, the height of the girls in the present study increased incredibly showing a vast difference between the ICMR values and the values in the present study.

However, when compared to CDC values, the mean heights of Matriculation school girls were found to be less in all age groups.

The mean heights of Corporation school children were lesser than both CDC and ICMR values. However, from ages 13 to 15, the values were more than ICMR values, showing a greater increment in height as a result of growth spurt in the girls.

Panchayat school girls had a lesser mean height when compared to the ICMR and CDC values, except at age 15, where the mean height was equivalent to that of ICMR value. Girls were very fussy eaters and did not consume adequate food. Also, girls were involved in less outdoor games after menarche which could be another contributing factor for delayed growth and lesser height increment.



MEAN HEIGHT OF GIRLS SELECTED FROM THE THREE TYPES OF SCHOOLS COMPARED WITH THE STANDARD VALUES

FIGURE 7

A comparison of the three types of schools revealed that Matriculation school girls showed higher mean height compared to Corporation and Panchayat school children. There was also an urban-rural difference with Corporation school girls faring better than the Panchayat school girls. As determined through Analysis of variance, the difference in heights of children from the three schools was found to be significant.

NNMB (National Nutrition Monitoring Bureau) surveys (1976 through 2010) showed that the heights and weights of rural children were lower than 'well-to-do' Indian children or NCHS standards. The well-nourished Indian children had growth spurt around 14 years, similar to that observed in Western children, while among undernourished boys and girls the growth spurt was delayed by about 2 years. The low socio-economic group of rural children was shorter than the 'well-to-do' urban group at all ages.

3. Mean body weight of boys

Table XV and Figure 8 show the mean body weight of selected boys along with the ICMR (2010) and CDC (2010) values for boys. The individual values of weight for all the 3098 boys are given in Appendix VII.

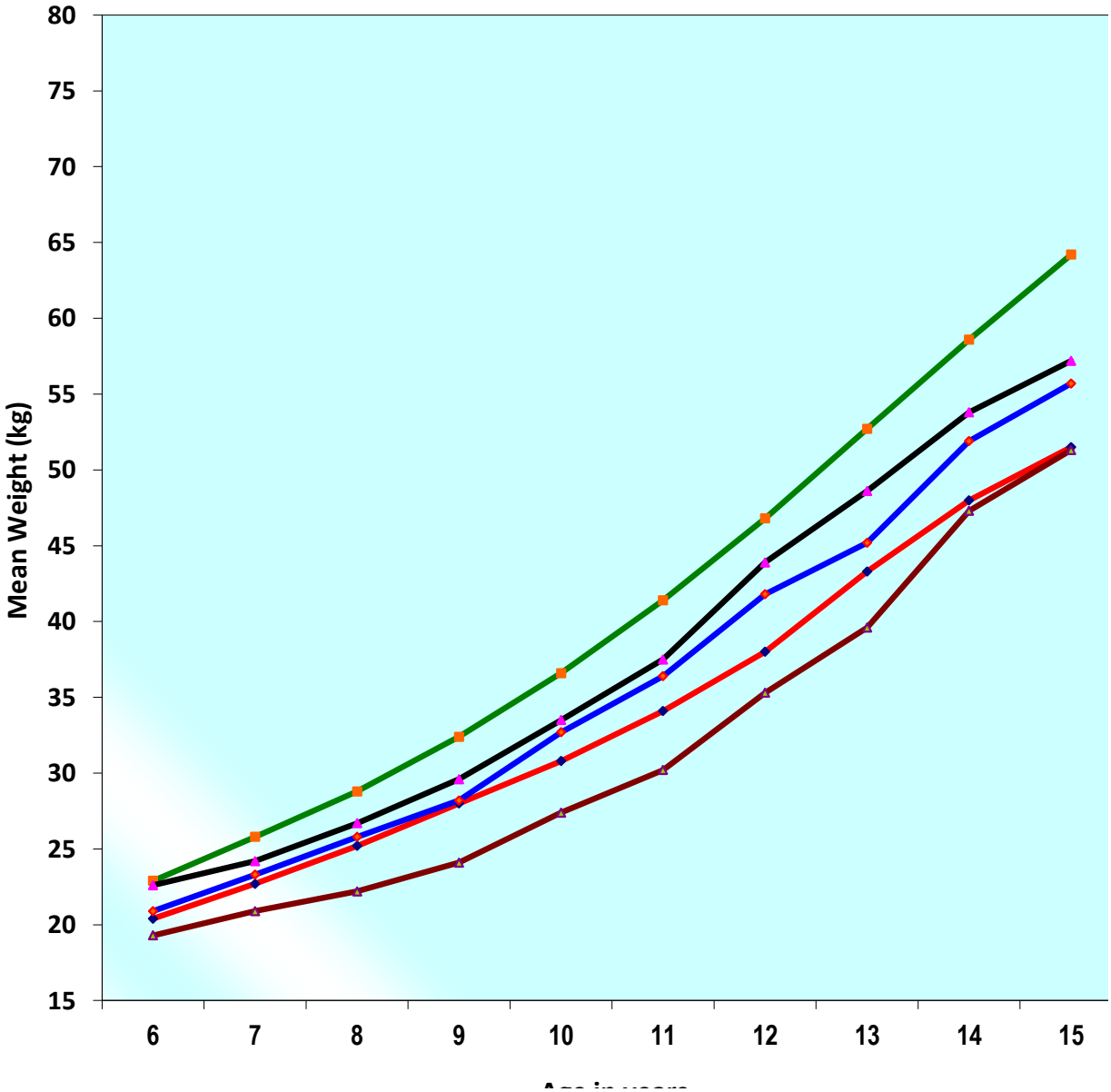
TABLE XV

MEAN BODY WEIGHT OF BOYS SELECTED FROM THE THREE TYPES OF SCHOOLS

(N = 3098)

Age (years)	ICMR value#	CDC value*	Mean Body Weight (kg) ± SD			ANOVA	
			Matriculation	Corporation	Panchayat	F	P
6	20.4	22.9	22.6±5.0	20.9±5.7	19.3±4.9	116.2	<0.0001
7	22.7	25.8	24.2±5.1	23.3±4.9	20.9±4.7	222.8	<0.0001
8	25.2	28.8	26.7±4.9	25.8±5.4	22.2±3.7	604.7	<0.0001
9	28.0	32.4	29.6±5.7	28.2±5.6	24.1±4.4	343.4	<0.0001
10	30.8	36.6	33.5±5.1	32.7±4.5	27.4±4.3	551.8	<0.0001
11	34.1	41.4	37.5±4.8	36.4±6.1	30.2±6.1	330.1	<0.0001
12	38.0	46.8	43.9±5.2	41.8±6.6	35.3±5.8	702.5	<0.0001
13	43.3	52.7	48.6±6.5	45.2±5.6	39.6±6.1	1297.6	<0.0001
14	48.0	58.6	53.8± 6.0	51.9±6.5	47.3± 8.0	137.2	<0.0001
15	51.5	64.2	57.2± 7.3	55.7± 6.9	51.3± 7.4	41.2	<0.0001

95th percentile values of ICMR (2010); *75th percentile values of CDC (2010)



MEAN BODY WEIGHT OF BOYS SELECTED FROM THE THREE TYPES OF SCHOOLS COMPARED WITH THE STANDARD VALUES

FIGURE 8

From Table XV it could be observed that the mean body weights of the Matriculation and Corporation school boys were higher than that of ICMR values at all age groups but lesser than that of CDC values. Panchayat school boys showed mean body weight which was lesser than both ICMR and CDC standards except in the age group of 15 years, during their peak growth spurt when the mean body weight was equivalent to ICMR standards.

Comparing the weights of urban and rural boys, it could be inferred that urban boys had greater body weight than rural children. The urban children had better economic status and consequently consumed a good diet, with high carbohydrate and high fat snacks, had reduced physical activity at home and had vehicle for transport to reach school with no necessity to walk. Energy expenditure was very less. These could be the contributory factors for the increase in mean body weights compared to Corporation and Panchayat school boys. Analysis of variance brought out a significant difference in the mean body weights between the three groups as well as when compared to reference values.

The Panchayat school boys received poor nourishment right from their birth due to their low socio-economic status which led to reduction in weight gain. They spent more time in outdoor games after school hours. They spent more energy by walking to school and consumed less junk foods compared to urban children.

4. Mean body weight of girls

Table XVI and Figure 9 show the mean body weight of selected girls along with the ICMR (2010) and CDC (2010) values of Indian and U.S. girls respectively. The individual values of weight for all the 3092 girls are given in Appendix VII.

TABLE XVI

MEAN BODY WEIGHT OF GIRLS SELECTED FROM THE THREE TYPES OF SCHOOLS

(N = 3092)

Age (years)	ICMR value#	CDC value*	Mean body weight (kg) ± SD			ANOVA	
			Matriculation	Corporation	Panchayat	F	P
6	20.0	22.7	22.4±4.3	20.6±4.0	20.3±4.2	83.1	<0.0001
7	22.3	25.7	24.1±5.2	23.9±4.9	22.9±4.2	112.5	<0.0001
8	25.0	29.2	26.8±4.1	25.9±4.2	25.1±4.0	229.1	<0.0001
9	27.6	33.3	30.6±4.7	29.8±4.4	27.9±4.8	178.2	<0.0001
10	31.2	38.0	34.3±5.1	32.7±5.2	31.1±4.6	501.6	<0.0001
11	34.8	43.2	38.8±5.7	38.3±5.1	35.9±5.5	287.0	<0.0001
12	39.0	48.3	42.9±6.2	42.7±6.7	42.3±6.3	396.0	<0.0001
13	43.4	53.0	48.9±5.4	47.6±5.3	45.3±6.2	197.2	<0.0001
14	47.1	56.8	50.4±6.0	50.1±6.1	48.4±6.9	598.0	<0.0001
15	49.4	59.4	53.6±5.4	52.8±4.4	50.3±4.4	278.8	<0.0001

95th percentile values of ICMR (2010)

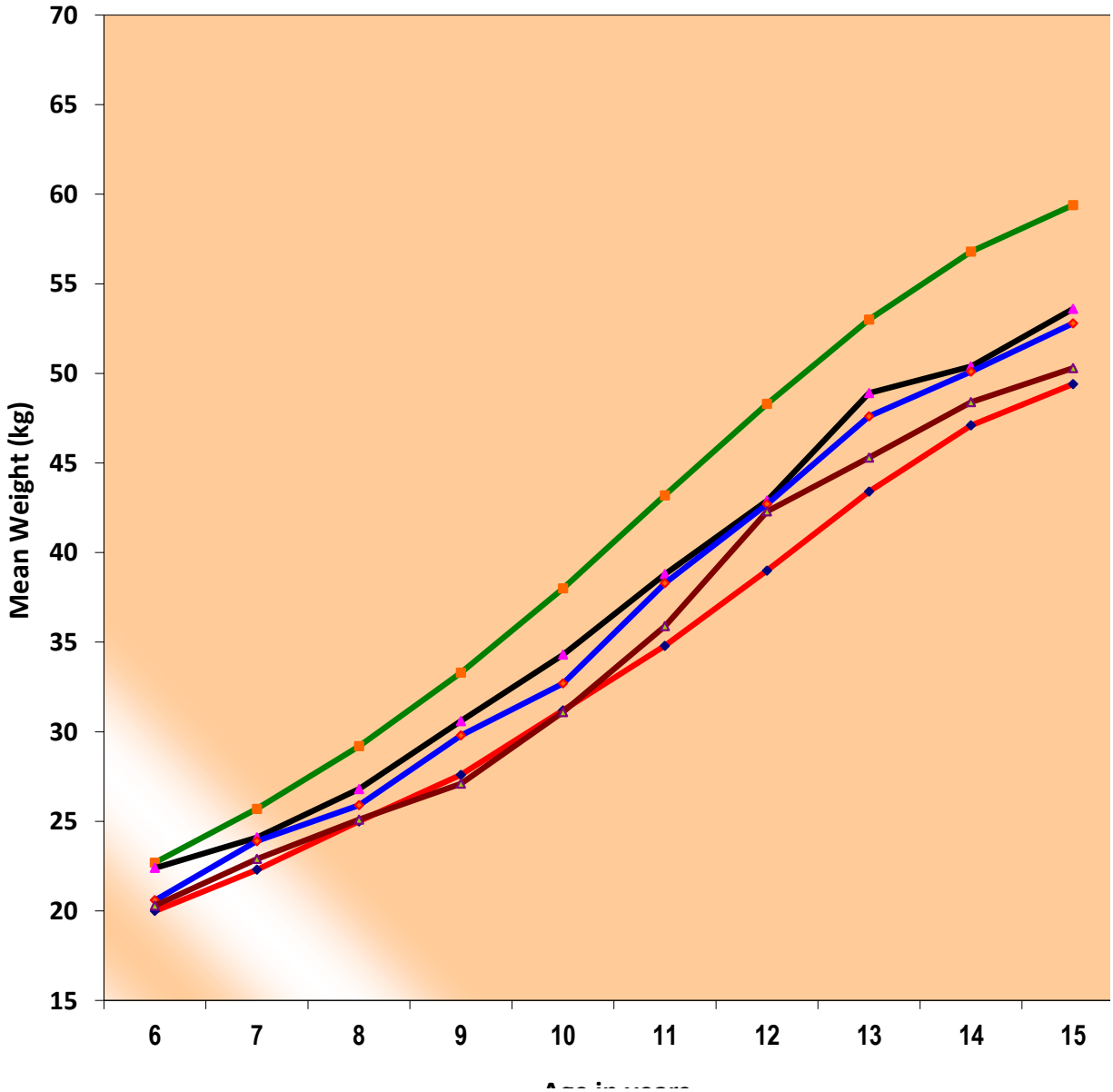
* 75th percentile values of CDC (2010)

Table XVI brings out the mean body weight of the selected girls. It could be observed that the mean body weights of children from all the three types of school were greater than the ICMR values. Overweight and obesity were greater among girls compared to boys according to Indian standards. Contrary to boys, girls from rural schools also recorded higher mean values compared to ICMR values.

Similar to the values of boys, the girls of Matriculation and Corporation schools recorded greater mean body weights showing an inclination towards overweight and obesity.

When compared with Matriculation school girls, the weights of Corporation and Panchayat school girls were lesser. However, an urban-rural divide was observed, similar to boys. Panchayat school girls had lesser mean body weights than their urban counterparts. This is evident from the significant values recorded in Analysis of variance. A significant difference was noticed between the means of the three groups.

Increased intake of junk foods, excess calorie consumption and lack of proper exercise pattern due to restrictions at home were thought to be the contributory factors for excess weight among urban children. It could be



MEAN BODY WEIGHT OF GIRLS SELECTED FROM THE THREE TYPES OF SCHOOLS COMPARED WITH THE STANDARD VALUES

FIGURE 9

noted that as the girls reached their puberty, they gained more weight. Low physical activity and increased food consumption were noticed among these girls. In rural areas, the girls spent more energy in housework.

In his study, Marques-Vidal (2008) demonstrated an upward trend for height and weight among children and adolescents of the Seychelles. For instance, at age 15.5 years, boys/girls were on average 10/13 cm taller and 15/9 kg heavier in 2005–06 than in 1956–57.

In the present study, the upward trends in height and weight among boys and girls in urban area were comparable in magnitude to those found in the studies from other countries, i.e. the USA (Freedman et al. 2000), Australia (Loesch et al. 2000), Brazil (Marmo et al. 2004) and Turkey (Simsek et al. 2005).

UNICEF (2006) proposed that general under-nutrition, characterized by under-weight among children was more prevalent among rural children and among children with illiterate mothers. In the present study also underweight was prevalent more among rural Panchayat school children than among children from urban schools.

5. Mean waist circumference of boys

Tables XVII and Figure 10 show the mean waist circumference of the selected boys along with PEACH study and NHANES (2003 -2006) values. The individual values of waist circumference of all the 3098 boys have been given in Appendix VII

TABLE XVII

MEAN WAIST CIRCUMFERENCE OF BOYS SELECTED FROM THE THREE TYPES OF SCHOOLS

(N = 3098)

Age (years)	PEACH study*	NHANES**	Mean waist circumference (cm.) ± SD			ANOVA	
			Matriculation	Corporation	Panchayat	F	P
6	56.5	59.4	55.25±4.25	53.63±4.80	52.58±4.65	49.0	<0.0001
7	58.6	61.9	57.10±5.02	56.57±5.14	53.11±5.40	198.4	<0.0001
8	60.8	67.3	60.01±4.75	58.68±5.46	53.97±6.16	226.1	<0.0001
9	63.1	68.8	62.73±4.86	62.13±5.06	56.54±6.59	185.4	<0.0001
10	65.6	76.3	65.04±4.45	63.72±5.66	59.17±6.49	185.4	<0.0001
11	68.1	83.1	68.15±4.71	66.98±6.14	61.56±6.66	175.2	<0.0001
12	70.7	82.5	71.57±5.59	69.59±7.20	63.64±7.90	54.9	<0.0001
13	73.4	84.2	72.42±7.06	70.71±7.67	66.63±7.15	132.3	<0.0001
14	76.1	82.9	75.69±7.19	72.90±7.79	69.30±7.93	92.2	<0.0001
15	78.7	86.9	78.17±6.48	75.67±7.74	71.31±8.58	61.3	<0.0001

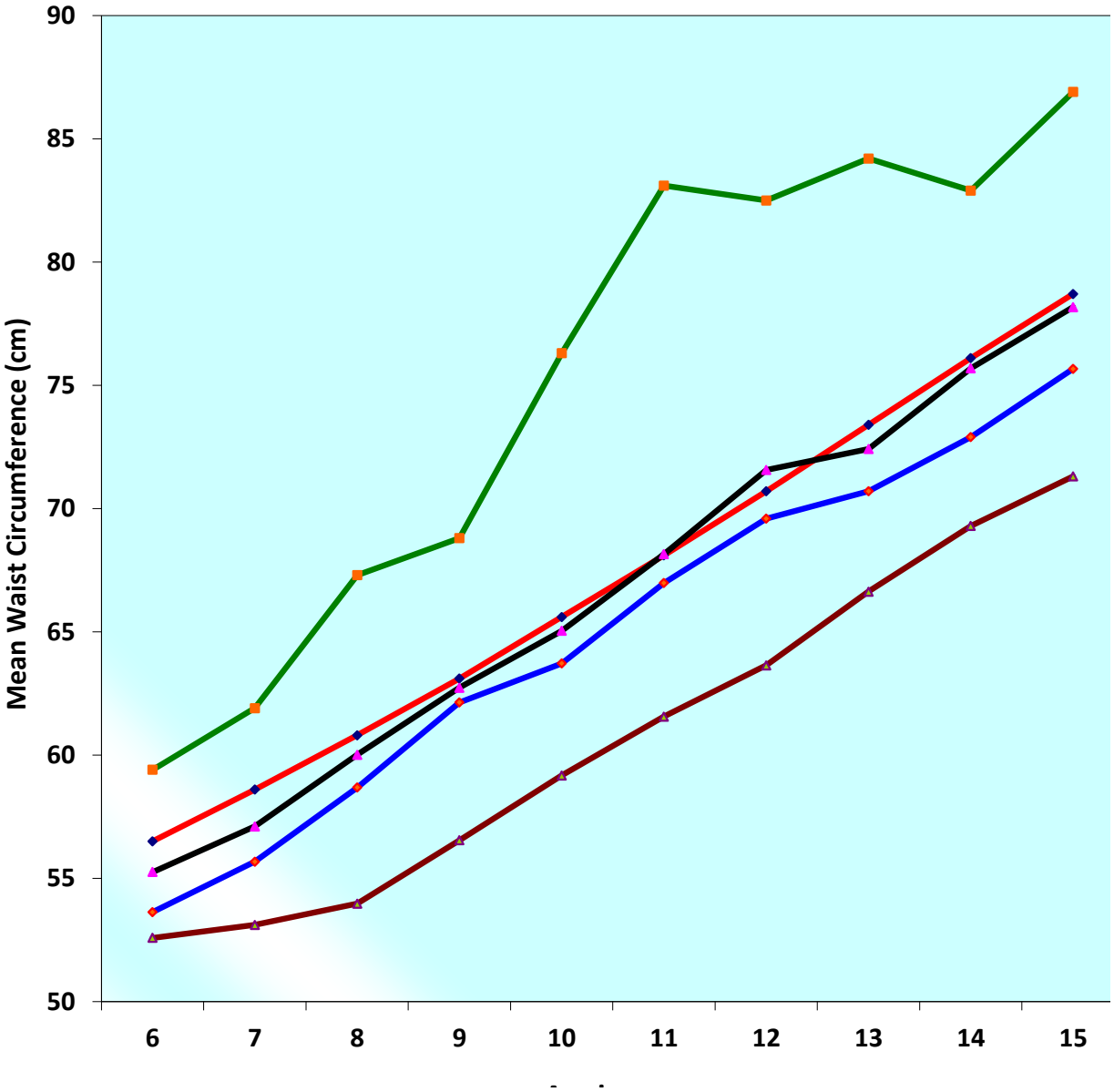
* 75th percentile values of Pediatric Epidemiology and Child Health study (PEACH) conducted by St. John's Research Institute, Bangalore (2011)

**75th percentile values of NHANES, U.S. study (2003-2006)

From Table XVII it could be inferred that the mean waist circumference values of boys from Matriculation schools were found to be lesser than NHANES data. Compared to the PEACH study values, the waist circumference was lesser except for the age groups of 11 and 12 years. Out of the selected three types of schools, Matriculation school boys had registered the highest values. In case of Corporation and Panchayat school boys, the mean waist circumference was lesser than the two standard values compared in all the age groups.

