CHAPTER 2

REVIEW OF LITERATURE

Adolescence is a developmental period from 10 - 19 years of age during which rapid changes in physical growth, maturation and psychological development occur (World Health Organization 1995). It is also considered as the second and the last chance to make up for lost opportunity of childhood for growth and development (Rhode 1993, Rao 1996). Improvement in nutrition health status during adolescence is of critical importance as it is inextricably linked with the quality of the next generation and therefore, will go a long way in improving national health (Tripathi et al 1985, Rao 1996). However, adolescents have remained a neglected group. Research and action programmes have focused largely on growth during pre-school age. It is encouraging that recent research on adolescent girls is gaining increasing attention, however, studies on adolescent boys in particular gender sensitive data on adolescent boys and girls are scarce. The literature relevant to the research topic has been organized under the following heads.

* Adolescents and gender
* Nutritional health status of adolescents : A gender perspective
* Environmental determinants influencing nutritional status of adolescent boys and girls
* Perceptions of adolescents regarding their own nutrition and health status

2. Adolescents and Gender

The term "Gender" is different from sex as it connotes social status. Comprehensively, sex is biologically determined whereas gender is a social construct which directs our behaviour and position in society (CHETNA, 1993). These social differences commonly phrased as "gender differences" are a result of socially perceived male and female roles and responsibilities (UNICEF 1993). A girl is expected to perform different domestic chores from boys – one that keep girl

closer to the home and may take more time than boy's chores. Consequently, girls are prevented from attending school and/or performing activities that contribute to their social, physical and cognitive development (Kurz and Prather 1995). Gender plays an important role in determining nutrition and health status.

In a report by Kurz and Johnson – Welch (1997) which summarizes data from 45 countries across the world revealed that girls have a higher mortality rate and poorer nutritional status than boys. The report further stated that according to National Family Health Survey (NFHS) in India, girl child mortality is more than twice that of boys in two northern states namely Uttar Pradesh and Haryana. Though the degree of the difference is not high as mortality, under nutrition prevalence tended to be high in girls. In Gujarat, Madhya Pradesh and Orissa, girl child mortality was higher by 20 to 45 percent. Fewer girls than boys received health care at a medical facility and immunizations. Another study by Desai (1995) in Vietnam demonstrated that girls under age 6 were significantly less likely to receive medical care than boys. When meager resources are available, it is the health of female that suffers the most.

Studies on feeding practices too have demonstrated preference for boys. In several Arab countries, girls were weaned before boys in order to bear second child soon and preferably son. However, its impact on nutritional status of girls was not assessed (Kurz and Johnson – Welch 1997). In India, rural Pune girls were exclusively breast fed for a shorter period than boys leading to higher prevalence of under nutrition in girls (Rao and Kanade 1992). On the contrary, in China girls were breastfed for longer duration - well past complementary food age compared with boys resulting in poor nutrition in girls. Nutrient intake of male and female too showed differences. In Narangwal – India, male female ratio of intake of micronutrients and energy favoured boys : 1.45 for calcium, 1.28 vitamin A, 1.19 protein, 1.14 iron and 1.16 for calorie (Pebley and Amin 1991). Another study in Bangladesh too reported similar male female ratio of intake of calorie and protein - 1.16 and 1.14 respectively (Chen Huq and D'Souza 1981). In another study in Indonesia, energy intake of boys was 42 % higher than for girls (Ralston 1997). The main two determinants of dietary intake were being a girl and

a growth index for adolescents. Hence, anthropometry is especially important during adolescence as it allows the monitoring and evaluation of the hormone - mediated changes in growth and maturation. World Health Organization (1995) has recommended certain anthropometric indicators for assessment of growth in adolescents and stunting and BMI (3rd percentile) as the criteria for under nutrition (Table 2.01).

Height for Age

According to Gopalan (1987), height measurement is a special index for socio-economic development in developing societies where the population segments have yet to find full expression to their genetic potential for growth. Quantification of height deficits in such populations could provide a measure of their underdevelopment. It was stated that not only height measurements will be helpful in monitoring secular trends in nutrition and economic status, they will also be useful in inter-regional and inter-class comparisons of nutritional status.

Table 2.01: Recommended Cut-off Values for Adolescents (World Health Organization 1995)

Indicator	Anthropometric Variable	Cut - off Values
Stunting or low height for age	Height for age (H-A)	< 3rd percentile or < - 2 Z scores
Thinness or low BMI for age	BMI for age	5th percentile
At risk of overweight	BMI for age	≥ 85th percentile
Obese	BMI for age	≥ 85th percentile BMI and
	skin fold thickness at triceps (SFTT)	≥ 90th percentile SFTT and
	skin fold thickness at subscapualr(SFTS)	≥ 90th percentile SFTS

According to the National Centre for Health Statistics (NCHS) standards, an increase of about 37 cms in boys' and 22 cms in girls' height occurs between 10 and 18 years of age. Most of the studies reported that the height deficits among poor adolescents became more pronounced with progression in adolescent years. Table 2.02 shows that in boys at the age of 10 years height deficits varied widely from 0.2 cms to 12.6 cms, which augmented to 6.0 cms - 16.8 cms by the age of 18 years compared with NCHS. During adolescence (10 – 18 years), the lowest increment in overall height was seen in Ahmednagar school children (18.9 cms) and the highest

in Italian boys (36.8 cms) followed by Rajasthani boys (35.6 cms). In other words, almost all the studies demonstrated that the total increment in height among boys was short of the NCHS norms (39.30 cms), demonstrating that overall catch up growth did not occur in these boys. Consequently, the height deficits were more at the age of 18 years than that were at the age of 10 years (Sing et al 1996, Kanani and Zararia 1996, Chatterjee et al 994, Shamssain 1989, Prazuck et al 1989, DeVilliers 1987, Gopaldas and Capoor 1981, Vijayaraghavan 1971).

In adolescent girls, a few studies illustrated catch up growth wherein the total height increment was higher than the NCHS norms : 23.2 - 30.42 vs. 22.5 cms (Table 2.02). In such instances, height deficits at the age of 18 years were less than the deficits at the age of 10 years (Kanani et al 1998, Chaturvedi et al 1996, Subapriya and Premakumari 1993). But a majority of the studies showed that height deficits in girls increased at the end of adolescence compared with the beginning, that is, the total increment in height among adolescent girls was below the NCHS standards (Table 2.02).

Peak Height Velocity (PHV)

Velocity of linear growth when plotted against age exhibits a sharp increase during certain years of adolescence. It rises to a maximum and then immediately begins to decline. This maximum velocity in linear growth is known as peak height velocity (Falkner and Tanner 1986). Table 2.03 presents a summary of the studies pertaining to age at PHV and height increment at peak height velocity (PHV). With regard to the age of PHV, no particular trend was evident in both boys and girls, considering socio – economic differences. In the boys, the age of PHV ranged between 11 - 12 years in poor Indian boys and 15 – 16 years in rural poor Bengali boys. Further, the highest gain in height at PHV occurred in affluent Gujarati boys - 12.09 cms and lowest in poor Indian boys - 5.16 cms (Gopaldas and Capoor 1981, Vijayaraghavan 1971). In the remaining studies, height increment at PHV in boys ranged between 6.76 cms and 9.57 cms.