When the waist circumference values of urban and rural children were compared, it could be deciphered that the waist circumference values of both Matriculation and Corporation school children were found to be higher than that of Panchayat school children, showing an urban-rural divide. The values of the three types of schools were significantly different from one another as evident from the results of analysis of variance among the three schools.

The difference in the waist circumference between urban and rural children could be due to less energy expenditure by urban children in terms of



MEAN WAIST CIRCUMFERENCE OF BOYS SELECTED FROM THE THREE TYPES OF SCHOOLS AND THE STANDARD VALUES

FIGURE 10

lesser physical activity and time spent outdoors, exposure to westernized food habits, increased comfort levels in the form of less walking. Leisure time activities like browsing the Internet and television viewing added the tendency to gain weight at the abdomen.

6. Mean waist circumference of girls

Tables XVIII and Figure 11 show the mean waist circumference values of the selected girls along with PEACH study and NHANES (2003-2006) values. The individual values of waist circumference for all the 3092 girls have been given in Appendix VII.

TABLE XVIII

MEAN WAIST CIRCUMFERENCE OF GIRLS SELECTED FROM THE THREE TYPES OF SCHOOLS

(N=3092)

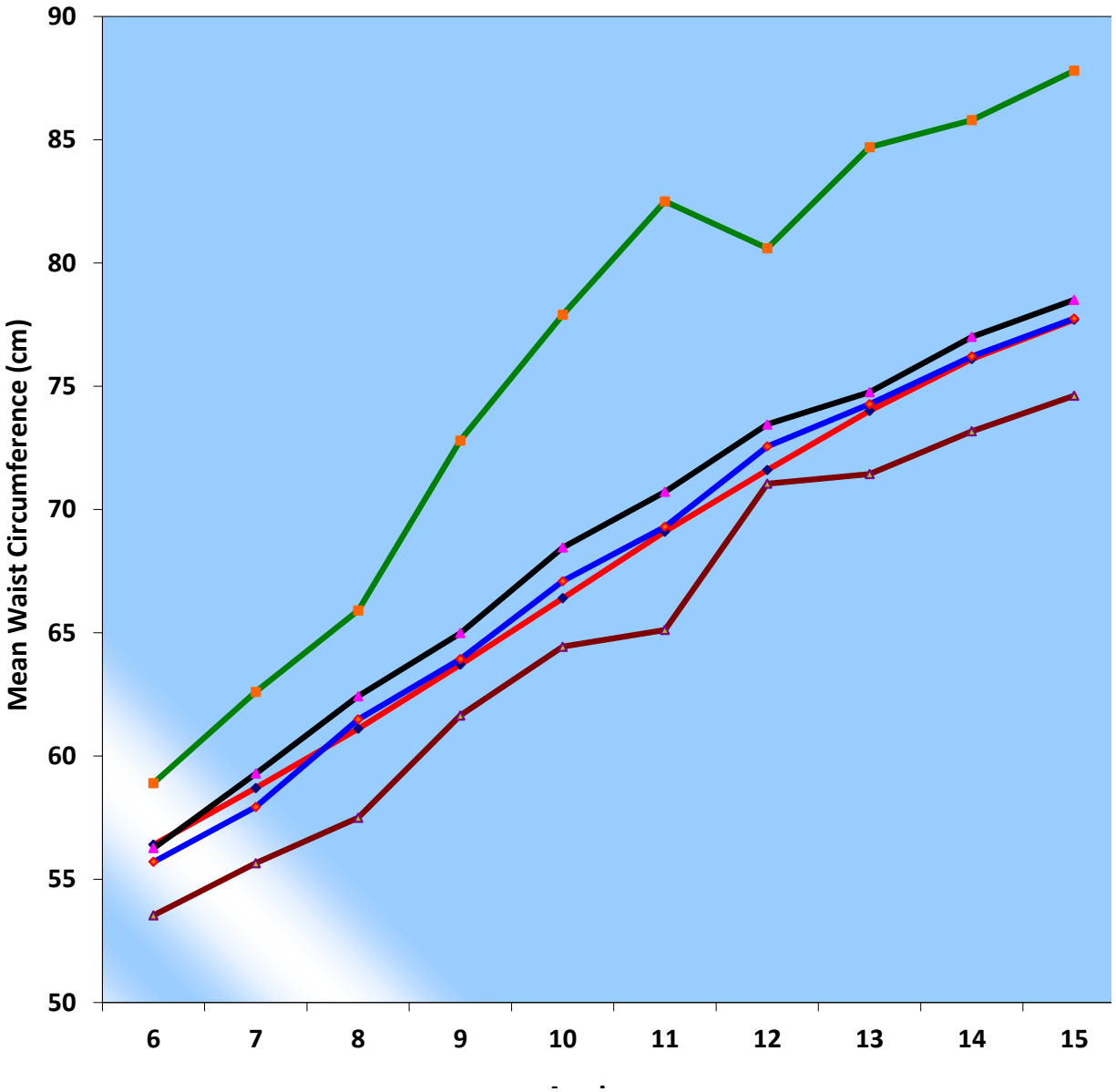
Age (years)	PEACH study*	NHANES**	Waist circumference (cm.) ± SD			ANOVA	
			Matriculation	Corporation	Panchayat	F	P
6	56.4	58.9	56.26 ± 3.48	55.70 ± 3.34	53.53 ± 3.47	200.9	<0.0001
7	58.7	62.6	59.28 ± 3.15	57.93 ± 3.98	55.65 ± 4.11	161.2	<0.0001
8	61.1	65.9	62.42 ± 3.50	61.48 ± 3.18	57.49 ± 4.79	141.4	<0.0001
9	63.7	72.8	64.98 ± 3.80	63.93 ± 4.16	61.64 ± 3.89	108.5	<0.0001
10	66.4	77.9	68.46 ± 3.82	67.09 ± 3.79	64.43 ± 3.78	101.6	<0.0001
11	69.1	82.5	70.71 ± 4.49	69.30 ± 5.00	65.11 ± 4.83	124.5	<0.0001
12	71.6	80.6	73.45 ± 3.10	72.56 ± 3.79	71.04 ± 3.73	35.9	<0.0001
13	74.0	84.7	74.76 ± 4.23	74.27 ± 4.94	71.43 ± 4.83	63.6	<0.0001
14	76.1	85.8	77.00 ± 4.68	76.21 ± 4.86	73.17 ± 4.74	55.7	<0.0001
15	77.7	87.8	78.50 ± 4.33	77.75 ± 4.18	74.62 ± 5.31	7.9	0.0006

*75th percentile values of Pediatric Epidemiology and Child (PEACH) study at St. John's Research Institute, Bangalore, India (2011)

** 75th percentile values of NHANES, U.S. study (2003-2006)

The mean waist circumference of both Matriculation and Corporation school girls was lower than that of the NHANES data but higher than that of PEACH study, India, except in the age groups of six in Matriculation school and six and seven in Corporation school girls. However, the mean waist circumferences of Panchayat school children were less than that of both the NHANES data and the PEACH study.

A comparison of the mean waist circumference between urban and rural girls showed greater values for urban girls. The difference in the mean waist circumference of girls from the three schools was significantly different



MEAN WAIST CIRCUMFERENCE OF GIRLS SELECTED FROM THE THREE TYPES OF SCHOOLS AND THE STANDARD VALUES

FIGURE 11

from each other as revealed through analysis of variance. This difference could be attributed to greater energy expenditure by the rural girls in terms of domestic work at home compared to urban girls. Rural children walked to their schools, while it was not so among urban girls. Urban girls were engaged in activities involving lesser physical exertion like playing indoor games and television viewing, while the leisure time activities of Panchayat school children was more vigorous like skipping, running and outdoor activities. Although the rural girls also watched television, the duration was limited.

Similar results have been demonstrated in the study by Kurian et al. (2011) on school children in the urban city of Bangalore, South India. They highlight that urban middle class children in India already demonstrated leaning towards the adult South Asian phenotype that has features collectively termed "metabolically obese".

7. Mean Body Mass Index of boys

Table XIX and Figure 12 show the mean Body Mass Index of the selected boys along with values of Centers for Disease Control and Prevention (CDC) (2010) and World Health Organization (2007). The individual BMI values of boys have been given in Appendix VIII.

TABLE XIX

MEAN BODY MASS INDEX OF BOYS SELECTED FROM THE THREE TYPES OF SCHOOLS

(N = 3098)

Age (years)	CDC*	WHO#	Matriculation	Corporation	Panchayat	ANOVA	
						F	P
6	16.36	15.5	15.76 ± 2.52	15.17 ± 2.67	14.84 ± 3.20	55.4	<0.0001
7	16.63	15.7	16.37 ± 2.88	15.65 ± 4.06	15.54 ± 4.12	86.4	<0.0001
8	17.06	16.0	16.99 ± 3.54	16.22 ± 3.70	15.93 ± 4.07	73.2	<0.0001
9	17.60	16.4	17.36 ± 3.52	16.98 ± 3.36	16.31 ± 3.82	77.9	<0.0001
10	18.25	16.9	18.22 ± 4.04	17.39 ± 4.02	16.69 ± 4.41	55.2	<0.0001
11	18.95	17.5	18.34 ± 4.30	17.65 ± 4.26	16.95 ± 4.88	72.9	<0.0001
12	19.69	18.2	19.20 ± 4.15	18.58 ± 4.55	17.74 ± 5.16	112.6	<0.0001
13	20.45	18.9	19.59 ± 5.16	19.13 ± 5.15	18.60 ± 5.48	82.9	<0.0001
14	21.21	19.7	20.12 ± 5.66	19.77 ± 5.67	19.30 ± 5.90	121.9	<0.0001
15	21.98	20.4	20.79 ± 5.92	20.21 ± 5.80	19.68 ± 6.10	118.2	<0.0001

*75th percentile values of CDC (2010);

75th percentile values of WHO (2007)

The Centers for Disease Control and Prevention (CDC) has established BMI values for the ages of 2 to 20 years. The 75th percentile values, as indicated for normal children, have been given in Table XIX for comparison. Similarly WHO (2007) values at 75th percentile levels have been given for comparison. Values equal to and greater than 85th percentile are indicated as overweight or obese.

Table XIX brings out the mean BMI values of the selected children. The Body Mass Index values were higher for Matriculation school children, followed by Corporation and Panchayat school children. A higher BMI values depict a higher body weight in comparison to the height for that particular age.

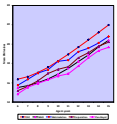
The BMI values of the Matriculation and Corporation school children were similar in all the age groups above nine years while the values of Panchayat school children were lesser than the two urban school values. The difference in BMI values showed an urban rural divide with rural school boys having lesser BMI compared to urban school boys.

The BMI values of all the three types of schools selected were less than that of the CDC values for all age groups. There was a statistically significant difference in the BMI values of boys from the three types of schools compared to CDC values.

Comparison of BMI values of boys with WHO values showed that the values of Matriculation school boys were greater in all age groups. In case of Corporation school children, the values were lower in the ages of six and seven years compared to WHO standards, beyond which the mean BMI of boys from Corporation school was found to be greater than the WHO values. In case of Panchayat school children, all age groups had lesser values compared to WHO values and the values were significantly different.

Compared to U.S. standards (CDC), the BMI values of Indian children were low, while comparison with WHO standards showed greater BMI values for Indian urban boys.

BMI is an indicator of underweight, normal weight, overweight as well as obesity. As children age, their mean BMI values also show an increase. According to CDC (2012), high BMI predicts future morbidity and death.



MEAN BODY MASS INDEX OF THE SELECTED BOYS

FIGURE 12

Therefore, BMI is an appropriate measure for screening for obesity and its health risks.

A comparative study of Dhingra et al. (2010) of school children from Delhi (India) in the age group of six to 14 years with WHO values indicated that both boys and girls were overweight.

8. Mean Body Mass Index of girls

Table XX and Figure 13 depict the mean Body Mass Index in the selected girls along with reference values of the CDC (2010) and WHO (2007). The individual BMI values of girls are given in Appendix VIII.

TABLE XX

MEAN BODY MASS INDEX OF GIRLS SELECTED FROM THE THREE TYPES OF SCHOOLS

(N = 3092)

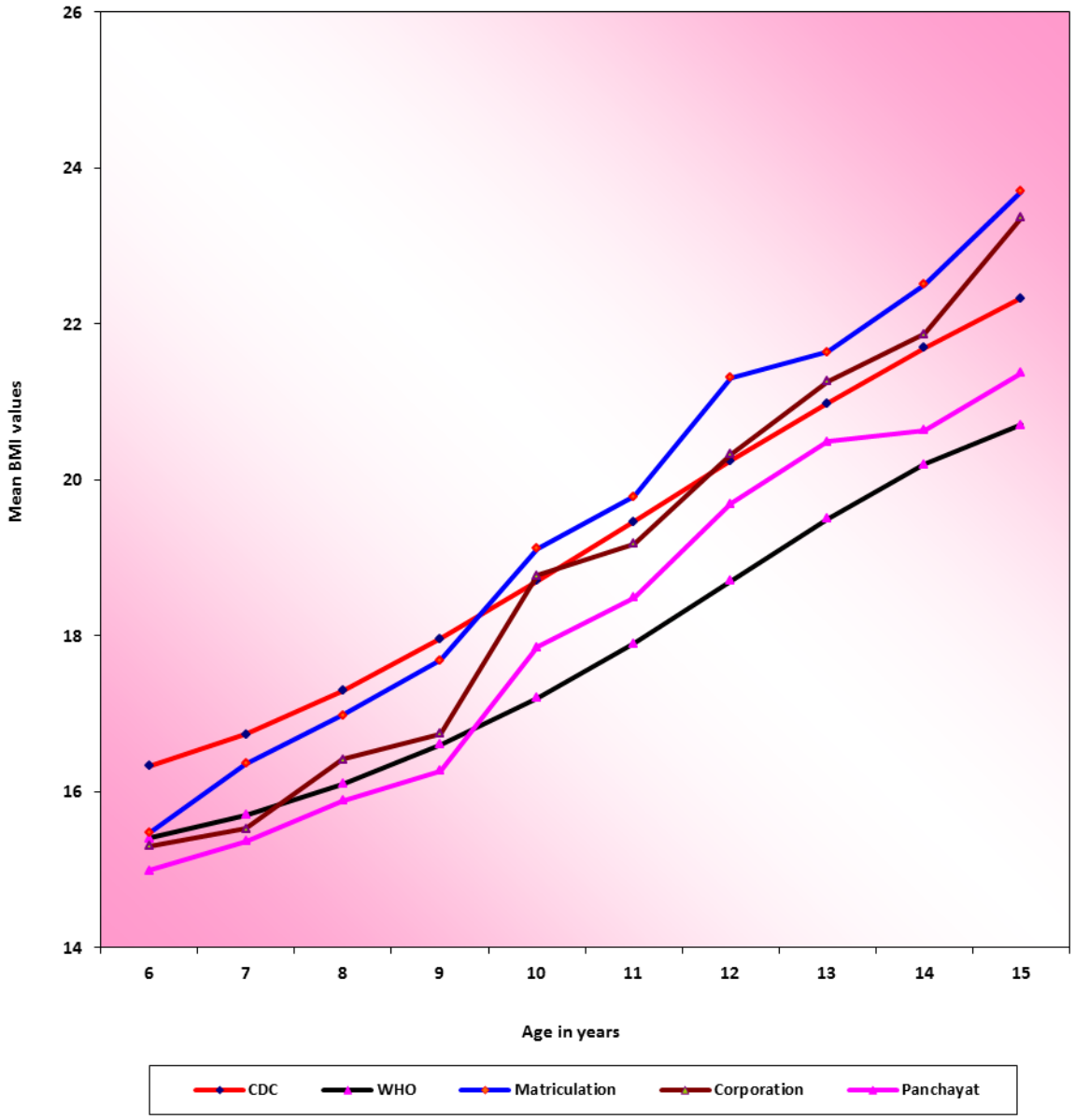
Age (years)	CDC values*	WHO values#	Matriculation	Corporation	Panchayat	ANOVA	
						F	P
6	16.33	15.4	15.47 ± 2.39	15.30 ± 3.48	14.99 ± 3.54	102.1	<0.0001
7	16.73	15.7	16.36 ± 3.06	15.52 ± 3.91	15.36 ± 3.60	118.1	<0.0001
8	17.29	16.1	16.98 ± 3.79	16.41 ± 3.68	15.88 ± 3.77	89.1	<0.0001
9	17.96	16.6	17.68 ± 4.49	16.74 ± 4.31	16.27 ± 4.63	97.3	<0.0001
10	18.70	17.2	19.12 ± 4.09	18.77 ± 4.47	17.85 ± 5.29	99.2	<0.0001
11	19.46	17.9	19.78 ± 4.48	19.18 ± 4.26	18.49 ± 4.53	57.9	<0.0001
12	20.24	18.7	21.31 ± 5.88	20.33 ± 5.65	19.69 ± 6.14	82.6	<0.0001
13	20.98	19.5	21.64 ± 5.83	21.26 ± 1.99	20.49 ± 2.36	119.2	<0.0001
14	21.69	20.2	22.50 ± 5.68	21.87 ± 5.84	20.63 ± 4.83	108.6	<0.0001
15	22.33	20.7	23.70 ± 6.03	23.36 ± 6.03	21.37 ± 5.11	99.1	<0.0001

*75th percentile values of CDC (2010)

#75th percentile values of WHO (2007)

Table XX and Figure 13 show the mean Body Mass Index (BMI) values of the selected girls. As evident from the Table, the mean BMI values of girls were more than that of CDC values from the age of ten in both Matriculation and Corporation schools. The mean BMI values of Panchayat girls were lesser than the CDC values in all age groups.

On comparison with the US (CDC, 2000) values, the 75th percentile of Indian children was very close to the 85th percentile on BMI charts, especially after seven years in boys and nine years in girls contend Khadilkar and



MEAN BODY MASS INDEX OF THE SELECTED GIRLS

FIGURE 13

Khadilkar (2011) in their study conducted on children from the five zones North, South, East, West and Central India.

A similar trend, with increase in BMI values, significantly different from the CDC values (as analyzed through Analysis of variance), was observed beyond nine years in urban girls in the present study.

When WHO values were compared, it was found that the mean BMI values of Matriculation and Corporation school girls were higher in all age groups, except for the ages of six and seven among Corporation school girls. When the mean BMI values of Panchayat school children were compared with WHO values, it was found out that up to the age of nine it was lesser than the reference values, but from 10 year onwards, the mean BMI values of Panchayat school girls were higher compared to WHO values. This shows greater gain in fat mass in the girls in the present study compared to the WHO standard.

Body Mass Index predicts a risk for increased body fat. It could be noted that the BMI of girls was slightly more than the boys from ten years of age. This showed the increase in body fat in girls compared to boys.

Analysis of variance revealed that there was a significant difference between the three groups of children in the Body Mass Indices confirming that urban children had a significantly higher BMI compared to rural children.

9. BMI classification

Table XXI shows the distribution of school children according to their Body Mass Index (BMI) classification with reference values from CDC (2010).

TABLE XXI

DISTRIBUTION OF CHILDREN ACCORDING TO BODY MASS INDEX CLASSIFICATION (CDC)

(N = 6190)

BMI classification* (percentiles)	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	%
Obese(≥ 95)	92	8	82	8	61	6	47	5	25	3	15	2
Overweight(85 to < 95)	183	17	204	19	175	16	163	15	83	9	84	9
Normal(5 – <85)	654	60	634	58	653	61	699	66	640	68	681	72
Underweight(<5)	161	15	170	15	176	17	148	14	195	20	165	17
Total	1090	100	1090	100	1065	100	1057	100	943	100	945	100

*CDC (Centers for Disease Control and Prevention) (2010)

Prevalence of obesity, overweight, underweight and normal weight among the selected school children are well depicted in Table XXI.

Overweight and obesity were more in urban schools compared to rural schools. Percentage prevalence of overweight and obesity among Matriculation school children was 25 and 27 respectively for boys and girls. For Corporation school children, the prevalence was 22 and 20 per cent respectively for boys and girls and for rural Panchayat school children it was 12 and 11 per cent respectively for boys and girls. On an average, obese and overweight children were more in Matriculation and Corporation schools (26% and 21% respectively) compared to rural Panchayat school children which was 11.5 per cent. In urban area, more children were overweight and obese compared to rural area.

Also Matriculation school girls showed a greater tendency towards overweight and obesity than boys while it was reversed in Corporation and Panchayat schools where more boys were found to be overweight and obese compared to girls.

With regard to underweight, the prevalence was more among rural school children compared to children from urban schools. In Panchayat schools in rural area, 20 per cent boys and 17 per cent girls were classified as underweight and severe energy deficiency. Underweight was prevalent among Matriculation school children also (15 %). Ignorance about good food

habits and poor sanitation and hygiene and consequent infections were found to be the reasons for underweight. But underweight prevalence was less among high socio-economic group namely Matriculation school children while in low socio-economic group it was greater.