Table 2.02 : Summary of Various Studies conducted on adolescent boys and girls with respect to Linear Growth

Author & Year	Place	Rural/ Urban	HSEG MSEG LSEG	Height (cms)		Height Deficits(cms) vs NCHS		Total Increment in Height (cms)
				At the age of 10 years	At the age of 18 years	At the age of 10 years	At the age of 18 years	
	Boys							
NCHS				**140.10**	**176.80**	-	-	**36.70**
Zoppi et al (1996)	Verona (Italy)	*	HSEG	139.90	176.70	0.20	0 10	36 80
Shamssain (1989)	Libya	Urban	HSEG	136.00	170.00	4 10	6 80	34 00
Prazuck et al (1989)	Mali (West Africa)	Rural	NR	NA	168 70	NA	8 10	NA
De Villiers (1987)	Tswania (Africa)	Rural	NR	138.17[a]	158 70	3 03	5 00	20 53[a]
Agarwal et al (1992)	8 states of India	Urban	HSEG	134.70	168.90	5.40	7 90	34 20
Gopaldas & Capoor(1981)	Gujarat	Urban	HSEG	135.01[b]	168 59[b]	5 09	8 01	33 58[b]
Vijayaraghavan (1971)	All India	Urban	HSEG	138.45[c]	168 40[c]	1.65	6 5	29 56[c]
Singh et al (1996)	Rajasthan	Rural	LSEG	128.40	164 00	11.70	12 80	35.60
Zarana & Kanani(1996)	Vadodara	Urban	LSEG	132 88	160 10	7.22	16 80	27.22
Rao (1996)	Pune	Rural	NR	128 20	157 17	11 90	19 63	28 97
Chatterjee et al (1994)	West Bengal	Rural	MSEG LSEG	131.08	165 12	9.02	11 68	34.04
Goyal & Chavan (1993)	Maharashtra	Urban	NR	147.60[d]	166 50[d]	5.17	10 30	18 90[d]
Vijayaraghavan (1971)	All India	Urban	LSEG	126.98[c]	156 35	13 12	18 55	29 37[c]
	Girls							
NCHS				**141.20**	**163.70**	-	-	**22.50**
Zoppi et al (1996)	Verona (Italy)	*	HSEG					
Shamssain (1989)	Libya	Urban	HSEG	137.00	158 00	4 20	5 70	21.00
Prazuck et al (1989)	Mali (West Africa)	Rural	NR	NA	160 9	NA	2 8	NA
De Villiers (1987)	Tswania (Africa)	Rural	NR	143 79[a]	166.80[a]	2 31	10 00	23 01[a]
Agarwal et al (1992)	8 states of India	Urban	HSEG	138 80	157 10	3 1	6.6	18 3
Gopalan (1989)	8 metro cities India	Urban	HSEG	141.20	158 80	0	4 90	17 60
Vijayaraghavan (1971)	All India	Urban	HSEG	138 90[c]	156 00[c]	2 3	7 4	17 1
Sing et al (1996)	Rajasthan	Rural	LSEG	131.50	150.10	9 70	13 60	18 60
Kanani et al 1998	Vadodara	Urban	LSEG	125 73	156 15	15 47	7.55	30 45
Agarwal & Kanani (1998)	Vadodara	Urban	LSEG	119.82	NA	21 38	NA	NA
Chaturvedi et al (1996)	Rajasthan	Rural	LSEG	128 93	153 43	12 27	10 27	24 50
Rao (1996)	Pune	Rural	NR	127 64	146 70	13 56	17 00	19 06
Chatterjee & Mandal (1991)	West Bengal	Rural	MSEG LSEG	131.66	151.98	9 54	11 42	20 32
Subapriya & Premakumari (1993)	Coimbatore	Urban + Rural	NR	124.00	148 00	17 20	15 40	24 00
Goyal & Chavan (1993)	Maharashtra	Urban	NR	147.70	158 90[d]	0 19	4 80	11 20[d]
Vijayaraghavan (1971)	All India	Urban	LSEG	128.35	149.10[c]	2.82	14 3	20.72[c]

a For the age of 11 - 18 years b For the age of 10 - 17 years c For the age of 10 - 16 years d For the age of 12 – 17 years * Reference charts LSEG Lower Socio Economic Group MSEG Middle Socio Economic Group
HSEG Higher Socio Economic Group

Table 2.03 : Studies Reporting Age of PHV and Height Gain at PHV among Adolescent Boys and Girls

Author & Year	Place	Rural/ Urban	HSEG# MSEG LSEG	Age at PHV (Years)	Gain in Height at PHV (cms)
	Boys				
Zoppi et al (1996)	Verona (Italy)	Reference charts	HSEG	13 - 14	7 40
Shamssain (1989)	Libya	Urban	HSEG	14 - 15	8 00
De Villiers et al (1987)	Tswanian (Africa)	Rural	NR	14 - 15	5.23
Agarwal et al (1992)	8 States of India	Urban	HSEG	14 - 15	7 70
Gopaldas & Capoor (1981)	Gujarat	Urban	HSEG	14 - 15	12 09
Vijayaraghavan et al (1971)	All India	Urban	HSEG	12 - 13	6.76
Sing et al (1996)	Rajasthan	Rural	LSEG	12 - 13	7 80
Zararia & Kanani (1996)	Vadodara	Urban	LSEG	14 - 15	8 34
Rao (1996)	Pune	Rural	NR	15 - 16	9 57
Chatterjee & Mandal (1994)	Bengal	Rural	MSEG LSEG	13 - 14	7 66
Vijayaraghavan et al (1971)	All India	Urban	LSEG	11 - 12	5 16
Goyal & Chavan (1993)	Maharashtra	Urban	NR	13 - 14	6 70
	Girls				
Zoppi et al (1996)	Verona (Italy)	Reference charts	HSEG	10 -11	6 60
Shamssain (1989)	Libya	Urban	HSEG	10 -13	5.00
De Villiers et al (1987)	Tswanian (Africa)	Rural	NR	10 -11	5.58
Agarwal et al (1992)	8 States of India	Urban	HSEG	10 -11	6 50
Vijayaraghavan et al (1971)	All India	Urban	HSEG	10 -11	6.10
Sing et al (1996)	Rajasthan	Rural	LSEG	12 -13	7.50
Chaturvedi et al (1996)	Rajasthan	Rural	LSEG	12 -13	6.93
Rao (1996)	Pune	Rural	NR	12 -13	5.80
Chatterjee & Mandal (1991)	West Bengal		MSEG - LSEG	12 -13	6 15
Vijayaraghavan et al (1971)	All India	Urban	LSEG	12 -13	6 00
Subapriya & Premakumari (1993)	Coimbatore	Urban + Rural	NR	13 -14	5 80
Goyal & Chavan (1993)	Maharashtra	Urban	NR	17 - 18	4 90

NR : Not Reported
HSEG : Higher Socio Economic Group MSEG : Middle Socio Economic Group
LSEG . Lower Socio Economic Group

In girls, PHV occurred earlier than boys, the age of PHV varied from 10 – 11 years in Indian affluent girls to 15 – 16 years in Tswanian girls (Vijayaraghavan et al 1971, De Villiers 1987). However, Comparatively more studies on girls stated that PHV took place between 12 and 13 years in poor girls and in Indian affluent girls, it was one year earlier : 10 – 11 years. But in affluent Italian and Libyan girls it was similar to poor girls : 12 – 13 years (Sing et al 1996, Chaturvedi et al 1996, Zoppi et al 1996, Agarwal et al 1992, Chatterjee and Mandal 1991, Shamssain 1989, Vijayaraghavan 1971). The velocity of height during PHV in girls was much lower than that reported for boys (3.56 cms - 6.21 cms vs. 5.16 cms – 12.09 cms).

Weight for Age

Weight for age (W-A) is a good indicator of current nutritional status in adolescents. Along with linear growth, increment in weight as per the NCHS norms is about 36 kg in boys and 22 kg in girls occur in normal adolescent growth. Studies reviewed have shown a varied pattern of weight gain in both adolescent boys and girls.

Many studies demonstrated progressive increase in weight deficits in boys compared to NCHS during pubertal growth, regardless of their socio-economic status (Table 2.04). However, weight deficits in affluent boys were less at the onset as well as at the end of puberty compared with poor boys. As is evident from Table 2.04, weight deficits in affluent boys ranged between 2.44 kg and 3.63 kg at the onset of puberty, whereas in poor boys the range was much higher : between 7.87 kg and 10.11 kg. Similar phenomenon prevailed at the age of 18 years too : 0.40 kg to 12.35 kg in affluent boys and 18.74 kg to 27.64 kg in poor boys. Further, weight deficits among Indian affluent boys were greater than in affluent boys from other countries. For example, Libyan affluent boys were lighter by 7 kg compared to NCHS, whereas weight of Indian affluent boys fell short of the NCHS norms by 9 kg (Table 2.04).

In affluent girls at the age of 10 years, weight deficits (versus NCHS) were lower than that seen in affluent boys : the affluent girls exhibited weight deficit of about 1 kg (Table 2.04). Also, girls were observed to be heavier than boys by at least 2 kg at 10 and 18 years of age (Table 2.04). Further the table demonstrates that Indian affluent girls showed higher weight deficits than girls from other countries. For

example, by the end of puberty, affluent girls in Libya overtook the NCHS norms by 3 kg, but affluent girls in India lagged behind by 7 kg (Shamssain 1989, Vijayaraghavan 1974). In Indian poor girls, weight deficits ranged between 13.78 kg – 21.19 kg at the end of adolescence (Table 2.04).

Total weight increment : Boys and Girls

During adolescence (10 – 18 years), total weight increment in boys ranged between 49 % and 87 % of the NCHS weight increment among the studies reviewed, whereas in girls the weight increment varied from 70 % to 117 % of the NCHS increment. Consequently, at the end of adolescence weight deficits were more pronounced in boys than in girls.

Peak Weight Velocity (PWV)

Velocity of weight increment plotted against age demonstrates a sharp rise during certain age of adolescent years. After maximum rise in weight it starts declining. This maximum velocity in weight is known as peak weight velocity (Falkner and Tanner 1986). It is often stated that peak weight velocity (PWV) affluent boys and girls occurs earlier than their poor counter parts. However, a summary of the studies presented here shows a different picture (Table 2.05). PWV occurred earliest in poor Rajasthani boys : between 12 and 13 years and much later in rural Pune boys : between 15 and 16 years (Sing et al 1996, Rao 1996). A similar range of period for PWV was also reported for affluent boys (Table 2.05). The weight gain during this period ranged between 4.60 (in Ahmednagar school going boys) and 7.76 kgs (in rural Pune boys).

In girls, in both poor and affluent groups age at PWV varied from 10 – 11 years to 15 – 16 years. Further, the weight gained also varied a lot (Table 2.05).

2.1.2 Prevalence of Under Nutrition

Stunting

According to World Health Organization (1995), the prevalence of under nutrition in adolescence is considerably lower than that in early childhood. Nevertheless,

Table 2.04: Summary of Various studies on Weight Growth among Adolescent Boys and Girls

Author & Year	Place	Rural/ Urban	HSEG MSEG LSEG	Weight (kg)		Weight Deficits (kg)		Total Weight Increment
				At the age of 10 years	At the age of 18 years	At the age of 10 years	At the age of 18 years	
	Boys							
NCHS				**33.20**	**68.90**	**-**	**-**	**35.70**
Zoppi et al (1996)	Verona (Italy)	*	HSEG	34.02	68 50	+0 82	0 40	34.48
Shamssain (1989)	Libya	Urban	HSEG	30.76	61.89	2.44	7.01	31.13
Agarwal et al (1992)	8 States of India	Urban	HSEG	28 70	59.70	4.50	9.20	31.00
De Villiers et al (1987)	Tswanian (Africa)	Rural	NR	34.14[a]	51 58	3 16	17 32	17 44[a]
Gopaldas & Capoor (1981)	Gujarat	Urban	HSEG	29.57[b]	54.85	3.63	12 35	25 28[b]
Vijayaraghavan et al (1971)	All India	Urban	HSEG	32 39[c]	55 54	0 81	8 61	23.15[c]
Sing et al (1996)	Rajasthan	Rural	LSEG	23.50	49.50	9 70	19.40	26 00
Zararia & Kanani (1996)	Vadodara	Urban	LSEG	25.33	43 27	7 87	25 63	17 93
Rao (1996)	Pune	Rural	NR	24.42	41.26	8 78	22 89	16.84
Chatterjee & Mandal (1994)	West Bengal	Rural	MSEG - LSEG	23.84	50.16	9 36	18 74	26.32
Goyal & Chavan (1993)	Maharashtra	Urban	NA	32.40[d]	46.50	9 7	20 66	14.10[d]
Vijayaraghavan et al (1971)	All India	Urban	LSEG	22.34	40.01	10.86	24.14	17 67
	Girls							
NCHS				**34.60**	**56.60**	**-**	**-**	**22.00**
Zoppi et al (1996)	Verona (Italy)	*	HSEG	34.06	56 67	0.54	+0 07	22 61
Shamssain (1989)	Libya	Urban	HSEG	33 75	59.58	0.85	-2.98	25 83
De Villiers et al (1987)	Tswanian (Africa)	Rural	NR	31.33[a]	49.44	3.27	7.16	18 11[a]
Agarwal et al (1992)	8 States of India	Urban	HSEG	29 60	49 00	5 00	7.36	19 40
Gopalan (1989)	4 metro cities of India	Urban	HSEG	31 70	48 6	2 90	8 00	16 90
Vijayaraghavan et al (1971)	All India	Urban	HSEG	33 58[c]	49 75	1 02	6 61	16 17[c]
Sing et al (1996)	Rajasthan	Rural	LSEG	24 50	39.80	10 10	16 80	15.30
Chaturvedi et al (1996)	Rajasthan	Rural	LSEG	22 34	39 8	12 26	16 80	17.46
Rao (1996)	Pune	Rural	NR	22.67	35.41	11.93	20 95	12 74
Chatterjee & Mandal (1991)	West Bengal	Rural	MSEG LSEG	24.47	43.89	10.3	12.8	19.42
Subapriya & Premakumari (1993)	Coimbatore	Urban + Rural		21.30	39.50	13 30	17.20	18 30
Goyal & Chavan (1993)	Maharashtra	Urban	NR	33 20[d]	43 20	10 40	13 49	10 0[d]
Vijayaraghavan et al (1971)	All India	Urban	LSEG	23.29	38 87	11 31	17.49	15.48