Biro and Wien (2010) bring out the consequences of childhood and adolescent obesity as earlier puberty and menarche in girls, which was observed in the present study also with obese girls having an average age of menarche at 10 years compared to normal weight children having average age of menarche at 12 years. Other consequences of obesity likely to occur are diabetes mellitus and increased incidence of metabolic syndrome in youth adulthood. These changes were found to be 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 was observed by Wang et al, (2002) in which the girls showed a greater tendency towards leanness compared to boys. This was observed in the present study also with 66 and 72 per cent of girls from Corporation and Panchayat schools belonging to the normal weight category compared to 61 and 68 per cent boys.

10. Mean waist to height ratio of boys

Table XXII and Figure 14 show the mean waist to height ratio of the selected children. British Standard Institute (BSI) (2006) and St. John's Research Institute (PEACH study) (2011), India, have recommended the use of waist to height ratio for children. Hence the values of the present study have been compared with the values suggested by BSI and the PEACH study.

TABLE XXII

MEAN WAIST TO HEIGHT RATIO OF BOYS SELECTED FROM THE THREE TYPES OF SCHOOLS

(N = 3098)

Age	BSI study*	PEACH study#	Matriculation	Corporation	Panchayat	ANOVA	
						F	P
6	0.45	0.50	0.46 ± 0.045	0.45± 0.055	0.42± 0.045	56.8	<0.0001
7	0.44	0.49	0.47 ± 0.053	0.46± 0.056	0.43± 0.043	62.9	<0.0001
8	0.43	0.48	0.46 ± 0.048	0.46± 0.058	0.43± 0.050	55.9	<0.0001
9	0.43	0.48	0.45 ± 0.053	0.44± 0.060	0.42± 0.054	77.2	<0.0001
10	0.43	0.47	0.45 ± 0.050	0.44± 0.062	0.42± 0.056	65.9	<0.0001
11	0.43	0.47	0.44 ± 0.063	0.42± 0.067	0.41± 0.058	72.8	<0.0001
12	0.43	0.46	0.44 ± 0.063	0.43± 0.063	0.41± 0.069	99.2	<0.0001
13	0.42	0.46	0.44 ± 0.063	0.43± 0.062	0.41± 0.072	87.2	<0.0001
14	0.42	0.46	0.44 ± 0.065	0.43± 0.065	0.41± 0.075	85.9	<0.0001
15	0.42	0.47	0.44 ± 0.062	0.43± 0.060	0.41± 0.077	57.9	<0.0001

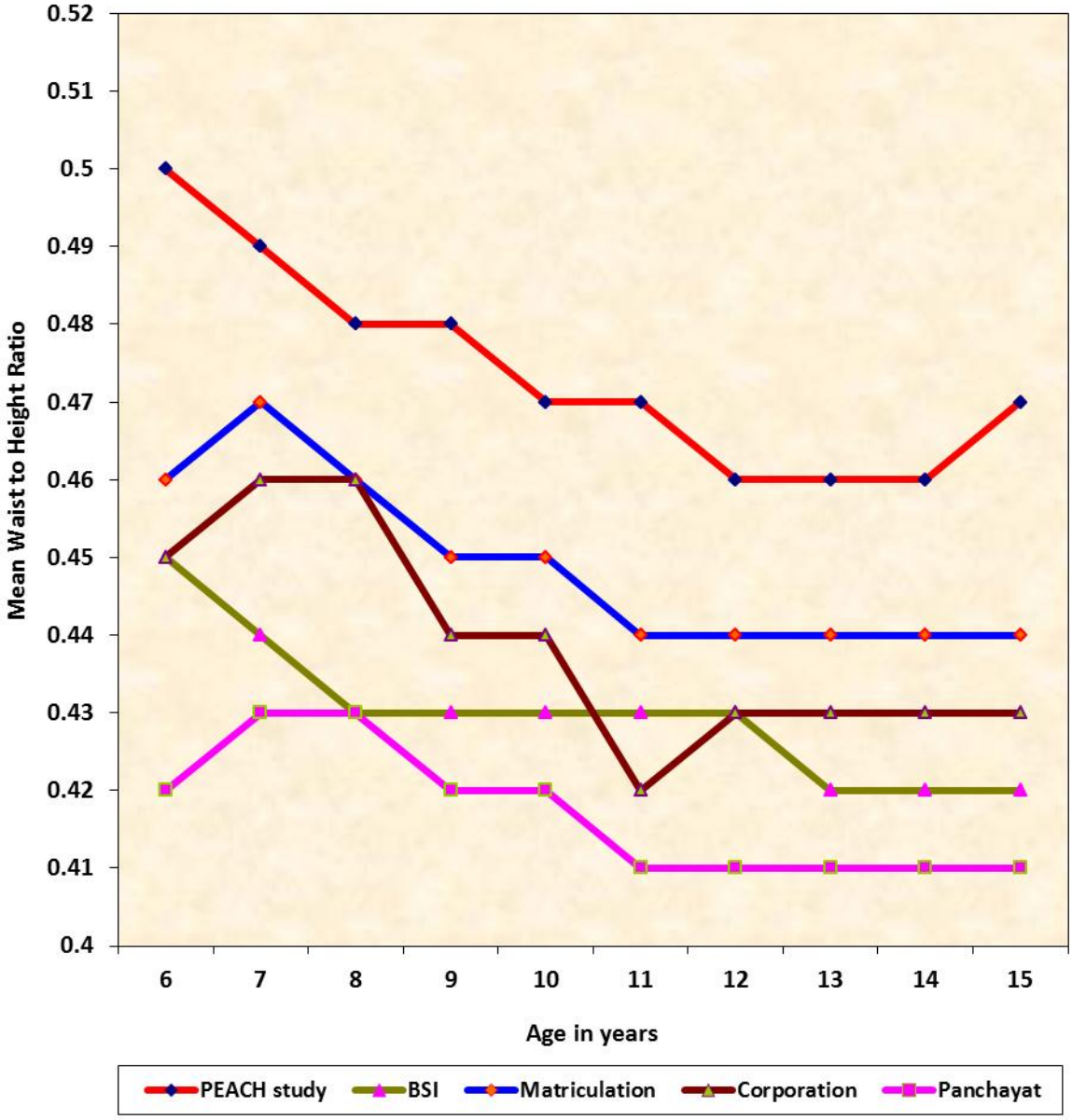
*Mean values of boys from the British Standard Institute (2006);

#50th percentile values of PEACH study, India (2011)

The mean waist to height ratio decreased with increasing age in boys of all the schools. Waist to height ratio is highly dependent on height of the children and hence decreased as children grew taller.

Compared to the values of the British children, the waist to height ratio of children in the present study was found to be greater. There was a significant difference between the means of the waist to height ratio of children from the selected schools compared to that of the British study. This shows that British children are much taller for weight and hence the waist to height ratio is low for them. Children of the present study were found to be shorter and fatter for height compared to British children.

When compared to the PEACH study, it could be observed that the mean waist to height ratio of the children in the present study was low. Bangalore is a metropolitan city and the socio-economic status is very high. Influence of affluence, urbanization and junk food consumption may be more in Bangalore.



MEAN WAIST TO HEIGHT RATIO OF THE SELECTED BOYS

FIGURE 14

11. Mean waist to height ratio of girls

Table XXIII and Figure 15 bring out the waist to height ratio of the girls of the present study in comparison with the values of the British Standard Institute (BSI) (2006) and PEACH study (2011).

TABLE XXIII

MEAN WAIST TO HEIGHT RATIO OF GIRLS SELECTED FROM THE THREE TYPES OF SCHOOLS

(N = 3092)

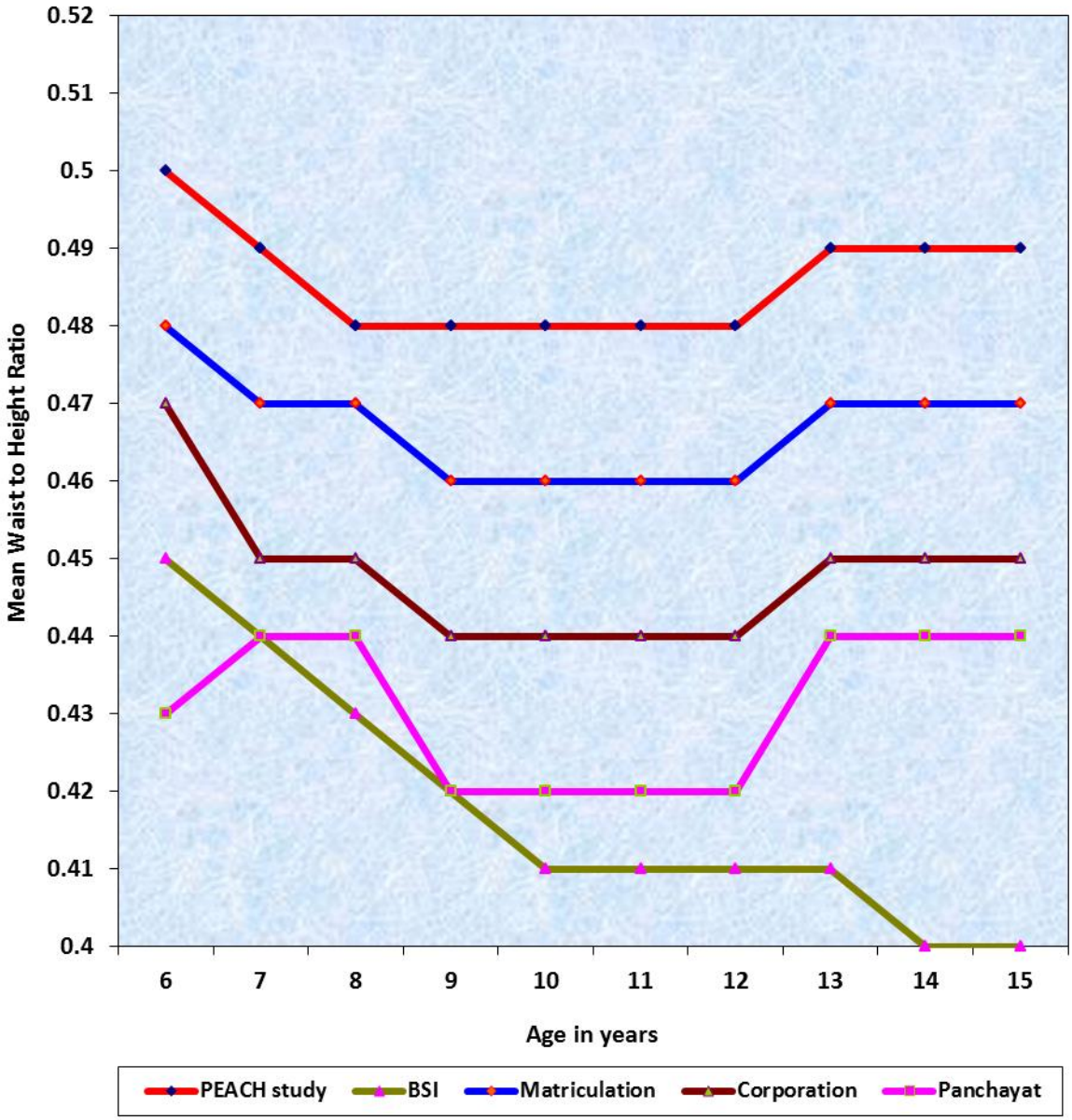
Age (years)	BSI study*	Bangalore study#	Matriculation	Corporation	Panchayat	ANOVA	
						F	P
6	0.45	0.50	0.48 ± 0.042	0.47 ± 0.046	0.43 ± 0.043	56.8	<0.0001
7	0.44	0.49	0.47 ± 0.046	0.45 ± 0.058	0.44 ± 0.045	62.9	<0.0001
8	0.43	0.48	0.47 ± 0.046	0.45 ± 0.059	0.44 ± 0.047	55.9	<0.0001
9	0.42	0.48	0.46 ± 0.048	0.44 ± 0.062	0.42 ± 0.052	77.2	<0.0001
10	0.41	0.48	0.46 ± 0.052	0.44 ± 0.063	0.42 ± 0.054	65.9	<0.0001
11	0.41	0.48	0.46 ± 0.053	0.44 ± 0.066	0.42 ± 0.057	72.8	<0.0001
12	0.41	0.48	0.46 ± 0.054	0.44 ± 0.067	0.42 ± 0.061	99.2	<0.0001
13	0.41	0.49	0.47 ± 0.057	0.45 ± 0.069	0.44 ± 0.063	87.2	<0.0001
14	0.40	0.49	0.47 ± 0.058	0.45 ± 0.070	0.44 ± 0.066	85.9	<0.0001
15	0.40	0.49	0.47 ± 0.058	0.45 ± 0.071	0.44 ± 0.067	57.9	<0.0001

*Mean values of girls from the British Standard Institute (2006);

50th percentile values of PEACH study, India (2011)

The mean waist to height ratio of girls increased between ages six and seven similar to boys and later on decreased. However, at the age of 13 years an increase in the ratio was observed only in girls. This could be due to the plateau in the increment of height and simultaneous increase in body weight in girls at age 13, especially after attaining puberty. Girls from Matriculation schools had registered the highest values followed by Corporation and Panchayat school girls.

Analysis of variance between the means of the three groups of children revealed that there was a significant difference between the groups and also with the reference values. A similar trend as observed for the boys was observed in girls also. Girls from the three types of schools had higher mean waist to height ratio compared to British children while lower mean waist to height ratio compared to children from the PEACH study. These results



MEAN WAIST TO HEIGHT RATIO OF THE SELECTED GIRLS

FIGURE 15

indicate that the girls of the present study were taller than girls from the Bangalore study but had greater fat accumulation compared to girls of British study.

12. Distribution of children according to waist to height ratio

Table XXIV shows the waist to height ratio distribution of the selected children from the three schools.

TABLE XXIV

DISTRIBUTION OF SELECTED CHILDREN ACCORDING TO WAIST TO HEIGHT RATIO CLASSIFICATION (BSI)

(N = 6910)

Waist to Height Ratio*	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	
High	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
≥ 0.50	523	48	598	55	466	44	498	47	235	25	287	30
Normal												
< 0.50	567	52	492	45	599	56	559	53	708	75	658	70

*British Standard Institute (BSI) (2006)

It could be observed from Table XXIV that urban boys and girls had high waist to height ratio when compared with rural children. More girls (55 and 47 % respectively) had high waist to height ratio (WHtR) when compared to boys (48 and 44% respectively) in Matriculation and Corporation schools. A similar observation was made in rural area where more girls (30%) had higher WHtR than boys (25%). Obviously girls were shorter and fatter for height than boys and hence their values were higher.

Rural children showed low waist to height ratio because they were thin for their height compared to urban children.

Urban children had high waist circumference with height remaining stagnant. This was observed more among children in the younger age group of 6 to 10 years who had not yet reached their puberty and whose height was lower compared to standard height for Indian children.

In rural area, based on BMI values combined percentage of overweight and obesity was only 12 and 11 in boys and girls respectively (Tables XIX and XX). However, when waist to height ratio was considered in the same Panchayat school children, the prevalence of overweight and obesity was at an alarmingly high rate of 25 and 30 per cent in boys and girls respectively.

Kurian et al. (2011) have found out that waist to height ratio is superior in its ability to predict cardiovascular disease compared with BMI or percentage body fat determined using waist to height ratio and 75th percentile of waist circumference can be used as an "action point" for Indian children to identify abdominal obesity.

Li et al. (2006) in their study on U.S. children concluded that girls have a higher risk of abdominal obesity than boys when their waist to height ratio was compared. This is in contrast to the study done among Hong Kong Chinese children where waist to height was slightly larger in boys than in girls (Sung et al. 2008). However, the present study follows the trend in U.S. children where more percentage of girls had high waist to height ratio compared to boys.

13. Mid Upper Arm Circumference (MUAC) of the selected children

Table XXV brings out the distribution of the selected children according to the mid upper arm circumference.

TABLE XXV

DISTRIBUTION OF CHILDREN ACCORDING TO MID UPPER ARM CIRCUMFERENCE VALUES

(N = 6190)

Mid Upper Arm Circumference* (cm.)		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	
> 13.5	Normal	N	%	N	%	N	%	N	%	N	%	N	%
		1090	100	1090	100	1047	98	1048	99	896	95	919	97
≥12.5 to ≤13.5	Mild/moderate malnutrition	0	0	0	0	18	2	9	1	47	5	26	3

*Reference values for MUAC – WHO (1996)

All the boys (1090) and all the girls (1090) of the Matriculation schools had normal mid upper arm circumference of greater than 13.5 centimeters. This shows that malnutrition was not prevalent among students of Matriculation schools. In Corporation schools, a total of 18 children had mild/moderate malnutrition as their mid upper arm circumference values were lesser than 13.5 centimeters. In girls the situation was better as only nine of them showed signs of malnutrition. This could be mainly contributed to inadequate intake of food and frequent illnesses.

In Panchayat school, 47 boys (5%) and 26 girls (3%) were at risk for malnutrition considering their mid upper arm circumference. 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 ≥12 years girls had normal mid upper arm circumference (not represented in the Table).

This showed a better trend in nutrition in the urban areas when compared to rural areas. In rural areas, inadequate knowledge on foods to be consumed and low socio-economic status were contributory factors for the prevalence of malnutrition.

The results of the MUAC of children of the present study have also brought out the extreme cases of under nutrition in both urban and rural areas. However, over nutrition is not indicated by this parameter. But from the results of the present study the investigator has developed a cut-off point above which over-nutrition and overweight and obesity can be assessed. This cut-off point was determined as 17.5 for boys and 16.7 for girls.

Roy (2000) points out MUAC as a potential anthropometric indicator of child nutrition.

B. DEFICIENCY DISEASES PREVALENT AMONG THE SELECTED CHILDREN

Table XXVI depicts the deficiency diseases present among the selected children.

TABLE XXVI

DEFICIENCY DISEASES PREVALENT AMONG THE SELECTED CHILDREN

(N = 6190)

Deficiency diseases	Matriculation				Corporation				Panchayat			
	Boys N = 1090		Girls N = 1090		Boys N = 1065		Girls N = 1057		Boys N = 943		Girls N = 945	
	N	%	N	%	N	%	N	%	N	%	N	%
Anaemia	367	34	434	40	503	47	525	50	391	41	428	45
Vitamin A Deficiency	64	6	90	8	61	6	80	8	40	4	60	6
Pellagra	21	2	30	3	96	9	89	8	105	11	97	10

Among the deficiency symptoms, as diagnosed through clinical examination, mild to moderate anaemia was predominant among children from all the three types of schools. The main symptoms presented were brittle nails, pale conjunctiva, fatigue, dizziness, hair loss and gasping.

However, girls and boys from Corporation schools were worst affected with anaemia showing a prevalence of 50 and 47 per cent respectively. The increased risk for anaemia among Corporation school children could be attributed to low consumption of green leafy vegetables, fruits and other vegetables. Frequent infections and reduced inclusion of iron rich foods were the main contributory factors. The low consumption of fruits could have reduced iron absorption in these children.

Mild vitamin A deficiency (VAD) was present in the form of poor adaptation to darkness and dry skin. From Table XXVI it is evident that vitamin A deficiency was equally prevalent among both Matriculation and Corporation school children. Prevalence of vitamin A was more in urban than in rural area. The children from Panchayat schools showed better consumption of green leafy vegetables which were available at low cost compared to urban children and consumed egg daily in the mid-day meal programme. Compared to urban children, fruits consumption was more among Panchayat school children.

Ansstas et al. (2010) bring out the effect of sub clinical forms of VAD as leading to the development of respiratory and diarrheal infections, decreased growth rate and bone development.

Symptoms resembling pellagra namely hyper pigmentation and skin irritation were noticed in rural school children compared to urban school children.

C. BIOCHEMICAL PROFILE OF THE SELECTED SUB SAMPLE

1. Blood glucose values of the selected subsample of children

Table XXVII shows the distribution of the subsample of children according to their blood glucose values. The individual values for all the 1852 children and the corresponding means are given in the Appendix IX

TABLE XXVII

DISTRIBUTION OF SELECTED CHILDREN ACCORDING TO BLOOD GLUCOSE VALUES

(N = 1852)

Blood glucose values mg/dl*	Matriculation N = 625				Corporation N = 615				Panchayat N = 612			
	Boys N = 307		Girls N = 318		Boys N = 286		Girls N = 329		Boys N = 318		Girls N = 294	
	N	%	N	%	N	%	N	%	N	%	N	%
Low < 75	5	2	10	3	11	4	14	4	16	5	11	4
Normal 75 – 100	293	95	294	93	268	94	306	93	296	93	280	95
Pre-diabetes 100-125	9	3	14	4	7	2	9	3	6	2	3	1
Total	154	100	146	100	137	100	158	100	156	100	142	100

*American Diabetes Association (2009) and Mohan et al., India (2007)

It could be observed from Table XXVII that 93 to 95 per cent of children had normal blood glucose values in the range of 75 to 100 mg/dl recommended by American Diabetes Association and Mohan et al. (2007). High blood glucose values were present among 3.5, 2.5 and 1.5 per cent of Matriculation, Corporation and Panchayat school children. Higher risk levels were observed among Matriculation school adolescent boys and girls. These children showed signs of metabolic syndrome like obesity (> 85th percentile for age), hypertension (systolic or diastolic BP >95th percentile for age) and evidence of dyslipidemia (low HDL levels or elevated triglyceride levels) in addition to being pre diabetic with blood glucose levels ≥ 125 mg/dl. These symptoms have been identified jointly by the ATP III and WHO for detecting metabolic syndrome in children.