a For the age of 11 - 18 years b For the age of 10 - 17 years c For the age of 10 - 16 years d For the age of 12 – 17 years * Reference charts LSEG Lower Socio Economic Group MSEG Middle Socio Economic Group
HSEG Higher Socio Economic Group

Table 2.05: Studies Reporting Age of PWV and Weight Gain at PWV among Adolescent Boys and Girls

Author & Year	Place	Rural/ Urban	SEG#	Age at PWV	Weight Gain at PWV (kgs)
	Boys				
Zoppi et al (1996)	Verona (Italy)	Reference charts	HSEG	13 - 14	6 36
Shamssain (1989)	Libya		HSEG	14 - 15	6.35
Agarwal et al (1992)	8 States of India	Urban	HSEG	14 - 15	6.30
Gopaldas & Capoor (1981)	Gujarat	Urban	HSEG	14 - 15	4 96
Vijayaraghavan et al (1971)	All India	Urban	HSEG	13 - 14	5.38
Sing et al (1996)	Rajasthan	Rural	LSEG	12 - 13	4.60
Zararia & Kanani (1996)	Vadodara	Urban	LSEG	14 - 15	4.61
Rao (1996)				15 - 16	7.76
Chatterjee & Mandal (1994)	West Bengal	Rural	MSEG LSEG	14 - 15	6 57
Goyal & Chavan (1993)	Maharashtra	Urban	NR	13 - 14	4.60
Vijayaraghavan et al (1971)	All India	Urban	LSEG	14 - 15	6.71
De Villiers et al (1987)	Tswanian (Africa)	Rural	NR	14 - 15	4.52
	Girls				
Zoppi et al (1996)	Verona (Italy)	Reference charts	HSEG	12 - 13	4.96
Shamssain (1989)	Libya		HSEG	12 - 13	6 21
De Villiers et al (1987)	Tswanian (Africa)			15 - 16	4.78
Agarwal et al (1992)	8 States of India	Urban	HSEG	10 - 11	4.70
Vijayaraghavan et al (1971)	All India	Urban	HSEG	13 - 14	4 13
Sing et al (1996)	Rajasthan	Rural	LSEG	12 - 13	5.10
Chaturvedi et al (1996)	Rajasthan	Rural	LSEG	12 - 13	6 00
Rao (1996)	Pune	Rural	NR	12 - 13	3.76
Chatterjee & Mandal (1991)	West Bengal	Rural	MSEG LSEG	12 - 13	6.15
Subapriya & Premakumari (1993)	Coimbatore	Urban + Rural	NR	13 - 14	3 80
Goyal & Chavan (1993)	Maharashtra	Urban	NR	13 - 14	4.70
Vijayaraghavan et al (1971)	All India	Urban	LSEG	13 - 14	4.13

NR : Not Reported
SEG . Socio Economic Group
LSEG : Lower Socio Economic Group MSEG · Middle Socio Economic Group
HSEG Higher Socio Economic Group

research has shown a high magnitude of under nutrition among adolescents which is a cause for concern. The prevalence of under nutrition ranged between 23 and 55 % in adolescents with twice as many boys than girls suffering in India, Nepal and Benin (Kurz et al 1994). Singh et al (1996) in their study reported a similar finding - twice as many boys were shorter than the girls and also the difference was significant in the 14 - 15 years age group (42 % vs. 22 %). Shahabudin (2000) in his study on rural Bangladeshi adolescents corroborated that the proportion of shorter boys increased compared to shorter girls as adolescent years progressed . At the age of 10 years 33 % boys and a similar proportion of girls were shorter. At the age of 17 years, 77 % of boys and 52 % of girls were short. Bharti et al (199?) observed that prevalence of under nutrition was high among rural than in the urban children (78 % vs 68 %) and contrary to the findings mentioned earlier, more girls than the boys were undernourished in rural as well as urban areas.

Wasting

Wasting signifies current under nutrition status (below normal weight for age). Review showed that the proportion of boys with their weight below the standards increased with growing years of adolescence. Overall 86 % of urban poor adolescent boys surveyed in Vadodara had their weight less than 80 % of the standards. Further, age wise prevalence revealed that 56 % of the boys at 10 years had their weight less than 80 %, which was doubled by the end of adolescence, that is, all 100 % boys were under weight (Zararia and Kanani 1996). Another study conducted in rural parts of Pune revealed that under weight prevailed in 84 % and 79 % of the boys and girls respectively (Chiplonkar et al 1992). Similarly, the prevalence was also high in school going children of Tswana (De Villiers 1987). But, it was quite low in rural poor Rajasthan boys and girls : 26 % and 27 % respectively (Sing et al 1996). Studies conducted on urban poor girls of Vadodara city demonstrated that throughout adolescence, at least 80 % of the girls had their weight below 80 % of the reference standards (Kanani et al 1998, Kanani and Ghanekar 1995, Kanani and Mair 1992, Kanani and Bhargava 1992). Thus, the prevalence of under weight in adolescent boys and girls is high. Again, comparative data were not available.

2.1.3 Body Mass Index (BMI)

Body mass index (BMI) also known as Quetelet's Index is a measure of adiposity in the body. It is calculated as weight (kg)/height (m^2), which reflects fat reserve in the body independent of height. BMI < 18.5 signifies chronic energy deficiency (CED) which has also been further categorized in to mild (17 - 18.5), moderate (16 - 17) and severe (< 16). Some studies also apply criteria of BMI < 80 % of the reference standards (Must et al 1991) to assess under-nutrition.

Aurelius et al (1996) conducted a study on Hanoi school going children and reported that 50th percentile of BMI at 10 years of age was 14.3. This BMI value indicated that these children were severly undernourished as per the criteria mentioned earlier. But Singaporean youth were reported to well-nourished by Wang et al (1993). This study further showed that males were better nourished than the females (21.4 % vs 20.3 %). Similarly, 17 – 19 years old Indian army recruits were found to be adequately nourished as shown by mean BMI : 19.4 ± 1.24 (Chiplonkar 1996). Another study conducted in urban Hyderabad revealed a relationship between economic status and BMI : 10 – 18 years old affluent children had higher mean BMI values compared with their under privileged counterparts (15 – 20 vs. 14 –18). The same study further showed that BMI of both the boys and girls improved with advancing growth. However, on comparison it was observed that up to 14 years boys were better than girls regardless of their socio-economic status. But from 14 years onwards girls exhibited slightly higher BMI values (Rao et al 1993). Thus, nutritional status of boys as measured by BMI declined as they grew up. This finding was corroborated by another study carried out on urban poor Vadodara adolescent boys by Kanani and Zararia (1996). The same study further stated that the proportion of boys suffering from chronic energy deficiency (CED) boys increased as these boys grew. Similar observation was made by Zutshi and Kanani (1999) on school going boys of Vadodara city. Also, the prevalence of CED was four times higher in boys compared with the girls (40 % vs. 11 %). Overall CED prevalence was very high : 73 % in Vadodara girls and much higher in Rajasthani girls - 93 % (Kanani et al 1998, Chaturvedi et al 1996).

2.1.4 Mid Upper Arm Circumference (MUAC)

Arm constitutes soft tissues of muscle and fat. Mid Upper Arm Circumference (MUAC) is correlated, with intake of calories and protein. MUAC is a very useful and feasible method to assess the muscle mass (Gopaldas and Seshadri 1987). During adolescence, boys lose fat with maximum rate of loss coinciding with PHV. While in girls, process of fat accumulation slows down as growth progresses but absolute fat loss does not occur - as seen in boys. At the end of adolescence, boys have larger muscles and more strength than girls (Tanner 1970). Studies reporting increase in arm circumference of boys and girls during adolescence are relatively few. Compilation of these studies is presented in Table 2.06 – 2.07.

As is evident from Table 2.06 mean MUAC of Indian well - to - do boys and girls revealed little gender difference : 18.5 - 24 cms in the boys and 19.1 - 23.0 cms in the girls (Viajayraghavan et al 1974). Studies conducted in several regions of India among affluent boys showed that up to the age of 13 years, mean MUAC values of these boys were similar (Agarwal et al 1992, Gopaldas and Capoor 1981, Vijayaraghavan et al 1974).

As for poor boys, a study carried out on Gujarati (Vadodara) boys revealed marginal under nutrition (Table 2.06). At all ages, mean MUAC values of these boys were 2 cms to 3 cms below the values reported for affluent boys (Kanani and Zararia 1996). Usually, adolescent athletes have larger muscle mass compared to normal adolescents. But a study conducted on YMCA sports boys (14 - 16 years) of Chennai revealed MUAC deficits of about 2 cms compared with Indian well - to - do boys (Chandrasekhar and Jacob 1992, Vijayaraghavan 1974).

With respect to the girls, no difference existed in mean MUAC values of affluent girls of various studies (Agarwal et al 1992, Vijayaraghavan et al 1974). However, Easwaran and Devdas (1984) reported slightly lower mean MUAC values for affluent girls of Coimbatore and even lower for of girls belonging to middle and lower income group (Table 2.07).

Table 2.06 : Studies Reporting Mid Upper Arm Circumference (MUAC) Data in Adolescent Boys

Author and Year	Place	Area	SEG	MUAC (cms)								
				10	11	12	13	14	15	16	17	18
Vijayaraghavan et al (1974)	India	Urban	HSEG	18.5	19.2	20.1	20.8	22.0	23.0	24.0	-	-
Agarwal et al (1992)	India	Urban	HSEG	17.95	18.70	19.5	20.35	21.20	22.10	22 95	23 80	24 30
Gopaldas and Capoor (1981)	Vadodara	Urban	HSEG	17.92	18.82	19.98	19.94	20.36	20.86	22.09	23.07	
Chandrasekhar and Jacob (1992)	Chennai	Urban	YMCA sports children	-	-	-	-	20.6 – 22.9			-	-
Zararia and Kanani (1996)	Vadodara	Urban	LSEG	16.28	16.95	17.37	17.93	19.02	20 10	21.22	20.87	22.30

Table 2.07 : Studies Reporting Mid Upper Arm Circumference (MUAC) Data in Adolescent Girls

Author and Year	Place	Area	SEG	MUAC (cms)								
				10	11	12	13	14	15	16	17	18
Vijayaraghavan et al (1974)	India	Urban	HSEG	19.1	19.5	20.8	21.1	21.8	22.6	23.0	-	-
Agarwal et al (1992)	India	Urban	HSEG	19.05	20.0	20.9	21.7	22 35	22.8	23.0	23 0	-
			LSEG	16.9	17.5	17.6	-	-	-	-	-	-
Easwaran and Devdas (1984)	Coimbatore	Urban	MSEG	17.7	17.8	18.2	-	-	-	-	-	-
			HSEG	18.8	19.0	19.7	-	-	-	-	-	-

HSEG – High Socio Economic Group MSEG – Middle Socio Economic Group LSEG – Lower Socio Economic Group

2.1.5 Skin Fold Thickness (SFT)

Skin fold thickness (SFT) at triceps is basically a measure of subcutaneous fat in the upper arm. Wang et al (1993) in their study on Singaporean youth observed high correlation between BMI and SFT and suggested that SFT may provide fairly consistent rankings of adiposity. However, SFT measurements are not considered a reliable indicator because of intra and inter variability in taking this measurement. Perhaps owing to this reason and simplicity in taking height and weight measurements, comparatively few studies on SFT measurements in adolescents are reported.

As stated during adolescence, muscle mass in boys increases and proportion of subcutaneous fat decreases, while in the girls subcutaneous fat increases. Thus, a decline in SFT values among boys and increase in the SFT values among girls is seen during adolescent period. A relationship between income and proportion of subcutaneous fat at triceps in the boys has been observed in some studies.

As is evident from Table 2.08, mean SFT values for age in privileged boys varies from 8.8 - 13.8 mm at 11 years of age to 10.0 – 10.2 mm at the age of 18 years. While in poor boys, it ranged between 5.0 – 7.1 mm at the age of 11 years and 4.8 – 6.7 at 18 years of age (Table 2.08). The affluent boys in urban Delhi and India exhibited a decrease in SFT values during adolescent period (Vijayraghavan et al 1971, Shamssain 1989). On the other hand, mean SFT values were seen to increase in Gujarati affluent boys. Another study conducted in eight states of India revealed that up to the age of 15 years, SFT values in urban affluent boys increased, thereafter it started declining. By the age of 18 years, hardly any change in SFT values was evident. Similar to this, Libyan boys showed a slight increase in mean SFT values up to 12 years and then a decline was evident : as a result no difference in mean values was seen between 10 years and 14 years old. This suggests that there is no consistent trend in SFT during growth in adolescent boys. A similar trend was evident in poor boys also. Overall, studies revealed that in boys (except Gujarati boys) proportion of subcutaneous fat diminished to a certain extent with progression in adolescent years. Further, it was observed that though there was a variation in mean SFT values among affluent boys, the values were at least 2 mms