Using ATP III and World Health Organization criteria, Goodman (2004) has reported in a school-based study of 1513 North American adolescents that 4.2 and 8.4 per cent boys and girls had metabolic syndrome, respectively whereas a study of 965 Mexican children and adolescents found a 6.5 and 4.5 per cent prevalence, respectively (Rodriguez-Moran et al. 2004).

In the present study 2.3 per cent boys and 2.7 per cent girls showed signs of metabolic syndrome.

2. Blood lipid levels of the selected sub sample

Table XXVIII gives a comparison of the blood lipid levels of the obese and comparable group of non-obese children from the three types of schools. The individual lipid profile values have been given in Appendix IX.

TABLE XXVIII

MEAN BLOOD LIPID VALUES OF SUB SAMPLE OF OBESE AND NON OBESE CHILDREN

(N = 60)

Criteria	Normal values*	Obese N = 30	Non Obese N = 30	t value	p value
Total cholesterol	<170 mg/dl	181.2± 15.3	131.4 ± 20.2	29.61	0.0011***
LDL cholesterol	<110mg/dl	116.6± 5.2	83.3±9.8	24.80	0.0016***
Triglycerides	54-110 mg/dl	106.8± 5.6	75.3± 5.0	58.52	0.0003***
HDL cholesterol	50-86mg/dl	34.1 ± 3.9	66.1± 10.1	-65.87	0.0002***

*Mahan (2010); *** Significant at one per cent level

Table XXVIII brings out the blood lipid values of the selected subsample of obese and non-obese children. A comparison between the lipid values of the obese and non- obese children showed a significant difference at one per cent level in total cholesterol, Low Density Lipoprotein cholesterol, High Density Lipoprotein cholesterol and triglyceride levels. The obese children were diagnosed with metabolic syndrome as their lipid levels, blood glucose values and body weight were above normal values. These children had wrong lifestyle factors namely, high carbohydrate and fat consumption, greater television viewing, increased consumption of junk foods and empty calories and reduced physical activity. Environmental factors namely employed mothers and high socio-economic status were also observed in these children. These factors in combination with one another increased the

risk of children becoming obese. These children could be classified as high risk children for lifestyle diseases and so proper education is needed to be imparted to change their lifestyle.

Fletcher et al. (2005) contend that the National Cholesterol Education Programme and the American Heart Association emphasize the population approach as the principal means for primary prevention of coronary heart disease beginning in childhood. The risk factors like blood cholesterol levels are targeted to be shifted to desirable levels to reduce prevalence of CHD among children.

3. Blood haemoglobin levels of the selected sub sample of children

Table XXIX shows the haemoglobin levels of the selected sub sample of children. The individual haemoglobin values of the 85 boys and 115 girls are given in Appendix IX.

TABLE XXIX

BLOOD HAEMOGLOBIN VALUES OF THE SELECTED SUB SAMPLE

(N = 200)

Groups	Blood haemoglobin levels (g/dl)		Student's t test	
	Boys (85) Mean ± SD	Girls(115) Mean ± SD	T value	p values
Clinically anaemic (Boys N = 14) (Girls N = 70)	10.6 ± 0.20	9.9 ± 0.59	5.15	0.03*
Clinically non-anaemic (Boys N = 71) (Girls N = 45)	12.6 ± 1.0	11.7± 0.79	4.79	0.04*
Standard value*	11-14.8	10.9-13.6		

*Prentice Hall Publications (2011); *significant at five per cent level.

From Table XXIX, the mean haemoglobin values of the selected groups of boys and girls are evident. As evidenced through clinical examination, mild to moderate anaemia was prevalent among the children. More number of girls was found to be anaemic compared to boys when clinically assessed. Out of the children who were clinically found to be anaemic, only 70 girls and 14 boys were willing to give blood for haemoglobin estimation. Another non-anaemic group of 71 boys and 45 girls gave

consent for haemoglobin estimation. The haemoglobin values of children are presented in Table XXIX.

The mean haemoglobin values of the anaemic girls was the lowest (9.9 g/dl) and for boys it was 10.6 g/dl. Non-anaemic boys had better values compared to girls.

A statistically significant difference at five per cent level was observed between the boys and girls in the mean haemoglobin levels both in the anaemic and non-anaemic groups.

Girls were more prone to anaemia because of the menstrual cycle on the onset of menarche. In the present generation of girls, there is an early onset of menarche, with the average age being 10 years (The Center for Development and Population Activity, 2001). This predisposes girls to greater risks of anaemia at a very early age. Other compounding factors to anaemia among girls are poor intake of iron rich foods, worm infestations and low consumption of fruits and vegetables.

In their study on adolescent girls, Patel and Shah (2009) observed that 47 per cent of the adolescent girls in Jaipur had haemoglobin levels in the range of 10 to12 g/dl. Similar findings were seen in the present study.

D. PREVALENCE OF LIFE STYLE DISORDERS AMONG THE SELECTED CHILDREN

Table XXX brings out the lifestyle disorders prevalent among the selected children of all the three types of schools.

TABLE XXX

PREVALENCE OF LIFESTYLE DISORDERS AMONG THE SELECTED CHILDREN

Lifestyle disorders	Matriculation				Corporation				Panchayat				Total			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Overweight (N = 6190)	183	17	204	19	175	16	163	15	83	9	84	9	441	14	451	15
Obesity (N = 6190)	92	8	82	8	61	6	47	5	25	3	15	2	178	3	144	2
Pre diabetes (N = 1852)	9	0.5	14	0.8	6	0.3	10	0.5	3	0.2	6	0.3	18	1	30	2
Elevated blood pressure (N = 6190)	12	0.2	6	0.1	0	0	0	0	0	0	0	0	12	0.2	6	0.1
High total cholesterol values (N = 30)	5	17	7	23	3	10	7	23	2	7	6	20	10	33	20	67
High triglycerides (N = 30)	5	17	7	23	3	10	7	23	2	7	6	20	10	33	20	67
High Low Density Lipoprotein (N = 30)	5	17	7	23	3	10	7	23	2	7	6	20	10	33	20	67
Low High Density Lipoprotein (N = 30)	4	13	5	17	1	3	5	17	1	3	2	7	6	20	12	40

Table XXX brings out the disorders related to lifestyle among the selected children. The overall prevalence of overweight was 14 per cent among boys and 15 per cent among girls, when all the three types of schools were accounted for. The prevalence of obesity was reversed with more boys (3%) remaining obese compared to girls (2%) when all the three schools were considered.

Compared to Corporation and Panchayat schools, greater prevalence of over

weight and obesity was observed among Matriculation school children.

Pre-diabetes was found in all the three types of schools with children from Matriculation schools showing higher prevalence rates compared to Corporation and Panchayat school children. Pre-diabetes was prevalent more among girls than boys.

Sharma (2008) recorded a prevalence of both type 1 and type 2 diabetes as one per cent among children getting treated in Government hospitals in India.

Obese children showed abnormal lipid levels. Total cholesterol, LDL-cholesterol and triglycerides were high for these children while HDL-cholesterol was low. Girls had greater prevalence rates of high lipid values compared to boys. Total-cholesterol, LDL-cholesterol and triglycerides were found to be more in 67 per cent girls compared to 33 per cent boys.

The situation was reversed with Matriculation boys having high blood pressure compared with girls. In Corporation and Panchayat schools, all the selected children had normal blood pressure levels.

These symptoms are collectively referred to as metabolic syndrome. The obese children had greater risks for metabolic syndrome. According to International Diabetes Federation (IDF, 2011), for children aged 10 or older, metabolic syndrome can be diagnosed with abdominal obesity (using waist circumference percentiles) and the presence of two or more other clinical features (elevated triglycerides, low HDL-cholesterol, high blood pressure, increased plasma glucose). Prolonged physical inactivity and wrong food choices could have been the causes for the observed risk in the present study.

E. FOOD AND NUTRIENT INTAKE OF THE SELECTED CHILDREN

1. Type of diet consumed

Table XXXI brings out the type of diet consumed by the selected children.

TABLE XXXI

TYPE OF DIET CONSUMED BY THE SELECTED CHILDREN

(N = 6190)

Type of diet	Matriculation N=2180		Corporation N=2122		Panchayat N = 1888	
	N	%	N	%	N	%
Non-vegetarian	1591	73	1797	85	1746	92
Ovo-lacto vegetarian	384	18	281	13	117	6.19
Lacto-vegetarian	138	6	34	1.6	24	1.27
Vegan	67	3	10	0.4	1	0.05
Total	2180	100	2122	100	1888	100

From Table XXXI it is evident that 73, 85 and 92 per cent of the selected children were non-vegetarians in Matriculation, Corporation and Panchayat schools respectively depicting that majority were non-vegetarians in all the three types of schools. The percentage of non-vegetarians was high in rural area compared to urban area. In urban area there were more non-vegetarians in Corporation schools compared to Matriculation schools.

In Matriculation schools, there were pure vegetarians who avoided all types of animal foods including milk. They belonged to the Jain community and followed a strict vegan diet. They avoided all types of animal foods including milk. In Coimbatore, which is an emerging Metropolitan city, lot of families belonging to the Jain community is present. These Jain community children study only in Matriculation schools. These children did not consume any non-vegetarian food including milk. They constituted 12 per cent of the total Matriculation school children.

In the present study, the children who were pure vegetarians had the risk of growth retardation (5% underweight), iron deficiency anaemia (2%) and vitamin A deficiency (1%) as detected through clinical examination. For pure vegetarians obtaining essential nutrients like omega 3 fatty acids from fish and vitamin B_{12} found in meats, eggs, dairy products and seafood would be a problem. Such a category was absent in the other two schools. Ovo-lacto vegetarians, who eat eggs and dairy products, may obtain vitamin B12 from these foods.

In Corporation and Panchayat schools, other than non-vegetarians, there were ovo lacto-vegetarians. In Tamil Nadu, in Government schools (Corporation and Panchayat schools) egg is provided for five days in a week under the mid-day meal programme. In Corporation and Panchayat schools, children from first to tenth standards were beneficiaries of school mid-day meal scheme. Hence all the children ate egg in these schools even if they were vegetarians at home.

The percentage of ovo-lacto vegetarians, lacto-vegetarians and vegans was high in Matriculation schools compared to Corporation and Panchayat schools.

2. Meal pattern

a. Types of foods consumed for breakfast

For breakfast, Matriculation school children ate rice based breakfast items like idli*, dosai*, appam*, adai*, pongal*, upma* and sevai* and wheat based items namely poori* and chappathi*. Both rice based and wheat based foods were given equal importance. Matriculation school children consumed breakfast cereals once or twice weekly. These ready-to-eat breakfast cereals were given prominence due to affordability and because of advertisements given in media (television) on the wholesomeness of these foods. As no elaborate preparation is involved, it was convenient for working mothers. Affluence of parents of Matriculation school children was the main factor in the choice of ready-to-eat breakfast cereals.

In contrast, majority of Corporation and Panchayat school children (74% and 67%) consumed rice based preparations like idli, dosai, sevai and rice which are typically South Indian dishes. Chappathi and wheat preparations were consumed occasionally for breakfast. Rice based food consumption was more because rice is the staple food of South India, available at comparatively cheaper rates and also made available through public distribution system (ration shops). Low economic condition of these families and lack of time for the mothers to prepare other varieties were the reasons given. In Panchayat schools, in addition to using rice, millets like finger millet (ragi), corn, sorghum (jowar), pearl millet/bajra and kodo millets (varagu in Tamil) formed part of the breakfast menu. The millets were prepared either as porridge or as dosai or adai.

A study done by Chitra and Reddy (2007) in Andhra Pradesh indicated that South Indian breakfast items like dosai, upma and idli and North Indian foods like chappathi were mostly consumed by school children for breakfast. The same pattern was observed in the present study also.

Beverages like milk, coffee or tea were commonly consumed along with breakfast by the children. In Matriculation schools, proprietary beverages

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* Glossary of terms given in Appendix X.

such as Complan, Horlicks, Bournvita, Maltova and Viva were mixed with milk and given. Parents of Matriculation school children who had high income preferred to provide milk and commercially available milk substitutes instead of tea and coffee.

In Corporation schools, 68 per cent of the children drank coffee or tea while the rest (32%) consumed milk. In Panchayat schools, tea was commonly consumed during breakfast. Milk and milk products consumption was very low among rural Panchayat school children.

Fruit consumption during breakfast was found only among 12 per cent of Matriculation, 9 per cent of Corporation and 13 per cent of Panchayat school children. The reasons for reduced consumption were inadequate knowledge of the parents on the importance of fruits, dislike by the children and inability to purchase fruits due to low socio-economic reasons.

Skipping breakfast was observed among children of all the three schools. The reasons mentioned were inadequate time for consumption, dislike towards foods offered for breakfast and inability of the mothers to prepare breakfast on time, especially in rural areas.

Gajre et al (2008) points out that poor time management is a contributory factor for children to regularly skip breakfast. Same trend was observed in the present study also.

b. Types of foods consumed for lunch

As far as Matriculation school children were concerned, three types of meal pattern were observed. Fifty nine per cent of children brought packed lunch from home, 22 per cent ate in the school canteen and 19 per cent went home to consume full meals. Among those who brought packed lunch, 52 per cent had rice based items while seven per cent had wheat based foods. None of the native people of Tamil Nadu consumed wheat preparations for lunch. Only those families who have settled in Coimbatore, who have migrated from North India, like Jains consumed wheat preparations for lunch.

Amount of vegetables was very less in the lunch boxes. Some lunch boxes had the same breakfast items for lunch. Wheat based preparations were chappathi and poori with any vegetable as a side dish, the quantity of

which was very less. Thus the quantity of vegetables consumed by the children was inadequate compared to the recommended allowances. Also there was much wastage of vegetables due to dislike. Children who consumed the same breakfast items for lunch did not include any vegetable in the menu. The lunch was not found to be wholesome. Pearson (2011) found that home packed lunches were not balanced and that children had a tendency to leave a part of it uneaten. The same trend was observed in the present study also. This led to imbalance in their nutritional status.

Those who went home to consume lunch consumed rice based full meals namely rice with sambar*, rasam*, curd and vegetable preparations. However, it was found that the quantity of rice was more compared to the recommended allowances and vegetable was less. The parents also had the intention of making the child consume more rice.

The children who ate in the school food service either had South Indian lunch comprising of rice, sambar, rasam, curd and vegetable or opted for mixed rice*, chappathi, paratha* and such breakfast items.

In the case of Corporation and Panchayat school children, 99 per cent consumed the food provided under the Tamil Nadu Government sponsored mid-day meal programme. The food consisted of one preparation of rice with dhal, a vegetable and an egg. The vegetable was either prepared as a separate curry or added along with rice. Boiled egg was given daily.

One per cent of the children from both Corporation and Panchayat schools did not consume food in the mid-day meal programme. They reported that the food caused indigestion or they disliked the food prepared at the noon meal programme and hence opted to go home for lunch. At home, they ate rice, a dhal preparation, curd and vegetables. However, these children ate egg provided at the noon meal programme. They did not want to miss the allowance given to them.

In the present study, skipping of lunch was not observed in any of the schools as the teachers ensured that children consumed lunch.

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*Glossary of terms given in Appendix X.

c. Types of foods consumed for dinner

Rice based items were consumed by 35 per cent of Matriculation school children while only four per cent consumed wheat based foods for dinner. Other food items like bread, millet preparations like finger millet (ragi) dosai*, corn adai*, pearl millet/bajra dosai* and ready-to-eat foods like noodles, pani poori* and bhel poori* were also eaten (12%). Twenty four per cent of children ate the same food which they consumed for breakfast. Twenty three per cent of the children ate dinner at hotels or food brought home from hotels.

Among Corporation school children, 28 per cent consumed foods bought from hotels, as most parents were daily wage earners and bought food while returning from work. Home-cooked rice based, wheat based and other breakfast foods were consumed by 26, one and 21 per cent of children respectively, while 22 per cent consumed same rice preparations prepared for lunch.

Panchayat school children (41%) consumed millet-preparations while 31 per cent ate meals consisting of rice. Rice-based preparations were consumed by 26 per cent while only one per cent consumed wheat based preparations.

The practice of eating out was present among 16 per cent of the children. Many parents were working in hotels or were owners of eateries. Commenting on eating out, Poti and Popkin (2011) reveal that eating location and food source has a significant impact on daily energy intake for children. Foods prepared away from home, including fast foods eaten at home and prepared foods eaten away from home fuelled the increase in total energy intake.

Skipping of dinner was observed only among one per cent of children in each of the schools. These children had food in the evening, soon after returning from school and drank milk or porridge during bedtime.

This result is in contrast with the study by Fontenot (2012) who reported that 22 per cent Caucasian, 34 per cent African-American and 38 per cent Hispanic children skipped dinner every night.

*Glossary of terms given in Appendix X.

It could be noted that in Matriculation, Corporation and Panchayat schools the quantity of vegetables consumed by children was inadequate compared to the recommended allowances. Roots and tubers such as potato and yam were the most liked by the children compared to green leafy vegetables. Only 10 per cent of Matriculation school children and 12 per cent each of Corporation and Panchayat school children preferred vegetables like carrot, beetroot, beans, ladies finger, cabbage and pumpkin. Green leafy vegetables were consumed weekly once or rarely by the children and had to be force fed by the parents. Only one to three per cent of the children among the three schools consumed green leafy vegetables twice a week. Gaines and Turner (2009) also found in their study that children did not consume the recommended allowances of fruits and vegetables.

d. Types of snacks consumed

Table XXXII lists the nature of snacks consumed by the children from the three different schools at school and at home.

TABLE XXXII

TYPE OF SNACKS CONSUMED BY THE SELECTED CHILDREN

Type of school	Snacks*	
Matriculation	• Biscuits • Potato chips • Sandwiches • Fruit juices • Cut fruits • Samosa • Puffs • Vegetable rolls • Bajji • Bonda • Vadai • Pakoda	• Bhelpuri • Pavbhaji • Cutlets • Chocolates • Cookies • Cakes • Ice cream • Murukku • Mixture • Omelette • Boiled egg • Sundal
Corporation/Panchayat schools	• Chips • Puffed rice • Flattened rice balls • Tapioca • Murukku • Mixture	• Fried crisps • Flavored ice • Sweets • Chocolates • Ber fruit bars

*Glossary of terms given in Appendix X

Snacks were consumed by the children both at school and at home. Snacks were consumed during school during breaks in the morning and evening or during lunch time. Snacks were either brought from home or purchased in the food service outlets inside or outside the school premises. Only Matriculation school children brought snacks from home for consumption during breaks.

Biscuits, potato chips, sandwiches, fruit juices and cut fruits were the items brought from home to be consumed during snack breaks by some of the Matriculation school children. Snacks available in the food service outlets at school comprised of samosa, puffs, rolls, bajji, bonda, vadai, pakoda, bhel puri, pav bhaji, cutlets, chocolates, cookies, ice cream and cakes. All these items are rich in fat and carbohydrate with very less quantity of protein and micro nutrients. About 68 per cent of children consumed these snacks regularly.

Corporation and Panchayat school children ate cut fruits like guava, mango, gooseberries, oranges and sapota, groundnut-jaggery cake, fried crisps, flavored ice, sweets and chocolates and ber fruit bars sold in the outside eateries. These children did not bring snacks from home.

At home, the Matriculation school children consumed sundal, egg and vegetable rolls, sandwiches, fruits, mixtures, murukku, vadai, omelette, boiled egg and chips as snacks while Corporation school children were provided with murukku, egg preparations, mixtures, sweets and chips. Panchayat school children ate tapioca (boiled), chips, puffed rice, flattened rice balls, murukku, mixture and sweets.

Consumption of carbonated beverages was a notable factor among children of both urban and rural areas. The practice of consumption of carbonated beverages, was however, more in urban area with particular reference to Matriculation school children who showed extra interest in the consumption of carbonated beverages. These children came from high socio-economic families and so had pocket money for the purchase of the same. Carbonated beverages consumption was less common among Corporation school children. In Panchayat school children the habit of consuming

carbonated beverages was less common due to socio-economic constraint, but they too showed a liking. Sherbet and other forms of soda were consumed occasionally by the rural children.

Fiorito et al. (2009) bring out the fact that consumption of soda tends to decrease milk consumption in children. A similar pattern existed in the children of all three types of schools.

e. Non- vegetarian foods consumption

Table XXXIII illustrates the types of non-vegetarian foods consumed by the children.