Table 2.08 : Studies Reporting Skin Fold Thickness (SFT) Data in Adolescent Boys

Author and Year	Place	Area	SEG	SFT (mm)								
				10	11	12	13	14	15	16	17	18
Vijayaraghavan et al (1971)	India	Urban	HSEG	8.5	8.8	8.9	8.5	8.3	8.1	8.0	-	-
Agarwal et al (1992)	India	Urban	HSEG	10.15	10.55	10.75	10.85	10.85	100.75	10.55	10 35	10.20
Gopaldas and Capoor (1981)	Vadodara	Urban	HSEG	10.15	10.24	10.33	11.33	12.24	12 53	11.93	12 0	-
Shamssain (1989)	Libya	Urban	HSEG	8.7	9.3	9.3	8.1	8.8	-	-	-	-
Kapoor et al (1991)	Delhi	Urban	HSEG	-	13.8	13.4	10.3	10.8	10.6	12.0	11.0	10.0
			LSEG	-	7.1	7.0	7 0	7.4	7.5	8.6	7.8	6.7
Chiplonkar (1990)	Pune	Army Recruits									7.2	
Chandrasekhar and Jacob (1992)	Chennai	Urban	YMCA sports children					6.6 – 8.3				
Zararia and Kanani (1996)	Vadodara	Urban	LSEG	5.03	5.45	5.66	5.52	5.28	4 90	4.98	4.31	4.78

HSEG – High Socio Economic Group
MSEG – Middle Socio Economic Group
LSEG – Lower Socio Economic Group

Table 2.09 : Studies Reporting Skin Fold Thickness (SFT) Data in Adolescent Girls

Author and Year	Place	Area	SEG	SFT (mm)								
				10	11	12	13	14	15	16	17	18
Vijayaraghavan et al (1971)	India	Urban	HSEG	10.6	10 2	12.1	12 7	12.8	13 2	14 1		
Agarwal et al (1992)	India	Urban	HSEG	12.15	13.25	14.15	14.95	15 55	15 95	16 0	16 0	-
Shamssain (1989)	Libya	Urban	HSEG	11.4	-	10.8	11 0	11 0	14.0	-	-	-
Kapoor et al (1991)	Delhi	Urban	HSEG	-	8.0	8.6	11.0	13.0	13.8	14 2	13 8	13 6
			LSEG	-	16.4	15 6	15 5	17 1	16 6	17.4	16 4	21.0
Easwaran and Devdas (1984)	Coimbatore	Urban	LSEG	7.6	7.8	11.5						
			MSEG	7.8	8.2	-						
			HSEG	7.9	8.7	11.9						

HSEG – High Socio Economic Group
MSEG – Middle Socio Economic Group
LSEG – Lower Socio Economic Group

higher than poor boys. This indicated a clear relation between economic status and SFT.

Similar to the boys, in girls proportion of adiposity in arms appeared to correlate with economic status. Privileged girls showed a higher amount of subcutaneous fat compared with underprivileged girls. The highest amount of subcutaneous fat at triceps was observed in urban affluent Delhi girls followed by the affluent girls of eight states in India (Kapoor et al 1991, Agarwal et al 1992). Affluent girls in studies by Vijayaraghavan et al (1971) and Shamassain (1989) had comparatively lower SFT values. While in poor girls, mean SFT values were less by at least 2 cms (Easwaran and Devdas 1984).

2.1.6 Iron Deficiency Anaemia (IDA)

Between 12 and 16 years, blood volume increases from 2.5 to 3.5 litres and growth reaches a peak during 12 - 14 years (Narsingrao 1985). Adolescence being a period of rapid growth, the risk of iron deficiency anaemia (IDA) re-appears for both boys and girls, after which it subsides for boys but remains for girls because of menstrual blood loss (Rajaratnam et al 2000). IDA has been recognized as a problem of high magnitude in adolescents - especially in girls.

There are numerous studies on IDA in girls and women as IDA in girls leads to poor reproductive performance, which ultimately affects health of future generations. The major consequences of IDA in girls and women are premature delivery, low birth weight babies and high maternal and infant mortality rates. The other equally important consequences of IDA are impaired psychomotor development and cognitive function, lowered maximal work capacity, reduced work out put and endurance resulting in poor economic development. However, these latter consequences affecting quality of life have not received as much attention as reproductive health consequences. Thus, in girl and women, there are far more number of studies on IDA compared to boys.

Haemoglobin (Hb) data on affluent adolescent boys was not available in literature reviewed. Contrary to common belief, overall magnitude of anaemia among

Table 2.10 : Prevalence of Anaemia among Adolescent Boys and Girls in Various Studies

Author & Year	Place	U/ R[b]	SEG	Age group (Years)	N	Mean Hb(g/dl)	% Prevalence	
							<11 g/dl	<12 g/dl
	Boys + Girls							
Iyer et al (2000)	Vadodara	U	HSEG	6 - 15	920	12 7	NR	21 0
Potdar et al (1993)	India	U	LSEG	10 – 19	138	NR	NR	55 0[@]
Regmi & Adhikari (1994)	Nepal	R	NR	10 – 18	1223	NR	NR	42 0[@]
	Boys							
Lwamboo et al (2000)	Tanzania	NR	NR	7 - 18	1688	NR	32 0	62 7
Chandrasekhar & Jacob (1992)	Chennai	U	NR	14 - 16	120	11 28	NR	65.0 – 85.0
Zararia (1996)	Vadodara	U	LSEG	10 - 19	124	13.12	NR	28 0
	Girls							
Malhotra et al (2000)	Delhi, UP & Rajasthan	R	NR	11 - 21	72	NR	NR	97 2
Sharma et al (2000)	Delhi & Rajasthan	U R	NR	11 - 18	520 185	NR	NR	61.9 85 4
Lwamboo et al (2000)	Tanzania	NR	NR	7 - 18	1712	NR	30.5	62 6
Rajaratnam et al (2000)	Coimbatore	U	HSEG	13 - 19	290	11 63* 11.52**	NR NR	40.7 45 2
Kanani & Bhargava (1992)	Vadodara	U	HSEG	10 – 12	166	11.30	41 0	71 0
Kanani & Sanghani (1992)	Vadodara	U	HSEG	13 – 15	184	11 70	46.0	54 0
Dubey et al (2000)	Jabalpur	R U	NR	9 - 17	NR	9.55 10.50	NR NR	91.0 51 0
Kanani & Shah (2001)	Vadodara	U	HSEG	11 - 14	91	11.8	12	30
Kanani & Sen (2001)	Vadodara	U	LSEG	11 - 16	160	11.3	33	62
Kanani & Mutreja (1998)	Vadodara	U	MSEG	10 - 15	259	10.70	46	77
Kanani & Agarwal (1998)	Vadodara	U	LSEG	8 - 13	473	9 93	75 0	90
Kanani & Poojara (1997)	Vadodara	U	LSEG	10 - 18	180	10.90	57	81
Kanani & Ghanekar (1995)	Vadodara	U	LSEG	10 - 19	60	9.30	90.0	NR
Kanani & Baxi (1991)	Vadodara	U	LSEG	10 - 18	105	9.0	97 0	NR

* Pre menarche ** Post menarche @ cutoffs level not available
U Urban R. Rural NR Not Reported
LSEG Lower Socio Economic Group
HSEG Higher Socio Economic Group

adolescent boys was high. Among poor boys a wide variation in IDA prevalence was evident : from 28 % in Vadodara to 85 % in YMCA athletes of Chennai at 12 g/dl cut off levels (Table 2.10). The mean Hb levels too varied –11.28 g/dl in Chennai boys to 13.12 g/dl in Vadodara boys (Kanani and Zararia 1996, Chandrasekhar and Jacob 1992).

What methods of estimation were used? Were they the same?

In girls, the affluent group exhibited higher mean Hb values compared to their poor counter parts (Table 2.10). Further, compared to boys, a very large number of girls manifested anaemia – 54 % to 97 % using 12 g/dl as cut off levels.

Yes. Was IDA moderate or mild?

To sum up, not only girls but many boys also suffer from anaemia. Anaemia is known to have adverse effects on sub maximal capacity and work output. Acknowledging the traditional role of men and boys as breadwinners and caretakers of family, a high magnitude of anaemia among this segment is also a matter of concern and should receive attention.

Yes

V. true

2.1.7 Morbidity

Adolescence is characterized by a low prevalence of most infectious and chronic diseases. They are generally considered healthy. Limited studies appeared to be available on morbidity among adolescents and in these studies the morbidity prevalence varied. A study conducted to assess point prevalence of morbidity on school children (5 - 16 years) in Imphal during the months of February to May showed that about 58 % of the school children suffered from at least one ailment (Yaima et al 1981).

which yr?

Kanani and Zararia (1996) in their study on urban poor adolescent boys observed that only 21 % of the adolescent boys suffered from ailments 15 days prior to the survey. The most commonly reported illnesses were cold, cough, fever and malaria. The illnesses lasted for about 3 - 6 days. It was further reported that treatment was sought generally for malaria - fever. No treatment or home remedies were taken for cold and cough. A similar trend in another study on 8 - 13 years old boys of urban Vadodara was found (Solanki 1981). A longitudinal study in Guatemala reported 39 % of the adolescents being ill (Martorell et al 1994).

In girls too morbidity prevalence varied. About 13 % of 10 - 18 years old girls experienced ailments during two weeks preceding the survey. The types of illnesses experienced were similar to that reported by boys (Kanani et al 1998). Another study on urban poor school going girls studied morbidity pattern in three seasons. The highest prevalence was observed in monsoon (43 %) followed by summer (33 %) and winter (15 %). In monsoons and winter, more than half of the subjects suffered from more than one ailment. Overall, an illness lasted for less than 4 days and majority of the girls sought treatment from doctors (Agarwal and Kanani 1998).

2.2 Environmental Determinants Influencing Nutritional Status of Adolescent Boys and Girls

As discussed earlier, adolescence is a unique opportunity to develop health behaviours, strengthen income earning potential and avoid a myriad of costly physical and social problems (Hecchinger 1992). For poor adolescents, it is a precarious juncture between an impoverished childhood and a demanding future. Numerous studies have shown that girls undertake heavy household work responsibilities early in their lives. However, correspondingly their food intake is not increased resulting in compromised growth and development. This is further compounded by reproductive cycles of pregnancy, childbirth and lactation imposing yet higher nutrition demands on girls. This occurs when the girls themselves are growing and developing. Consequently, inadequate pelvic growth takes place which in turn increases risk of maternal death from obstructed labour.

With regard to boys, the economic conditions too have grave consequences. Lower economic status motivates adolescent boys to take on a role of a provider and protector at an early age which generally results in dropping out from school. Consequently they are forced to accept labourer's job which have higher physical demands as they lack better qualification. Like in girls correspondingly, their food intake is not enhanced. And their growth and development is compromised especially in terms of reduced physical work capacity. This lowers their earning potential with far reaching consequences. Hence, to improve nutritional health status

of adolescents, a broad approach guided by six principles needs to be employed (Kurz and Johnson – Welch 1994).

- Improve adolescent's food intake
- keep boys and girls in school
- postpone first pregnancy
- reduce work load and improve work conditions
- improve adolescent's health for better nutritional status
- enhance girls' self esteem (Fig 2.01)

Of these six principles, food intake, energy expenditure (for example, work load), reproductive health (postponement of first pregnancy) and adolescents' health care are proximal factors which have direct impact on nutritional status of adolescents. Education of boys and girls are distal factors which are indirectly influenced by socio-economic variables. Some of these are family income, education and occupation of parents. Studies illustrating the association of proximal and distal factors with nutritional status of children are presented below.