TABLE XXXIII
TYPE AND FREQUENCY OF NON VEGETARIAN FOODS CONSUMED BY THE CHILDREN OF THE SELECTED SCHOOLS

(N = 5916)

Non-vegetarian foods	Frequency of consumption	Matriculation N =1975		Corporation N =2078		Panchayat N = 1863	
		N	%	N	%	N	%
Meat	Weekly	989	50	1233	59	1191	64
	Rarely	602	31	564	27	638	34
Fish and sea foods	Weekly	1305	66	1365	66	1352	73
	Rarely	286	14	422	20	394	21
Poultry	Weekly	1350	68	1617	78	1526	82
	Rarely	241	12	180	9	220	12
Egg	Daily	1062	54	2028	98	1850	99
	Weekly	881	45	33	2	13	1
	Rarely	32	2	17	1	0	0

A comparison of non-vegetarian food consumption pattern among children of the three types of schools revealed that consumption of all forms of non-vegetarian foods was more among children in rural area compared to children in urban area. Availability of non-vegetarian foods was greater in rural area, as rural people owned goats and poultry farm. The price was also less compared to urban area. Compared to meat, consumption of poultry was more in all the three types of schools.

Consumption of egg was more among Corporation and Panchayat school children. They consumed egg daily in the mid-day meal programme.

Kuriyan et al. (2011) suggest that increased consumption (above the RDA) of non-vegetarian foods among Indian children has led to higher BMI and Waist circumference. However, in the present study, there was no

significant correlation between the consumption of non-vegetarian foods and waist circumference values in children (r = 0.23). However, a positive correlation was observed between consumption of non-vegetarian foods and BMI values (r = 0.99). Non-vegetarians had higher BMI values compared to vegetarians.

3.Mean food intake of the selected children

Table XXXIV depicts the mean food intake of the selected Matriculation, Corporation and Panchayat school children as calculated from the 24 hour recall survey.

TABLE XXXIV

MEAN FOOD INTAKE OF THE SELECTED CHILDREN

(N = 6190)

Food Groups (g)	4-6				7-9				10-12				13-15			
	RDA	M	C	P	RDA	M	C	P	RDA	M	C	P	RDA	M	C	P
Cereals	200	225±30	210±25	240±20	250	285±50	265±50	275±50	320	350±50	330±20	350±20	430	450±30	440±40	450±40
Pulses	50	40±10.4	38±7.9	25±7.8	60	43±15.3	33±12.4	28±12.1	60	45±12.3	30±8.6	28±8.4	50	42±15.2	38±15.7	27±15.3
Green leafy vegetables	75	15±5.8	20±5.8	35±6.4	75	29±4.2	25±10.3	38±10.6	100	20±6.9	35±5.8	42±5.9	100	23±5.6	20±5.3	29±5.9
Other Vegetables, roots and tubers	50	40±3.7	35±3.7	30±3.5	50	38±5.4	29±4.6	22±4.7	75	63±5.9	45±5.2	37±5.2	150	112±5.3	102±6.9	93±5.7
Fruits	50	15±4.8	12±4.6	10±4.7	50	13±5.8	10±5.8	9±5.7	50	15±5.3	10±7.3	10±2.7	30	15±3.9	12±3.8	10±3.5
Milk	200	150±30.6	100±30.4	110±20.9	200	120±20.6	110±15.5	120±15.7	200	110±30.7	90±20.3	85±20.5	150	100±20.5	60±20.4	50±20.2
Fats and Oils	25	40±4.7	45±4.8	48±4.3	30	45±5.8	50±5.7	55±4.8	35	55±5.7	60±5.1	64±4.8	40	55±7.4	57±7.3	59±8.6
Meat, fish and eggs	30	40±5.3	45±5.1	55±6.3	30	50±6.9	53±6.9	58±6.9	30	55±5.3	65±7.2	68±5.3	30	60±10.7	65±12.5	68±6.2
Sugar and jaggery	40	50±6.3	50±5.9	45±5.9	50	63±8.5	60±5.7	55±5.6	50	55±10.4	45±10.6	43±10.6	30	55±7.4	50±7.9	26±5.3

Table XXXIV brings out the mean food intake of the selected children. It could be observed that there was an excess intake of cereals, fats and oils, meat, fish and eggs and sugar and jaggery among the various age groups of Matriculation children when compared to the Recommended Dietary Allowances. Other food groups such as pulses, green leafy vegetables, other vegetables, roots and tubers, fruits and milk were found to be inadequate in the diets of these children.

Mean food intake of the selected Corporation school children revealed that cereals, fats and oils, meat, fish and eggs and sugar and jaggery (except in the age group of 10-12 years) were consumed in excess, while other food groups like pulses, green leafy vegetables, other vegetables and roots and tubers, fruits and milk were consumed in lesser amounts compared to the recommended allowances by all the age groups. This brings out a similar pattern of intake among both Matriculation and Corporation school children.

From the mean food intake of the Panchayat school children it could be seen that cereals, fats and oils, meat, fish and eggs and sugar and jaggery (except by the age groups of 10-12 years and 13-15 years) were consumed in excess while food groups like pulses, green leafy vegetables, other vegetables, roots and tubers and fruits were found to be inadequate compared to the ICMR recommended allowances.

The frequency of fruits, vegetables, and dairy products consumption was low while cereal products were consumed two to three times per day among children in the present study. A similar pattern was observed by Nnakwe and Yegammia (2002) in their study in Coimbatore, South India. They concluded that both the rural and urban diets were predominantly cereal based. The frequency of consumption of milk products, fruits and vegetables was below the Indian Council of Medical Research recommendation.

A comparison of the mean food consumption of the three types of schools revealed that cereal consumption was greater in Matriculation and Panchayat schools compared to Corporation school children. The same pattern was observed in mean milk intake except among the older age groups where Corporation school children consumed better than Panchayat school children. In all other food groups, Matriculation school children showed higher intake, followed by Corporation and the least being Panchayat school

children. The only exception was the mean intake of green leafy vegetables. The Panchayat school children consumed greater quantity of green leafy vegetables in comparison to the urban school children.

Kulsum et al. (2008) observed increased intake of cereals and pulses among children with linear increase as age advanced. This is similar to that observed in the present study.

Consumption of other vegetable and roots and tubers was more than green leafy vegetables. This could be due to availability of seasonal vegetables at the doorstep through local vendors at reasonable costs. However, the quantity consumed did not meet recommendations. The consumption of green leafy vegetables was better in rural area compared to urban area. Green leafy vegetables were grown in these areas and were available at a cheaper rate.

The quantity of fruits consumed by all three types of school children were less compared to recommended dietary allowances due to ignorance and inability to purchase fruits.

Consumption of fats and oils was found to be more in urban children belonging to Corporation schools (low socio-economic status).This could be attributed to the varieties of food eaten in hotels and the consumption of more quantity of fried snacks.

Consumption of milk and milk products was inadequate compared to the recommended allowances among all children irrespective of age and sex. Consumption of non-vegetarian foods was more than the recommended dietary allowances in all children of all the three types of schools. When compared to other two types of schools, Panchayat school children in all age groups consumed more meat, fish and eggs.

The visible difference in dietary pattern of children from urban low socio-economic groups and rural areas can be attributed to the two dimensions of food security, namely availability and accessibility of food as endorsed by Gross et al. (2000).

5. **Mean Nutrient Intake of the Selected Children**

Table XXXV brings out the mean nutrient intake of the selected children calculated from the 24 hour recall survey.

TABLE XXXV

MEAN NUTRIENT INTAKE OF THE SELECTED CHILDREN

Nutrients*	4-6 years				7-9 years				10-12 years				13-15 years			
	RDA	M	C	P	RDA	M	C	P	RDA	M	C	P	RDA	M	C	P
Energy(Kcal)	1350	1925 ±50	1985 ±50	1735 ±50	1690	2565 ±25	2755 ±20	2545 ±20	B2190 G2010	2915 ±30 2425 ±25	2965 ±30 2975 ±20	2425 ±30 2275 ±20	2750 2330	2975 ±20 2520 ±25	3275 ±20 2950 ±20	3225 ±20 2750 ±25
Protein(g)	23.5	18± 5.2	23 ±5.3	23 ±4.9	29.76	24.5 ±8.3	29.7 ±5.9	29.9 ±5.8	B39.86 G40.43	34.7 ±8.5 36 ±7.3	40.3 ±8.4 39.4 ±8.6	40.9 ±8.5 40.8 ±8.9	B54.23 G51.86	50.9 ±5.3 47.7 ±6.8	55.3 ±6.4 52.6 ±6.9	57.3 ±5.9 51.5 ±6.9
Fat (g)	25	45 ±10.1	55 ±10.7	49 ±10.4	30	52 ±5.7	55 ±8.2	55 ±8.7	B35 G35	48 ±12.5 55 ±10.3	55 ±12.6 65 ±7.8	53 ±12.8 58 ±7.3	B45 G40	55 ±5.9 50 ±4.8	53 ±5.9 58 ±4.9	52 ±7.4 52 ±8.3
Calcium(mg)	600	320 ±5.6	218± 5.6	205 ±5.3	600	315 ±6.3	220 ±6.7	220 ±6.4	B800 G800	505 ±10.4 485 ±12.4	465 ±10.7 475 ±12.3	445 ±10.5 365 ±15.6	B800 G800	520 ±10.5 425 ±14.7	410 ±10.6 265 ±10.7	405 ±10.6 245 ±10.4
Iron(mg)	13	11 ±3.5	12 ±3.7	12 ±3.8	16	14 ±2.4	14 ±2.9	14 ±2.7	B21 G27	19 ±2.3 25 ±3.5	21 ±2.1 28 ±3.6	21 ±2.8 26 ±3.7	B32 G27	29 ±4.3 18 ±8.5	30 ±4.2 25 ±3.7	32 ±4.9 24 ±3.8 Contd.

Nutrients	4-6 years				7-9 years				10-12 years				13-15 years			
	RDA	M	C	P	RDA	M	C	P	RDA	M	C	P	RDA	M	C	P
Vitamin A																
Retinol (I.U)	400	350 ±20.4	320 ±20.5	269 ±20.5	600	375 ±23.5	325 ±20.5	325 ±20.8	B600 G600	445 ±10.5 465 ±12.2	365 ±10.7 525 ±12.5	320 ±10.4 475 ±12.6	B600 G600	490 ±12.6 455 ±14.9	510 ±10.8 345 ±10.4	470 ±10.4 325 ±10.6
Beta carotene(µg)	3200	750 ±15.3	650 ±15.3	615 ±15.7	4800	970 ±12.4	750 ±10.7	755 ±10.4	B4800 G4800	1250 ±10.3 1145 ±12.4	950 ±10.7 945 ±12.7	825±10.6 875±12.6	B4800 G4800	1150 ±19.4 1055 ±17.4	750±15.6 655±15.9	720±15.9 625±15.8
Vitamin C(mg)	40	19 ±5.3	10±3.9	9 ±3.1	40	18 ±3.6	12 ±3.2	11 ±3.8	B40 G40	20 ±2.4 18 ±3.3	15 ±2.3 12 ±3.7	14 ±2.9 11 ±3.8	B40 G40	20 ±7.6 22 ±6.3	15 ±5.6 15 ±3.9	13± 5.7 13 ±3.7

*****RDA – Recommended Dietary Allowances, ICMR (2010)

Table XXXV shows the mean nutrient intake of the selected children. It could be observed that except for energy and fat all other nutrients were found to be deficient in the diets of the Matriculation children when compared to the Recommended Dietary Allowances. This was mainly due to the intake of junk foods which provided only carbohydrates and fat.

It could be observed that in the case of Corporation school children also mean energy and fat intake were in excess. Among the 10 to 12 year boys iron intake was sufficient and met the Recommended Dietary Allowances, while all other nutrients did not meet the RDA. This could be attributed to intake of iron rich foods like red meat among the 10 to 12 year old boys while all other age groups ate less quantities of meat.

The nutrient intake of the Panchayat school children also revealed that energy and fat intake were in excess while all other nutrients were found to be inadequate. This was due to less intake of vegetables, fruits and milk by these children.

In the study in Andhra Pradesh by Chitra and Reddy (2008) the mean nutrient intakes calculated from 24-hour recall revealed inadequacy compared with the recommended values for energy and protein. The only exception was 10-year-old girls; both protein and energy intake of this group were higher than RDA levels. For all other age groups, energy and protein intakes were lower than recommended for both boys and girls. The energy intake values indicated a daily deficit of 600 to 900 kcal. This is in contrast with the results of the present study where cereals were consumed in greater quantities compared to the RDA by children of all three types of schools.

Chitra and Reddy (2008) point out a deficit in the intake of green leafy vegetables with higher intakes of other vegetables and roots and tubers due to easy availability but in reduced quantities compared to RDA. The same trend was observed in the present study also.

A comparison of the mean nutrient intake of the three types of schools revealed that energy consumption was greater among Corporation school children, though they consumed lesser quantity of cereals compared to the children from the other two schools. This shows that energy was obtained

from junk foods. The Corporation and Panchayat school children met the Recommended Allowances for protein as they consumed egg daily while the Matriculation school children had inadequate protein intake. A similar pattern was observed for iron intake in which except in the age of 7 to 9 years, the mean iron intake of Matriculation school children was lesser than the Corporation and Panchayat school children. This could be due to greater quantity of non-vegetarian foods consumed by Corporation and Panchayat school children compared to Matriculation school children.

Mean calcium, retinol, beta carotene and vitamin C intakes were found to be more in Matriculation school children compared to the other two schools due to better consumption of milk, vegetables and fruits by the Matriculation school children.

However, the quantity of nutrients except for energy and fat did not meet the RDA in all the three types of school children.

Levioza (2011) opines that children in slums do not have access to proper food due to cost, whereas children from middle and upper class do not eat proper food. They eat food which is tasty but poor in vitamins and minerals. Dietary habits of these children have changed to fast food which contributes to energy and fat but poor in vital elements.

The foods available in low-income neighborhoods are of lower quality (Zenk et al. 2006), cost more, and have less variety, than foods available in more affluent neighborhoods, because larger suppliers tend to target higher income consumers (Moore and Roux, 2006). Moreover, healthy foods such as fruits and vegetables, poultry, fish and whole grain cost more compared with less healthy alternatives which may promote obesity such as refined grain, French fries, bakery products, and snacks containing high starch, sugar and fat (Drewnowski and Darmon, 2005).

PHASE III : EVALUATION OF THE IMPACT OF FOOD SERVICE OUTLETS IN THE SELECTED SCHOOLS ON HEALTH STATUS OF CHILDREN

A. Type of food service in the selected Matriculation, Corporation and Panchayat schools.

B. Nature of foods sold in the food service outlets.

C. Nutritional status of regular and occasional customers to the food service.

D. Health and hygiene practices in the food service outlets.

A. TYPE OF FOOD SERVICE IN THE SELECTED MATRICULATION, CORPORATION AND PANCHAYAT SCHOOLS

1. Food service in Matriculation schools

All the three Matriculation schools had food service outlets. In one Matriculation school, food service was managed by the school authorities (Matriculation school 1) while the food services of the other two schools were under private management (Matriculation 1 and Matriculation 3). All the three food services served lunch, snacks and beverages during school hours.

One food service outlet (Matriculation school 1) had the policy of serving pre-ordered foods. Children ordered lunch and snacks for a month and procured tokens. In this school, the students were asked to assemble in the school food service premises during snack and lunch time. Younger children (6 to 8 years) were assisted by food service employees to have lunch while older children came independently. Waiter service was adapted in this food service and the students were made to sit and food was served.

This was similar to the canteen policy of the Hethersett High School (2011), where students can pre-order take-away packs (breakfast or lunch) if required and they also cater for most dietary limitations for students.

In the other two schools, Matriculation schools 2 and 3, food could be procured as and when needed by the children against tokens sold at break and lunch times. Both snacks and lunch were sold in the food service counters. Counter service was followed and students procured food from the counter, which was pre-plated, and ate within the canteen premises at the

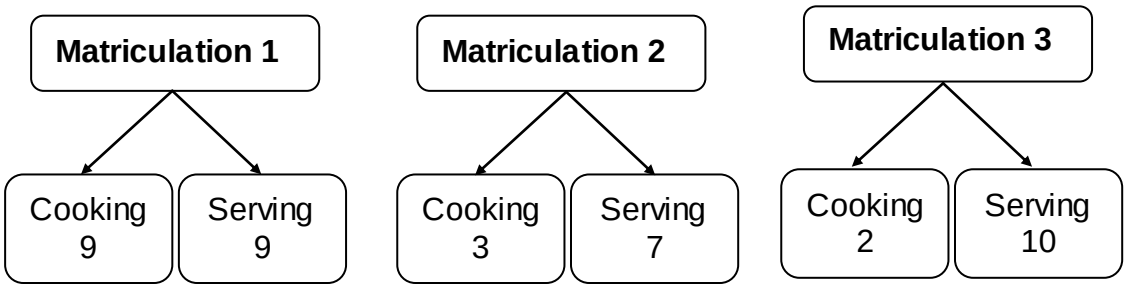
dining tables provided. However, dietary modifications in the menu were not possible in the school canteens under study.

Finance was controlled entirely by the manager of the food service. The supervisor took over the task of checking items purchased and ensured proper stock control and maintenance of food items procured. The management of the left over foods was decided jointly by the manager and the supervisor.

It is a norm in canteens functioning in schools in Western countries to have an effective canteen management policy which requires that everyone involved knows its goals and objectives and is familiar with its policies (www.eduweb.vic.gov.au/).

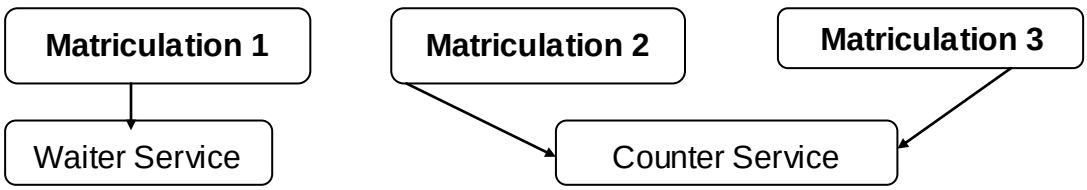
But, in the present study in the selected school canteens, only the manager and supervisor had the authority and planning capacity.

Number of personnel in the food services



In Matriculation school 1, the number of cooks was five as all the menu items were prepared in the canteen premises. Cooking was more elaborate as South Indian meals were served daily. In Matriculation school 3, the ten personnel involved in serving worked in shifts for serving lunch and snacks. In Matriculation school 2, there were adequate persons for cooking and serving. Each employee worked for eight hours.

1. **Type of service in the food services**



Two types of service were widely adapted in the selected food services. In Matriculation school 1, waiter service was followed, where food service personnel served food either on plate or plantain leaf after the students were seated. South Indian cuisine was followed. In this school, the food intake of the students was more as lunch consisted of boiled rice with several side dishes. Second serving was available and unlimited quantities of foods were served. Hence cereal intake of children was more.

In other two schools (Matriculation schools 2 and 3), counter service was followed. In counter service, fixed menu namely one rice preparation with small quantity of vegetable or pickle was served for lunch. The lunch menu was pre-plated prior to serving. Food was pre-plated in the kitchen and served at the counter for those who had procured tokens. The quantity of food was limited and no second serving was provided. Hence food intake was limited. Quantity of vegetables was very low. Choices were offered in the snacks served. Plate III shows counter service in Matriculation school food service outlets.

Ralston et al. (2009) found that pre-plated meals were popular among 69 to 100 per cent of the students participating in the lunch program at schools in the U.S. In the present study 42 per cent of Matriculation 1, 31 per cent of Matriculation 2 and 44 per cent of Matriculation 3 children ate lunch in the canteen daily.

Pre-plating of meals offered the added advantage of deciding portion sizes and planning of purchasing strategies. This has been endorsed by the Central Production Facility of the Food and Nutrition Services Center of United States (2011), which has a pre-plate assembly area where food is pre-plated to be distributed to elementary schools.

2. Corporation and Panchayat schools

The Corporation and Panchayat schools did not have any food services within their premises. Children purchased food from eateries functioning outside the school premises. There were no organized restaurants or

canteens but fried foods, cut fruits, boiled grams, flavored ice, sweets and chocolates were sold in small carts and petty shops. No lunch was available.

The shops from where foods were purchased were mostly mobile carts, made of wood and covered with polythene wrappers or plastic sheets. The petty shops had hardboard or wooden structure with built –in space for the vendor to stand and sell the eatables. Cooked, ready-to-serve foods were sold. The food items were kept in glass bottles or on plastic plates and most of the food items except for boiled grams were handled with bare hands. Boiled gram was dished out using a spatula. Neither the carts, boxes nor the bottles used for storing food items were washed. Muinde and Kuria (2005) endorse that most street food stalls were made of polythene bags and wood and discuss about the unhealthy conditions under which the stalls operate. Similar situation was observed in these vending carts. Plate IV depicts a typical eatery present outside a Corporation school.

B. NATURE OF FOODS SOLD IN THE FOOD SERVICE OUTLETS

1. Matriculation school canteens

Table XXXVI lists the types of food items sold in the canteens of the selected schools.

TABLE XXXVI

TYPES OF FOODS* SOLD IN THE FOOD SERVICE OUTLETS

Lunch		Snacks	Beverages
Matriculation 1	Matriculation 2 and 3	Matriculation schools 1, 2 and 3	
South Indian lunch • Rice • Sambar (dhal and vegetable) • Rasam • Vegetable • Curd/Buttermilk	• Noodles • Fried rice • Curd rice • Sambar rice • Poori channa • Chicken fry • Egg biriyani • Egg (boiled) • Chappathi, kuruma • Parota • Oothapam, kuruma • Vegetable biriyani • Tomato rice • Lime rice • Coconut rice • Idly, chutney and sambar	• Bajji • Bonda • Vadai • Samosa • Ragi pakoda • Puffs –egg and vegetable • Pav bhaji • Cutlet • Spring Rolls • Aloo Chat • Bhel puri • Pani puri • Vegetable salads • Sprouted grams • Ice creams • Chocolates • Cookies • Cakes	• Hot beverages milk, Tea, coffee, chocolate and malt based beverages Fruit juices • Carbonated beverages

***Glossary of terms are given in Appendix X

Table XXXVI brings out the types of food sold in the canteens of the selected schools. In Matriculation school 1, where South Indian lunch was served, a five day cyclic restricted table d'hôte menu was followed with no choice offered between menu items. In the other two Matriculation schools snacks, breakfast and lunch items were served. These included breakfast items like chappathi, parota, poori and idli and lunch items like fried rice, noodles and variety rice like lime rice, tomato rice and coconut rice and snacks like spring rolls, cutlet, samosa and puffs which were popular among the students. It could be observed from the Table that hot beverages like milk, tea, coffee, chocolate and malt beverages were also sold. Similarly fruit juices and carbonated beverages were available in all the schools.

Refined flour, fat-rich fried foods and empty calorie sweet preparations dominated the menu. There were less of whole grains, vegetables and no

fruits. Most of the foods were junk foods with little importance given to fruits and vegetable based products. Even though vegetable salads were offered on the menu, it was not preferred by the students.

The results indicated the necessity to provide a lot of education to the authorities, organizers and planners for improving availability of nutritious foods in these food services.

The Australian nutritional guidelines (2010), have recommended foods like breads and cereal foods- whole grain varieties, fruits - preferably fresh, but including frozen and canned, vegetables - fresh, frozen and canned, reduced fat varieties of milk, cheese, yoghurt, lean meats, skin-free poultry, fish, eggs, baked beans and other legumes and plain water which were not available in the selected school canteens. The necessity for such an education was noticed from the results in Phase III.

2. Outside eateries in Corporation and Panchayat schools

Table XXXVII shows the list of foods sold in the eateries outside the Corporation and Panchayat schools.

TABLE XXXVII

LIST OF FOODS SOLD IN EATERIES OUTSIDE THE CORPORATION AND PANCHAYAT SCHOOLS

List of foods
• Fried foods
• Cut fruits
• Boiled grams
• Flavored Ice (in sachets)
• Groundnut-jaggery toffee
• Sweets
• Hard candies
• Chocolates

There were limited food items sold in the outside eateries in accordance with the demand from the children. Fried foods comprised of Bengal gram flour snacks, crisps and potato fries. Seasonal fruits like papaya, pineapple,

water melon, guava, mango and gooseberries were cut and sold. Boiled grams were green gram, groundnut or whole Bengal gram. Flavored ice comprised of flavored and sweetened water which was frozen and sold. Sweets included burfi*, mysore pak* and milk sweets.

Compared to the snacks served in the Matriculation school canteens, the items available in the eateries outside Corporation and Panchayat schools were healthy foods with fruits and whole grams. However, the problem pertained to the hygienic serving of these foods. Foods were not properly covered. The fruits were cut and exposed to dust and flies. The fried foods were not prepared fresh. The sweets and chocolates contributed to empty calories. Boiled grams were a better option. Cost was the limiting factor for these children in the purchase of outside foods and they preferred to buy in small quantities due to the limited amount of money they possessed. With regard to fruits, children bought only one or two cut sections of fruits which barely met the requirements of daily allowances.

Compared to Panchayat schools, more number of Corporation school children ate from the outside eateries mainly due to affordability and availability of more number of eateries outside the school.

C. NUTRITIONAL STATUS OF REGULAR AND OCCASIONAL CUSTOMERS TO THE FOOD SERVICE

1. Mean anthropometry of the regular and occasional customers of food service in Matriculation schools

Table XXXVIII and Figure 16 show the mean height, weight and waist circumferences of the two groups of children (regular and occasional customers).

TABLE XXXVIII

MEAN ANTHROPOMETRIC DATA OF REGULAR AND OCCASIONAL CUSTOMERS TO THE FOOD SERVICE IN MATRICULATION SCHOOLS

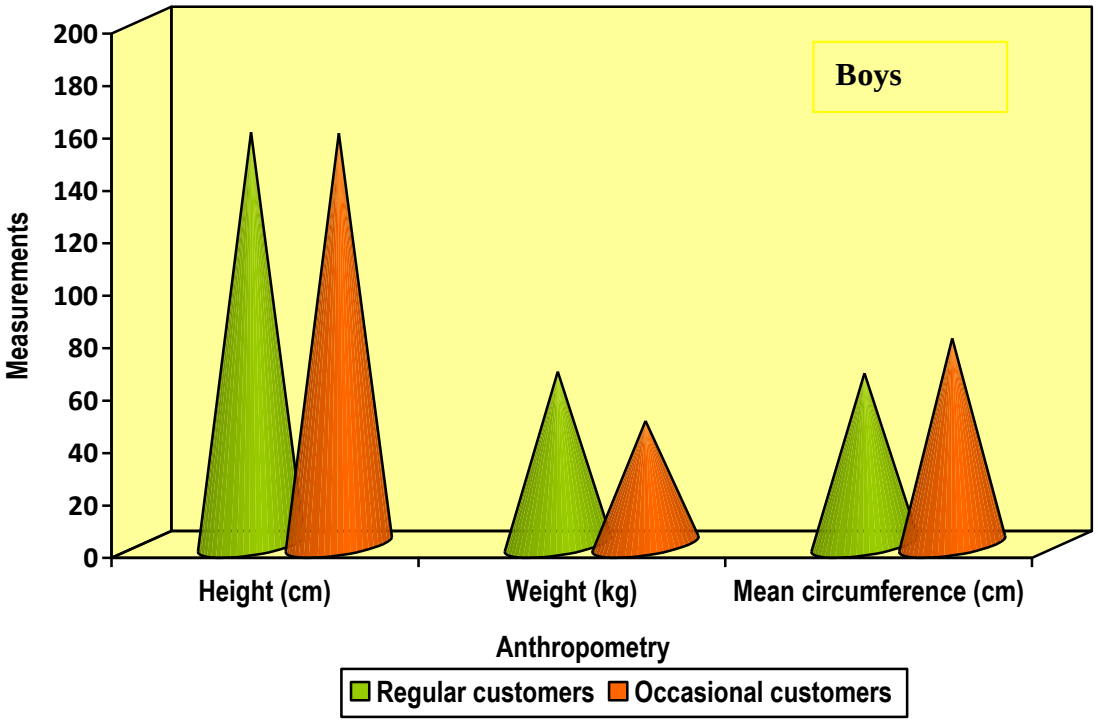
(N = 3028)

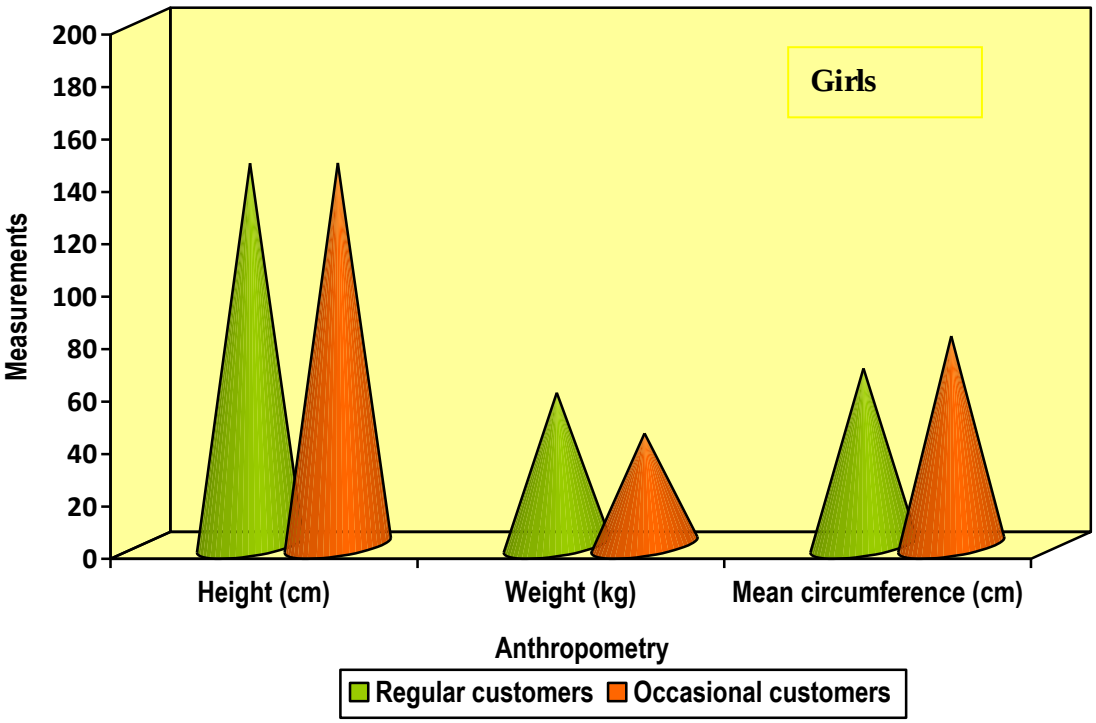
Measurements (Age group 11-14 years)		Group 1 N = 1936	Group 2 N = 1092	t value	p value
Height (cm.)	Boys	157.2 ± 8.2	156.9 ± 8.9	0.016	0.98^{NS}
	Girls	145.8 ± 6.9	145.9 ± 7.2	0.011	0.95^{NS}
Weight (kg.)	Boys	65.93±10.98	47.1±11.29	4.86	0.001***
	Girls	58.3 ± 9.44	42.8 ± 10.2	5.92	0.001***
Waist circumference cm.)	Boys	65.3 ± 2.97	78.6 ± 2.82	3.42	0.01**
	Girls	67.5 ± 2.32	79.9 ± 2.36	3.94	0.01**

Group 1 – Regular customers Group 2 – Occasional customers
***highly significant **significant NS – Not Significant

It could be observed from Table XXXVIII that there was no significant difference in the height of the children who consumed lunch and snacks regularly from the food service outlets and those who did not. However, in case of body weight and waist circumference, there existed a significant difference. Those who were regular customers to the canteen had higher mean body weight as well as waist circumference compared to those who rarely went to the canteen or never went. Those who ate in the canteen regularly had a greater tendency to become overweight and obese. Especially, it was observed that these children were obese. Since teachers and parents objected, it was not possible to take photographs of the two groups of children. The foods served in the canteen were rich in carbohydrates and fat, supplying extra calories. This had significantly increased the body weight and the children looked fat.

Similar results have been observed by Bhatt (2009) who found out that the nutrient content of school lunches had a perceptible impact on children's weight.





MEAN ANTHROMETRIC DATA OF REGULAR AND OCCASIONAL CUSTOMERS TO THE FOOD SERVICE IN MATRICULATION SCHOOLS

FIGURE 16

2. Mean anthropometry of children who frequented and did not frequent the outside eateries in Corporation and Panchayat schools

Table XXXIX and Figure 17 show the comparison of anthropometric measurements of the Corporation and Panchayat school children who consumed snacks from outside eateries and who did not consume.

TABLE XXXIX

MEAN ANTHROPOMETRIC DATA OF SELECTED CHILDREN FROM CORPORATION AND PANCHAYAT SCHOOLS

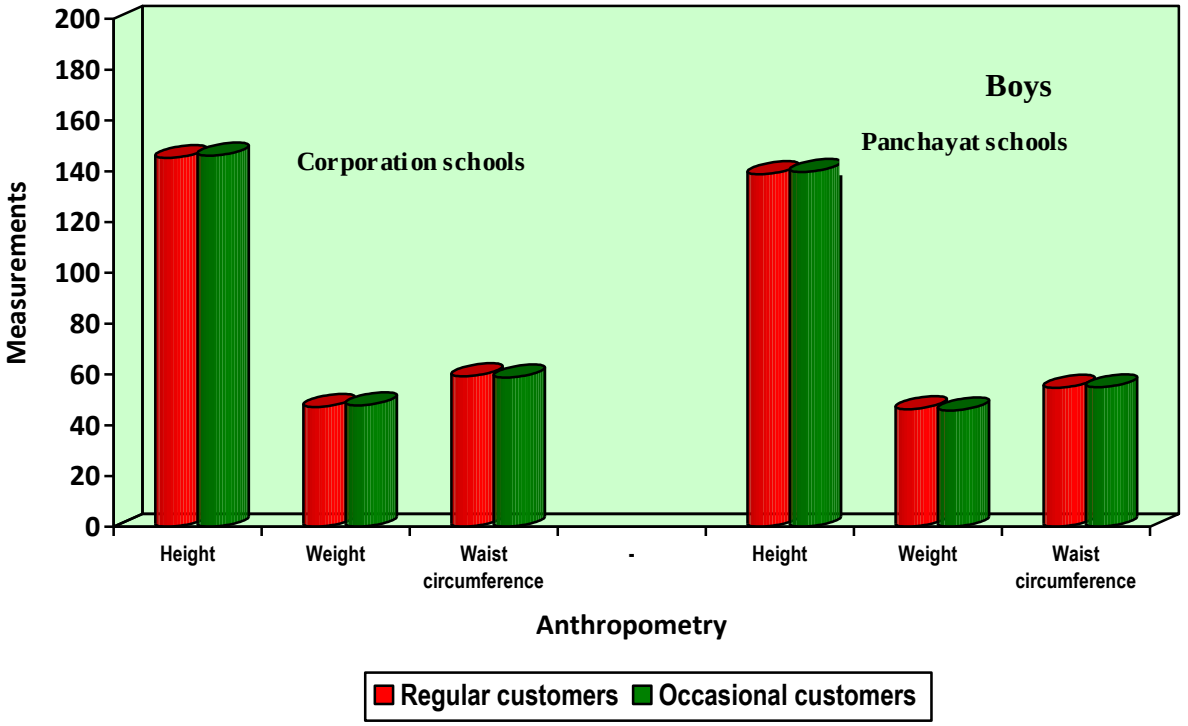
(N = 1730)

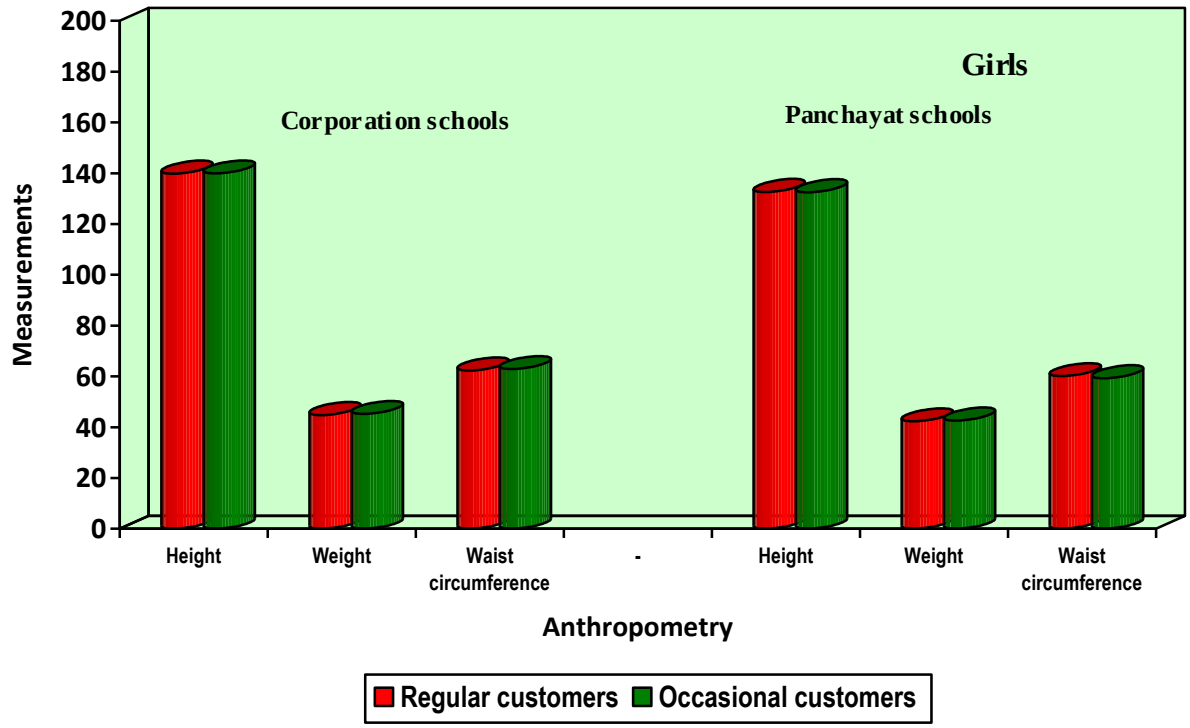
Measurements		Corporation schools N = 980				Panchayat schools N = 750			
		Group 1 N = 490	Group 2 N = 490	t value	p value	Group 1 N = 375	Group 2 N = 375	t value	p value
Height (cm.)	Boys	145.2± 8.13	146.1± 7.29	0.019	0.80^{NS}	138.8± 4.78	139.7± 5.34	0.117	0.90^{NS}
	Girls	139.8± 7.45	139.9 ± 8.22	0.021	0.87^{NS}	132.6 ± 5.22	132.5 ± 4.78	0.032	0.88^{NS}
Weight (kg.)	Boys	47.2± 11.8	47.8± 11.24	0.94	0.40^{NS}	46.3± 11.7	45.8± 12.9	0.86	0.40^{NS}
	Girls	44.8± 9.7	45.2± 9.5	0.95	0.41^{NS}	42.3± 9.9	42.6± 9.3	0.86	0.40^{NS}
Waist Circumference (cm.)	Boys	59.25± 8.62	58.78± 7.23	1.11	0.30^{NS}	54.71± 6.86	54.92± 6.97	1.22	0.30^{NS}
	Girls	62.34± 9.22	62.89± 8.87	1.22	0.32^{NS}	60.12± 7.23	59.28± 7.79	1.27	0.34^{NS}

Group 1 – those who consumed outside food; Group 2 – those who did not consume outside food;
NS – Not significant

From Table XXXIX it is evident that there was no significant difference between those who consumed food from outside eateries and those who did not in terms of height, weight and waist circumference. As already indicated, the nature of foods consumed outside the school premises from mobile vending carts were low calorie and low fat containing foods. These vendors sold short eats like cut- fruits, fruit pulps, crackers and sweets. The quantity consumed was also less. As the children were from low socio-economic group, they could rarely afford to eat one or two of these varieties and so it did not contribute much to their total caloric content and hence there were no significant difference in their body measurements.

But, these children had greater chances of acquiring infectious diseases and they often fell sick.





COMPARISON OF MEAN ANTHROPOMETRIC DATA OF SELECTED CHILDREN FROM CORPORATION AND PANCHAYAT SCHOOLS

FIGURE 17

The children from Corporation and Panchayat schools, teachers and parents should be educated along with the vendors on the effects of unhygienic foods.

3. Food and Nutrient Intake of the Selected Children from Food Services in Matriculation Schools

Table XL, Figure 18 and 19 bring out a comparison between the food and nutrient intake of the regular patrons and occasional patrons of the Matriculation school food service outlets.

TABLE XL

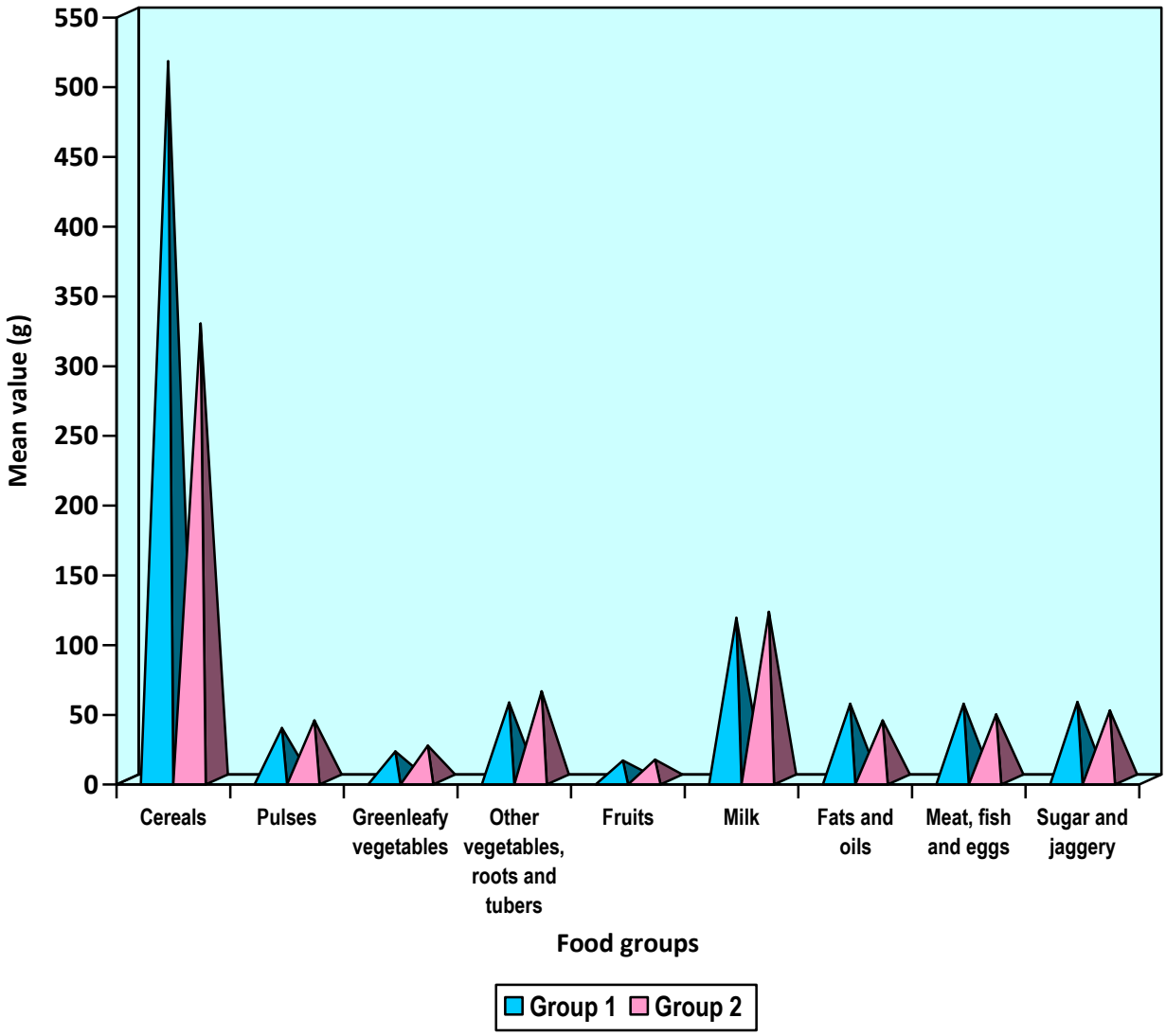
COMPARISON OF MEAN FOOD AND NUTRIENT INTAKE OF THE SELECTED MATRICULATION SCHOOL CHILDREN WHO FREQUENTED AND DID NOT FREQUENT THE FOOD SERVICE OUTLETS

(N = 3028)

Food groups	Group 1	Group 2	T value	p value
Food intake (g)				
Cereals	515±78.9	327±96.3	7.29	0.0001***
Pulses	37±3.6	42.5±2.8	4.51	0.0020***
Green leafy vegetables	20.2±8.23	24.3±9.89	0.674	0.519 NS
Other vegetables, roots and tubers	55.25±27.34	63.25±34.42	1.79	0.1112 NS
Fruits	13.8±2.1	14.4±1.8	0.52	0.506NS
Milk	116±8.3	120.3±10.6	0.676	0.518NS
Fats and Oils	54.28±2.78	42.5±2.8	13.5	0.0001***
Meat, fish and eggs	54.3±6.38	46.75±4.79	3.93	0.0044**
Sugar and jiggery	55.75±5.38	49.5±5.8	2.4	0.043*
Nutrient intake				
Energy(Kcal)	2425±315	1860±385	3.19	0.012*
Carbohydrates (g)	450.25±55.6	329.75±35.9	5.62	0.0005***
Protein(g)	39±5.2	34±4.2	2.09	0.0513NS
Fat (g)	52±3.9	45±2.8	5.62	0.0005***
Calcium(mg)	463±38.9	450±48.6	0.606	0.5613NS
Iron(mg)	25±7.2	26±6.3	1.94	0.1178NS
Retinol (IU)	520±45.7	415±52.8	4.29	0.0027**
Beta carotene(ug)	1098±355.6	1005±322.8	0.408	0.6940NS
Vitamin C (mg)	22.9±3.9	19.25±2.5	1.80	0.1096NS

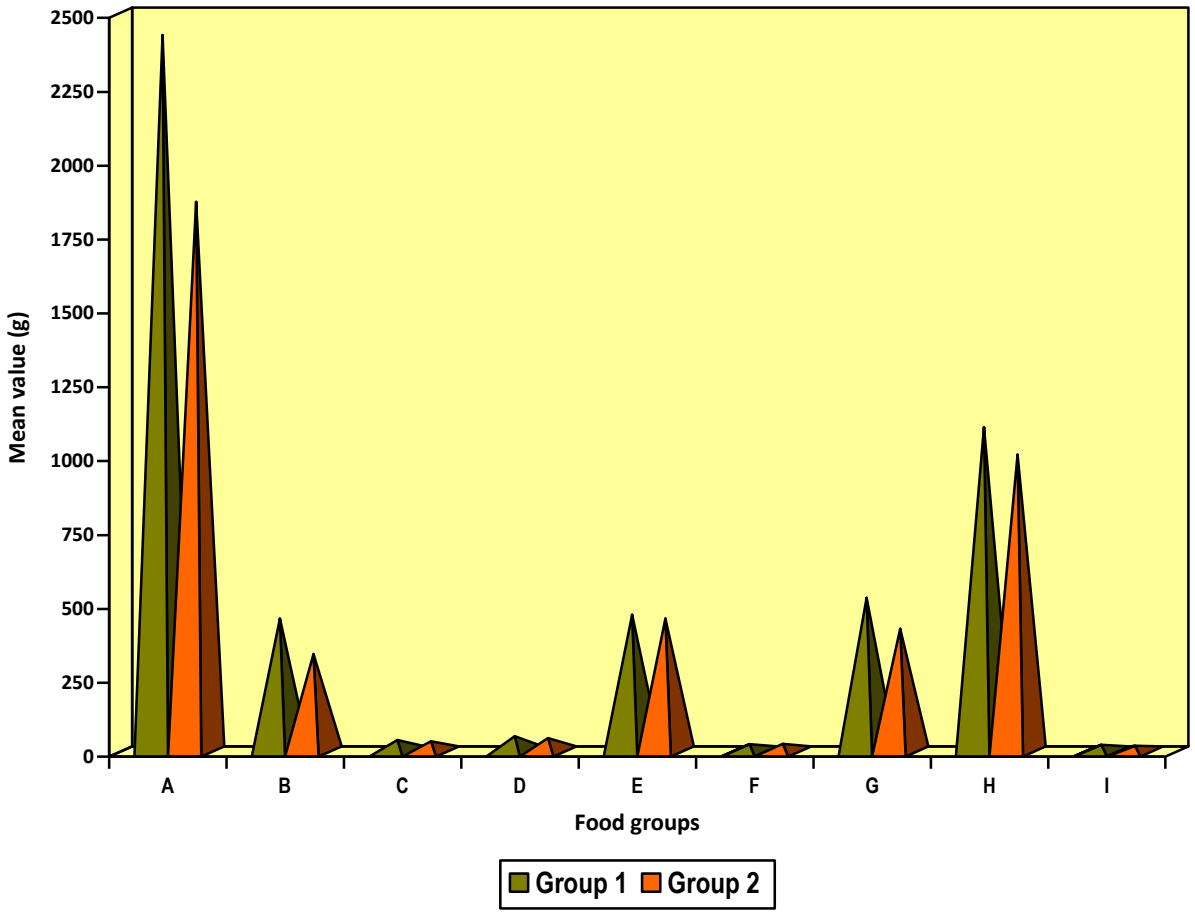
***extremely significant; ** very significant; *significant; NS – Not Significant

It could be observed from Table XL that there was profound difference in the consumption of cereals, meat, fats and oils and sugar and jaggery between the two groups, with group I consuming more. The



COMPARISON OF MEAN FOOD INTAKE OF THE SELECTED MATRICULATION SCHOOL CHILDREN WHO WERE REGULAR AND OCCASIONAL CUSTOMERS

FIGURE 18



A. Energy (Kcal)	F. Iron (mg)
B. Carbohydrate (g)	G. Retinol (I.U)
C. Protein (g)	H. Beta carotene (mcg)
D. Fat (g)	I. Vitamin C (mg)
E. Calcium (mg)	

COMPARISON OF MEAN NUTRIENT INTAKE OF THE SELECTED MATRICULATION SCHOOL CHILDREN WHO FREQUENTED AND DID NOT FREQUENT THE FOOD SERVICE OUTLETS

FIGURE 19

consumption of pulses, milk, green leafy vegetables, other vegetables, roots and tubers and fruits were more in group II.

In the case of nutrient consumption, carbohydrates and fats were significantly greater for group I. Statistical analysis showed that the difference was found to be extremely significant. The consumption of all other nutrients was greater for the regular patrons, but no statistically significant difference was observed. The consumption of non-vegetarian foods, sugar and jaggery as well as energy and retinol were found to be significantly higher for group I who were regular customers to the canteens.

No significant difference was found in the consumption of milk, fruits, vegetables and nutrients like protein, calcium, beta carotene and vitamin C. Though the consumption of protein by the customers to the food service was observed to be more due to intake of non-vegetarian foods, the difference in consumption when compared to occasional customers was found to be statistically insignificant. It could be observed that the food served in the food service outlet tended to increase energy and fat consumption of children without contributing much to other nutrients. There were more of snacks and junk foods. The consumption of junk foods led to the development of obesity and other related nutritional disorders among children. These children wasted food brought from home, mainly vegetables, leading to the lack of consumption of micro nutrients.

Paeratakul et al. (2003) found that children who reported eating fast food had higher intake of energy, fat, saturated fat, sodium, carbonated soft drink, and lower intake of vitamins A and C, milk, fruits and vegetables than those who did not report eating fast food.

Frequent consumption of fast food has adverse effects on nutrition because of excessive content of energy and fat and low nutritional value. (Sebastian et al. 2009 and O'Donnell et al. 2008). Moreover, Grier et al. (2007) associated the consumption of fast food with other poor nutritional habits.

4. Comparison of the food and nutrient intake of the selected Corporation and Panchayat school children

Table XLI shows a comparison of food and nutrient intake of those who

frequent outside eateries and those who do not among the Corporation and Panchayat school children.

TABLE XLI

COMPARISON OF MEAN FOOD AND NUTRIENT INTAKE OF THE SELECTED CORPORATION AND PANCHAYAT SCHOOL CHILDREN

(N = 1730)

Food groups	Corporation				Panchayat			
Food intake (g)	Group 1	Group 2	T value	p value	Group 1	Group 2	T value	p value
Cereals	355± 87.8	353± 90.7	0.315	0.76^{NS}	366± 79.6	363± 86.3	0.345	0.87^{NS}
Pulses	39.2± 4.2	38.5± 3.7	0.696	0.50^{NS}	36.9± 4.1	35.2± 3.9	0.576	0.6^{NS}
Green leafy vegetables	29± 4.5	27± 5.2	0.364	0.72^{NS}	32.9± 4.8	30.2± 5.7	0.287	0.69^{NS}
Other vegetables, roots and tubers	51.89± 8.7	52.75± 9.7	1.72	0.12^{NS}	50.5± 8.5	48.6± 7.8	1.68	0.13^{NS}
Fruits	13.6± 2.9	5.5± 3.9	3.64	0.0005*	15.8± 3.4	5.9± 2.6	3.98	0.0005*
Milk	87± 42.8	90.7± 35.7	0.589	0.57^{NS}	88± 34.8	86± 33.9	0.592	0.65^{NS}
Fats and Oils	53.45± 3.8	55.26± 4.2	0.911	0.38^{NS}	54.87± 3.6	53.29± 4.9	0.891	0.42^{NS}
Meat, fish and eggs	71.8± 11.6	69.5± 12.3	0.29	0.77^{NS}	73.2± 11.4	67.8± 12.9	0.38	0.87^{NS}
Sugar and jaggery	62.2± 11.2	45.2± 7.6	3.64	0.006*	60.3± 9.3	47.3± 6.2	3.78	0.005***
Nutrient intake								
Energy (Kcal)	2312± 431	2234± 422	0.910	0.38^{NS}	2098± 356	2063± 323	0.934	0.43^{NS}
Carbohydrates (g)	415.6± 50.7	384.6±55.6	0.922	0.38^{NS}	379.5± 51.8	359.8± 52.7	0.945	0.47^{NS}
Protein(g)	42.7± 8.2	47± 9.5	0.522	0.615^{NS}	43.23± 11.3	44.56± 12.1	0.621	0.71^{NS}
Fat (g)	53.2± 3.7	56.4± 4.6	2.84	0.02***	45.2± 4.8	49.5± 6.9	2.92	0.01*
Calcium(mg)	379.6± 24.1	335.2±21.8	3.99	0.0040***	389.1± 22.8	376± 23.7	4.22	0.003*
Iron(mg)	28.3± 7.9	28.6± 6.7	0.137	0.89^{NS}	26.8± 9.2	27.9± 7.8	0.126	0.92^{NS}
Retinol(IU)	499± 47.1	403± 45.2	2.04	0.07^{NS}	492± 54.2	395± 32.8	1.98	0.08^{NS}
Beta carotene (ug)	1056 ±312.1	998± 358.6	0.343	0.74^{NS}	1023± 276.2	945± 318.8	0.412	0.87^{NS}
Vitamin C (mg)	27.31± 3.9	25.9± 3.9	3.29	0.011**	24.23± 3.7	21.25± 2.5	3.91	0.012**

***Extremely significant; **Highly significant; *Significant; NS- Not Significant

From Table XLI it could be inferred that among food groups only fruits and sugar and jaggery were significantly different in the intake between the

two groups of Corporation and Panchayat school children who consumed and did not consume outside foods.

It could be observed that among the nutrients, a significant difference was observed for fat and calcium. There was greater fat intake due to fried food and fat rich sweets consumption by children from outside eateries and less calcium intake due to avoiding milk and consuming other beverages. A significant difference in vitamin C intake was due to the consumption of more fruits by children who ate in outside eateries compared to those who did not.

Though the intake of fruits from the outside eateries was an advantage, the way they were displayed for sale was found to be unhygienic.

Food and Agricultural Organization of the United Nations (2006) had described a similar situation in Tanzania. The deep fried foods help meet daily energy needs, but generally lack a variety of other nutrients essential for active growing children.

Unfortunately, in India too, energy-dense, but nutrient-poor, snacks are the only foods many of the children can afford.

UNICEF (2011) reported that Asians are susceptible to diarrhea and food poisoning from unhygienic meals. The bakery items prepared in street shops are never made with fresh oil and flour and can result in bad fat.

D. HEALTH AND HYGIENE PRACTICES IN THE FOOD SERVICE OUTLETS

1. Matriculation schools

a. Cleanliness of the canteen

The cleaning practices, in order to maintain sanitation in the food services, could be categorized as daily, weekly and spring cleaning techniques.

In food services offering waiter service in the form of leaf/plate service, daily cleaning was carried out for floors, plates, cooking and serving equipment, shelves where plates were placed, work surfaces, drawers and racks. In case of counter service outlets, counters, tabletops, floors, serving equipment and shelves inside counters were cleaned daily.

Weekly cleaning was done by dusting chairs, tables, mopping floors, cleaning display boards in counter service operations. Cleaning of floor, tables and storage areas were followed weekly in Waiter service area.

Spring cleaning involved cleaning of fans, removing cobwebs from ceiling, dusting window panes and doors, exhaust hoods, stoves, gas tops and large vending machines.

Disinfectants were used for floor and tiles. Mopping was done once or twice a week based on the sanitary conditions of the food service.

Cooking and serving equipment and utensils were cleaned using dish wash liquids. In all the three foodservices, manual cleaning was done.

Visual and physical inspection of food contact surfaces was periodically carried out by the managers of the food services to ensure cleanliness and sanitation. This procedure has been recommended by HACCP of USDA (2010).

b. Personal hygiene of the workers

Table XLII brings out the practices of personal hygiene followed in the school food service outlets.

TABLE XLII

PERSONAL HYGIENE OF WORKERS OF FOOD SERVICE OUTLETS

(N = 36)

Practices	Matriculation 1 N = 12		Matriculation 2 N = 10		Matriculation 3 N = 14	
	Yes	No	Yes	No	Yes	No
Employee in good health	12	0	10	0	14	0
Limited jewelry	12	0	10	0	14	0
Proper hand washing	2	10	3	7	5	9
Trimmed nails	2	10	0	10	2	12
Employee uniform	2	10	1	9	3	11
Usage of disposables when coughing and sneezing	0	12	0	10	0	14
Headwear	0	12	0	10	1	13

Table XLII depicts the hygiene practices observed among the foodservice workers. The management of the schools laid down rules for

employees to wear limited jewelry and held periodical medical check-ups to maintain the health of the employees.

However, facilities for hand washing were limited. The workers did not have the facility and practice of washing hands prior to handling food and after using restrooms. No instructions were given for washing hands before and after handling food. The workers touched non-food contact surfaces and used the same hands without washing to handle foods. Similarly trimming of nails was not practiced and only few personnel wore uniform.

While stressing the need for hand washing in food service establishments, Ramos (2010) opines that only through frequent and appropriate hand washing one can assure that hands are free of deadly bacteria and other contaminants.

c. Hygiene in food preparation and service

Compliance to hygiene in procedures followed in the pre-preparation, preparation and service of food in the food service outlets varied depending on the knowledge of the food service workers, their practices and facilities available. It could be observed that cleanliness of utensils and equipment was ensured through proper washing. The management had ensured the availability of potable water in the food services.

However, compliance was not found in pre-preparation, preparation and personal hygiene aspects. It was observed that vegetables were washed after cutting and the wash water was repeatedly used. Vegetables were cut long before preparation and left open.

Hand washing was not practiced among the workers prior to and after handling food.

Serving of food was not done at correct temperatures and wearing of gloves was not followed either during dishing out or serving of food. Food was handled with bare hands.

USDA (2010) procedure on HACCP has laid down recommendations for proper handling of food, cleaning hands and washing fruits and vegetables before they are cut to prevent the risk of food borne illnesses through

contamination. All these practices stressed the need for counseling on good food handling methods.

2. Corporation and Panchayat schools

a. Hygiene and sanitary practices

The quality of the food items sold in the outside eateries was poor with fruits being already cut and exposed to dust, flies and handled with unclean hands of the seller. Sweets and chocolates were stored in tin jars with no lids, while boiled grams were kept in open and distributed in newspaper packets, which made it soggy and the ink got stuck onto the food.

Flavored ice, being available in polythene packets was stored in open and the water from which they were prepared was not tested for microbial load.

Simopoulous and Bhatt (2000) have also pointed out that the microbial content of cut fruits was found to be high in Indian street foods. The street foods were found to be unsatisfactory from the point of view of appearance, smell, taste, edibility and freshness. It was found that 29.6 per cent of water samples provided by street vendors in Pune did not confirm to the water standards of potable water as laid down by WHO.

The results also indicated the need for imparting education on hygiene and sanitation to the food handlers.

PHASE IV: PROMOTION OF GOOD FOOD HABITS AND HEALTHY LIFESTYLE IN CHILDREN AND COUNSELING OF TEACHERS, PARENTS AND FOOD SERVICE PERSONNEL

A. Impact of nutrition education on children
B. Impact of counseling imparted to teachers, parents and food service personnel
C. Effect of intervention programme on children

A. IMPACT OF NUTRITION EDUCATION ON CHILDREN

The effect of nutrition education was assessed in terms of percentage scores using a questionnaire before and after conducting nutrition education for children. The mean scores obtained by the control group and experimental group are presented in Table XLIII. The data is also presented in Figure 19.

TABLE XLIII

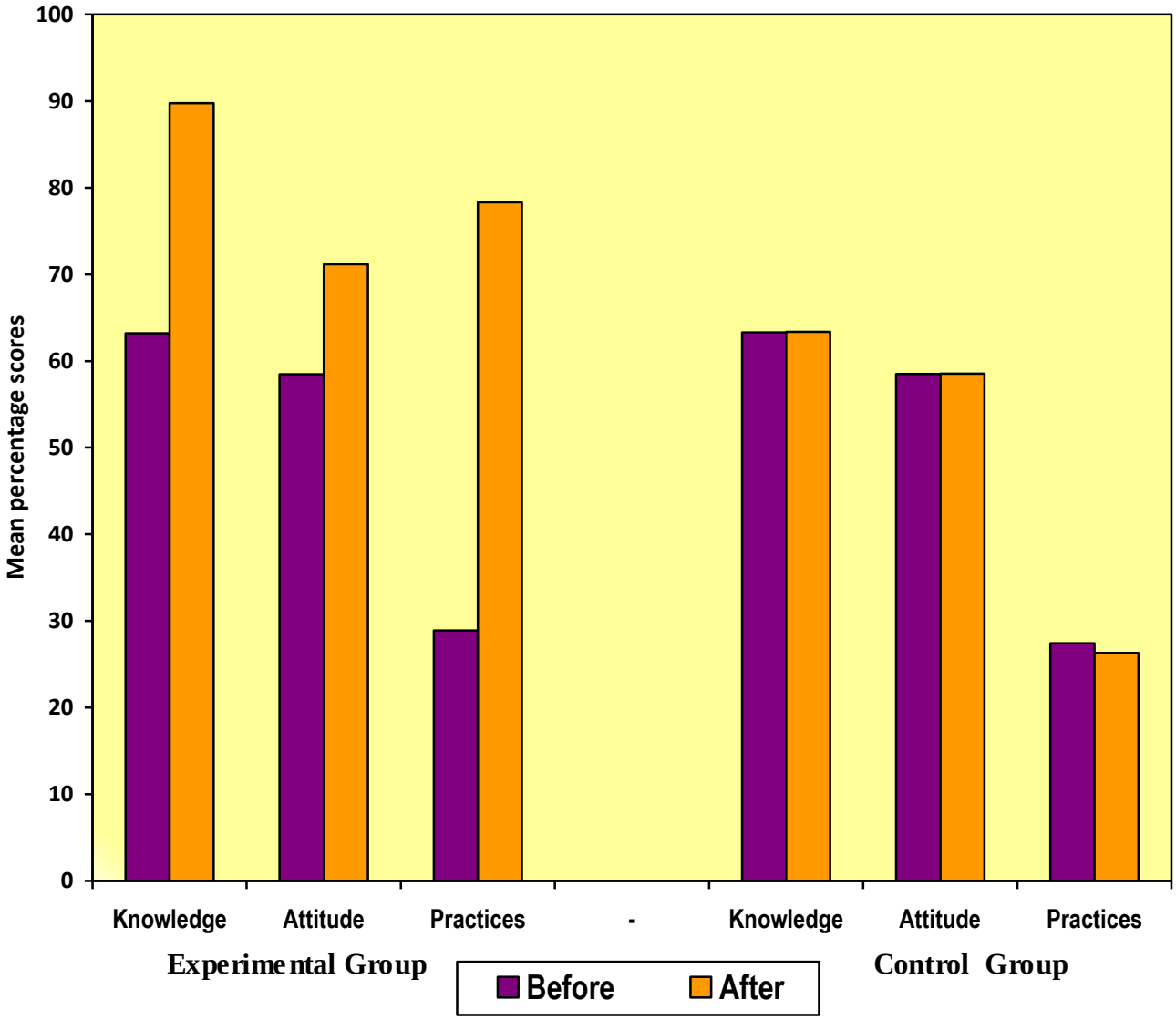
MEAN PERCENTAGE SCORES OBTAINED BY THE SELECTED CHILDREN BEFORE AND AFTER NUTRITION EDUCATION

(N = 3600)

Criteria	Experimental group (N=1800)				Control Group (N= 1800)			
	Before	After	t value	p value	Before	After	t value	p value
Knowledge	63.21 ±18.97	89.76 ±11.21	51.12	<0.0001**	63.30 ±19.52	63.38 ±21.31	1.69	0.06^{NS}
Attitude	58.46 ±16.34	71.15 ±24.12	18.48	<0.0001**	58.52 ±18.21	58.54 ±21.41	0.966	0.16^{NS}
Practices	28.91 ±14.25	78.31 ±22.12	79.65	<0.0001**	27.43 ±17.31	26.31 ±16.21	1.004	0.16^{NS}

**Significant at one per cent level; NS – Not Significant

From Table XLIII it could be observed that the scores obtained for knowledge, attitude and practices of the experimental group showed significant improvement after nutrition education. Improvement in knowledge was seen in terms of nutrient content of foods, daily food and nutrient requirements, types of foods needed by the body, quantity of foods consumed, ill effects of junk foods, health and hygiene aspects. The improvement in knowledge was statistically significant at one per cent level. The improvement in attitude was assessed in terms of preference for nutritious foods compared to junk foods, consumption of more vegetables and fruits and in the choice of suitable recreational activities. The scores obtained before and after



MEAN PERCENTAGE SCORES OBTAINED BY THE SELECTED CHILDREN BEFORE AND AFTER NUTRITION EDUCATION

FIGURE 20

education showed improvement which was statistically significant at one per cent level. The practices of children in the form of improved choice for good quality and perfect quantity of foods consumed, inclusion of more vegetables and fruits in the diet, improved physical activity and reduction in television viewing time was found to be highly significant at one per cent level.

Rao et al. (2007) and Sabariah et al. (2006) observed that nutrition education intervention produced significant improvements in nutrition knowledge, attitude and practices among primary school children. Similar observations were made while administering educational programme intervention by Tavakoli et al. (2009) who found out an increase in knowledge, attitude and practice of experimental group when compared to the controls.

Improvement was recorded in nutrition knowledge, concomitant with changes in dietary attitude and practices of the experimental group but not in the control group in the present study. A significant improvement was observed in case of experimental group while only a slight improvement was noticed in the control group which was not statistically significant. This slight improvement in scores could be attributed to the familiarity of the questionnaire by the children in the control group which prompted them to answer correctly.

B. IMPACT OF COUNSELING ON

1. Teachers

The impact of education of teachers, evaluated through a questionnaire helped to analyze the improvement in mean percentage scores after counseling compared to pre-counseling scores. Table XLIV shows the mean scores of knowledge, attitude and practices before and after counseling of the selected teachers.

TABLE XLIV

MEAN PERCENTAGE SCORES OF THE SELECTED TEACHERS BEFORE AND AFTER COUNSELING

(N = 500)

Criteria	Experimental (N=250)				Control(N=250)			
	Before	After	t value	p value	Before	After	t value	p value
Knowledge	46.32 ±16.31	81.65 ±18.13	22.91	<0.0001**	49.11 ±16.32	50.15 ±13.84	0.767	0.22^{NS}
Attitude	39.13 ±13.97	86.71 ±13.12	39.25	<0.0001**	36.71 ±15.21	37.25 ±15.16	0.39	0.35^{NS}
Practices	38.12 ±12.54	87.11 ±11.12	46.21	<0.0001**	28.32 ±11.36	29.27 ±12.73	0.88	0.19^{NS}

**Significant at one percent level ; NS – Not Significant

From Table XLIV it is clear that counseling brought out a significant impact and improvement in knowledge, attitude and practices of the selected teachers. The knowledge of the teachers on the physical growth of children, deficiency symptoms, nutrient requirements, sanitation of the environment and personal hygiene of children showed a marked improvement after counseling. This was found to be statistically significant. The attitude of the teachers in deciding to supervise the food habits of children and the practices of talking to students about good food habits, stressing on the habit of eating vegetables and fruits among the children, monitoring their height and weight, deficiencies, if any and enhancing their sanitary practices in the form of proper toilet training and hand washing showed marked improvement which was found to be statistically significant.

Involving teachers in counseling helped triangulation of information among the teachers- children and parents and led to modification of the negative food habits in children. Counseling led to effective implementation of good food habits during lunch in schools which improved in nutritional quality through inclusion of vegetables, legumes and potable water. In Matriculation, Corporation and Panchayat schools, use of water from filters for drinking purposes was stressed and children were instructed through teachers to drink only from those water filters.

Teachers also helped in effective transmission of information to children and their words had a better weightage even among stubborn adolescents.

Patino (2005) and Manios et al. (2006) feel that counseling for children involving teachers is especially important in these days of increased prevalence of life style disorders among children.

Garcia-Casal et al. (2011) and Kain et al. (2001) showed in their study that effective dissemination of information through teachers helped in modifying the dietary habits of children.

2. Parents

A questionnaire was administered to the parents before and after counseling. The impact of education was interpreted in terms of mean percentage scores obtained by the parents. Table XLV brings out the mean percentage scores for the control and experimental groups of parents before and after education.

TABLE XLV

MEAN PERCENTAGE SCORES OBTAINED BY THE SELECTED PARENTS BEFORE AND AFTER COUNSELING

(N = 500)

Criteria	Experimental (N = 250)				Control (N = 250)			
	Before	After	t value	p value	Before	After	t value	p value
Knowledge	33.34 ±16.32	79.13 ±16.14	31.5	<0.0001**	38.41 ±18.23	40.21 ±19.32	1.07	0.14^{NS}
Attitude	28.31 ±15.92	76.91 ±23.11	27.4	<0.0001**	24.43 ±13.65	25.76 ±14.27	1.06	0.15^{NS}
Practices	18.43 ±14.86	79.41 ±21.34	37.1	<0.0001**	17.36 ±5.32	17.43 ±6.54	0.13	0.45^{NS}

**Significant at one percent level; NS – Not Significant

From Table XLV it is clear that improvement in scores was observed among the experimental group of parents for whom nutrition counseling was imparted. There was no improvement in the control group. Improvement in knowledge was found to be significant at one per cent level. Improvements in knowledge regarding food groups, nutrients required for the children, food allergies, food restrictions and food fads and fallacies were noticed. Significant improvements in attitude of parents in providing breakfast for their

children, inclusion of more vegetables and fruits, restricting junk foods and the importance of physical activity were observed. Parents showed a change in practices to target better health for their children by restricting usage of saturated fats, fried snacks and including more sprouted grams, salads and nuts. Better methods of cooking and reduced frequency of consumption of outside food by the families were also noticed.

The main target in the counseling sessions was the mother who formed the back bone in determining the dietary intake of the children. Through repeated counseling sessions and by using various themes and methods, the mothers were counseled on the methods of providing appropriate food to maintain better health status of their children. Parents were also guided on modifying lifestyle activities like limiting the duration of television viewing, junk food consumption and encouraging outdoor play of their children.

Kipping et al. (2011) had recorded a similar observation in a school-based obesity prevention intervention in Bristol in the United Kingdom, where joint venture by both children and parents was highly effective in controlling unhealthy habits of the children in the form of junk food consumption and television viewing.

Golley et al. (2011) also found that food choices of children could be influenced through effective counseling of parents.

3. Food service personnel

The knowledge gained by the food service personnel through counseling was evaluated using a checklist. Table XLVI depicts the mean percentage scores obtained by the food service personnel before and after education.

TABLE XLVI

MEAN PERCENTAGE SCORES OF THE SELECTED FOOD SERVICE PERSONNEL BEFORE AND AFTER COUNSELING

(N = 36)

Factor	Experimental (N= 20)				Control (N = 16)			
	Before	After	t value	p value	Before	After	t value	p value
Knowledge	16.21 ±12.26	71.25 ±18.31	14.98	<0.0001**	19.31 ±11.31	21.81 ±11.45	0.932	0.18^{NS}
Attitude	29.37 ±13.14	76.91 ±13.12	15.36	<0.0001**	26.71 ±12.36	26.78 ±12.32	0.024	0.49^{NS}
Practices	18.11 ±12.61	67.23 ±11.64	17.17	<0.0001**	18.34 ±11.52	19.37 ±12.16	0.369	0.36^{NS}

**Significant at one percent level ; NS – Not Significant

Table XLVI shows the mean scores of the experimental and control groups. Prior to counseling, the mean scores of both the groups were low. However, the post-counseling scores improved greatly for the experimental group compared to the control group. The improvement was evident in following correct methods of pre-preparation, preparation and service of food which was statistically significant at one per cent level. Washing vegetables prior to cooking, cutting immediately before the commencement of preparation, keeping raw as well as cooked food in closed containers and wearing gloves while serving food were observed after counseling.

Attitude towards personal hygiene and sanitation in terms of hand washing, food handling during preparation and service enhanced after counseling. When assessed statistically, the improvement was significant at one per cent level.

Practicing safety procedures in terms of HACCP techniques showed good response among food service personnel who were counseled on those topics when compared to those who were not counseled. Practical demonstrations and posters on the methods of maintaining sanitation and hygiene such as washing fruits and vegetables before cutting, hand washing and environmental cleanliness yielded better results in improving such practices among the personnel. The improvement in practices of the personnel was found to be significant at one per cent level.

As part of counseling, educating the food service personnel on principles of safety and sanitation was also stressed and a continuing and effective training program was carried out with the help of the manager of the food service. Food service personnel were thoroughly indoctrinated in personal hygiene, as well as in the methods and importance of preventing food-borne illnesses. Posters on hand washing, maintaining food at proper temperature and safety operation of machines were displayed on the walls and other appropriate places.

Such activities have been endorsed by the United States Coast Guard (2003) as an effective method in preventing the spread of food borne illnesses, which is especially important in school food services.

When compared to the control group who did not undergo food safety training, the experimental group with training showed a significant improvement in knowledge after the training and the scores were significantly greater compared to the control group. A similar difference was found by Park et al. (2010) in his study carried out among food service personnel.

C. EFFECT OF INTERVENTION PROGRAMME ON CHILDREN

As an intervention measure, aerobic exercises, yoga and strict restriction of junk foods was carried out on selected groups of obese children. With the permission of school authorities, daily one hour yoga and exercise were taught and monitored by the investigator. Plate V highlights the intervention programmes carried out among the children. It could be observed that along with obese children, normal weight children also formed part of the sessions as the investigator did not want to differentiate obese children in order to avoid discrimination of children based on their body weight.

Body dimensions were assessed before and after a period of nine months.

Table XLVII provides information on the mean body dimensions before and after intervention in the three groups of children. Figure 21 also brings out the impact of intervention programmes.

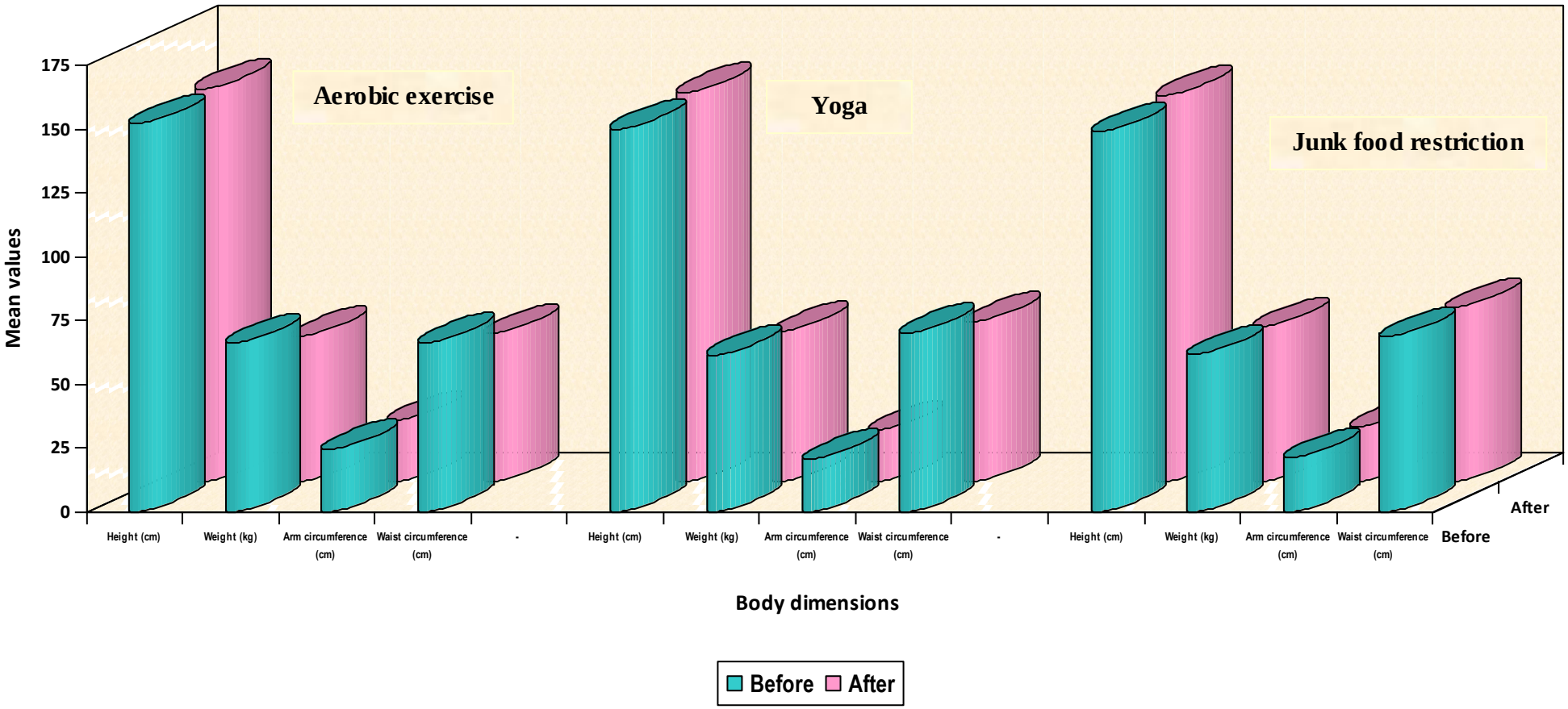
TABLE XLVII

MEAN BODY DIMENSIONS OF THE SELECTED CHILDREN BEFORE AND AFTER INTERVENTION

(N = 120)

Body dimensions Mean age 12 ± 2.3		Aerobic exercise				Yoga				Junk food restriction			
		Before	After	T value	p value	Before	After	t value	p value	Before	After	t value	p value
Height (cm.)	Boys	152.2 ±9.3	154.2 ±8.2	2.06	0.02^{NS}	150.1 ±8.6	152.8 ±9.1	1.11	0.14^{NS}	148.9 ±20.2	151.7 ±18.3	1.13	0.13^{NS}
	Girls	147.3 ±9.5	150.4 ±8.9	2.08	0.17^{NS}	149.6 ± 7.3	150.2 ±	1.99	0.18^{NS}	150.1 ± 7.1	150.8 8.2	0.48	0.68^{NS}
Weight (kg)	Boys	66.2 ±4.9	57.2 ±5.1	4.66	<0.0001**	61.4 ±11.4	59.1 ±11.2	1.58	0.25^{NS}	61.6 ±12.1	60.8 ±12.2	0.51	0.31^{NS}
	Girls	63.2 ±5.4	58.2 ±4.8	5.12	0.04*	63.2 ±9.4	62.9 ±7.3	1.77	0.22^{NS}	62.1 ± 11.2	61.9 ± 10.5	0.87	0.48^{NS}
Mid Upper Arm circumference (cm.)	Boys	24.5 ±4.8	24.2 ±5.9	0.43	0.33^{NS}	20.8 ±3.2	20.3 ±3.1	1.22	0.11^{NS}	21.2 ±2.1	21.8 ±2.6	1.31	0.19^{NS}
	Girls	21.9 ±3.6	21.7 ±4.2	0.49	0.67^{NS}	21.3 ±5.2	20.9 ±4.7	0.98	0.43^{NS}	20.7 ±4.6	19.8 ±4.8	1.54	0.26^{NS}
Waist circumference (cm.)	Boys	66.3 ± 8.9	58.1 ±5.6	9.58	<0.0001**	70.1 ±7.4	62.9 ±7.7	7.39	0.01*	68.7 ±6.8	68.2 ±6.9	0.57	0.62^{NS}
	Girls	69.2 ±7.3	60.5 ± 6.8	9.72	0.01*	68.2 ±8.2	62.8 ± 8.7	8.99	0.01*	68.4 ±7.5	68.7 ± 6.7	0.59	0.61^{NS}

**Significant at one per cent level; *Significant at five per cent level; NS – Not Significant



COMPARISON OF MEAN BODY DIMENSIONS OF THE SELECTED BOYS BEFORE AND AFTER INTERVENTION

FIGURE 21

Table XLVII brings out the impact of interventions on the selected anthropometric measurements of the children from the three categories. It could be observed that in all the three types of interventions, there was no significant difference in the heights of the children.

Any changes in height are a result of normal physiological process carried out in children. A general rule of thumb is that a child grows 5 to 6 centimeters (2.5 inches) from six years onwards each year until puberty. Girls average a peak height velocity of 9 cm/year at age 12 and a total gain in height of 25 cm during the pubertal growth period. Boys, on average, attain a peak height velocity of 10.3 cm/y 2 years later than girls and gain 28 cm in height. Similar changes in height have been recorded in the intervention groups where there was a normal increase in height unaltered by the extent of physical activity. A similar observation was made by Rogol et al. (2000) that exercise does not contribute to any changes in the height of children.

ICMR, Tenth five year Plan (2002 -2007) points out that it is unlikely that any extra food or exercise at the stage of adolescence can accelerate or extend the duration of physical growth. Additional dietary intake at this period can only lead to adolescent obesity

However, at the end of the intervention period of nine months, a significant difference in the body weights of the intervention group children was observed. The impact of aerobic exercises was more on weight reduction compared to yoga. This could be attributed to the extra energy expended in vigorous aerobic exercises compared to yoga. David (2009) brings out several advantages of aerobic exercise, chief among those being weight reduction and disease prevention.

No significant difference was observed in the group that restricted junk foods. Restriction of junk food consumption for a longer period would produce significant changes in physical stature.

Waist circumference decreased in the groups that performed aerobic exercise and yoga. The decrease was significant at one per cent level. There was no difference in the group for whom junk foods were restricted. Both aerobic exercises and yoga involved the exercising of abdominal muscles

which led to the decrease in waist circumference in these obese children. Physical activity was found to be essential for weight reduction in children and adolescents.

There was no significant difference in the mid-upper arm circumference values in any of the groups.

Lack of opportunity to engage in physical activity in schools and the growing availability of more sedentary alternatives have contributed to the rising prevalence of overweight, obesity and metabolic syndrome among children and adolescents. Aerobic exercises had an impact on both weight as well as waist circumference in children, while yoga influenced only a reduction in waist circumference. Though it was not tested, it is believed that yoga will improve both the mental and physical alertness in children.