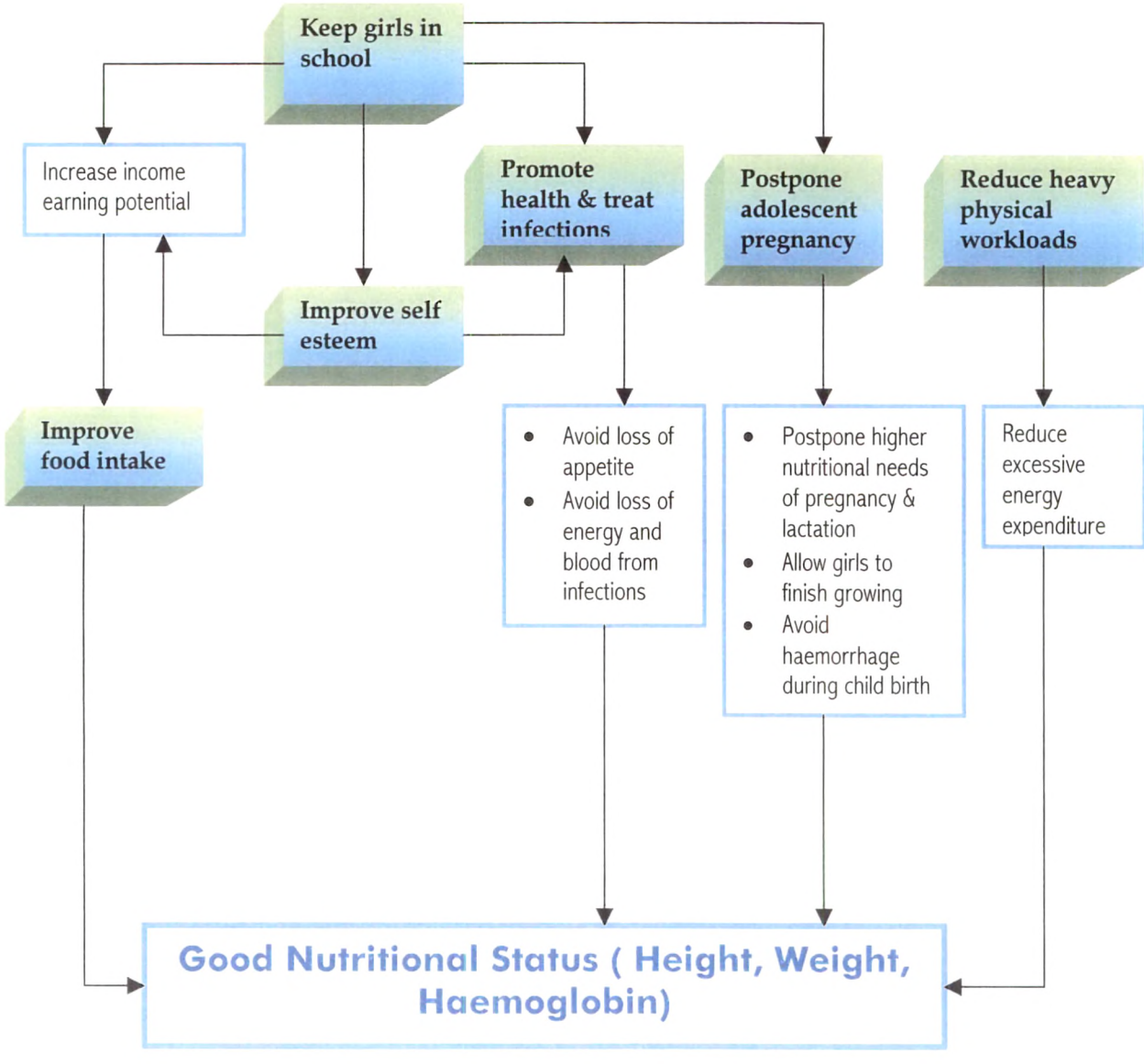
Nutrient Intake

According to Satyanarayan (1988) growth retardation among Indian children is more of environmental factors. Among the environmental factors, nutrition is the most important determinant than of racial and genetic origin.

The extent to which growth potential is realized depends on the availability of nutrition. Adolescence is also a period of increased nutritional requirements. Rapid accretion of new tissue and other wide spread developmental changes are accompanied by increased nutritional requirements relative to the childhood years. Because the onset of adolescence triggers a growth rate greater than any other stage, except the first year of life, adolescents have higher nutritional needs (Kurz 1994). More than 20 % of total growth in stature and up to 50 % of adult bone mass are achieved during adolescence resulting in a 50 % increase in calcium requirement. Studies on nutrient intake of adolescent boys and girls are discussed below.

Ca, P, Vit D, Vit A ?

Fig 2.01: Relationship Between the Six Principles and Adolescents' Nutritional Status



Source : Kurz and Johnson-Welch 1994

Energy

Daily requirement for energy during adolescent period takes into account energy required for basal metabolism, growth and activity performed by adolescents. Based on this Indian Council of Medical Reaserch (1989) has recommended 1907 to 2061 Kcal/day for 10 to 18 years old adolescent boys and girls.

In India, the common staple cereals consumed daily by the adolescent are reported to be rice, wheat, maize, jowar and bajra. Though cereals form major part of the diet, energy intake was found low among adolescents.

In boys, energy intake was reported to be as low as 57 % to as high as 86 % but never above RDA (Table 2.11). In girls, a similar range of energy intake was observed : 46 % in school going girls of urban Vadodara to 82 % in rural Rajasthani girls, with an exception of 102 % in 16 – 18 year old rural Rajasthani girls (Saru priya and Mathew 1988, Kanani and Mutreja 1998, Kanani and Poojara 1997, Chaturvedi et al 1996, Kanani and Ghanekar 1995). Further, Pant (1986) and Kanani (1984) reported that in 7 % of the school going children, energy intake was below 50 % of RDA. But Kanani and Sinha (1994) observed that mean energy intake of school going girls was 46 % that is, diet of the most subjects was grossly inadequate in energy. To sum up, high energy deficits in the diet of Indian adolescents prevailed.

Protein

Protein is essential as new tissues are synthesized and broken tissue are replaced. Quality of protein plays an important role in meeting nutritional requirements as optimal utilization of dietary protein depends upon availability of essential amino acids (EAA) in diet. Indian diet usually consists of either vegetable protein or combination of vegetable and animal protein. Based on this, RDA for protein for adolescents is 53 - 74 g/day (Gopalan et al 1989). In the literature reviewed adolescents obtained their protein from all kinds of dals, peas, cowpeas and rajma. However, diet of urban poor adolescent boys lacked in protein by 35 % – 40 % (Zararia and Kanani 1996, Kanani 1984). In contrast, protein intake among rural and affluent adolescents exceeded RDA (123 – 150 % of RDA). A similar trend in girls

Table 2.11 : Nutrient Intake as % RDA by Adolescent Boys and Girls as Reported in Various Studies

Author & Year	Place		SEG	Age Group (Years)	N	% RDA				
						Calories	Protein	Iron	Vitamin A	Vitamin C
	Boys									
Shatenstein & Ghadirian (1996)	Canada	U	HSEG	10 - 12	15@	1978	85	12.9	5385	132
				13 - 15	24@	2486	103	15.5	6583	177
				16 - 18	4@	2909	118	18.3	6181	266
Zararia & Kanani (1996)	Vadodara	U	LSEG	10 - 12	20	57	63	43	19.	98
				13 - 15	21	67	65	44	19	101
				16 - 18	9	62	60	40	18	108
Saruprıya & Mathew (1988)	Rajasthan	R	NR	13 - 15	NR	76	128	55	-	-
				16 - 18	NR	86	150	53		
Gopaldas & Capoor (1981)	Gujarat	U	HSEG	10 - 18	64	110	123	146	141	74
	Girls									
Shah & Kanani (2001)	Vadodara	U	HSEG	10 – 12	18	113	110	80	-	165
				13 - 15	32	94	89	46	-	130
Saruprıya & Mathew (1988)	Rajasthan	R	NR	13 - 15		82	146	44	-	-
				16 - 18		102	170	57		
Chaturvedı et al (1996)	Rajasthan	R	NR	10 - 12	64	71	-	-	-	-
				13 - 15	66	68				
				16 - 18	74	77				
Sen and Kanani (2001)	Vadodara	U	LSEG	11 – 13	30	46	43	30	-	52
				14 - 16	28	50	44	25	-	64
Kanani et al (1998)	Vadodara	U	LSEG	10 - 12	20	74	61	72	20	86
				13 - 15	20	70	60	46	19	50
				16 - 18	12	77	61	35	16	75
Mutrja & Kanani (1998)	Gujarat	U	LSEG	10 - 12	20	76	63	41	13	61
				13 - 15	20	66	54	43	12	32
Ghanekar & Kanani (1995)	Gujarat	U	LSEG	10 - 19	60	59	37	35	15	
Sinha & Kanani (1994)	Gujarat	U	LSEG	8 - 13	70	46	70	33	22	

@ Percent RDA not available

U : Urban R Rural NR : Not Reported

LSEG . Lower Socio Economic Group

HSEG Higher Socio Economic Group

was evident. In urban poor girls, protein intake fell short of RDA by 40 % - 50 %. But protein intake of tribal girls was more than adequate (Table 2.11).

Calcium

During adolescence, bones becomes longer and harder and are increased in number as well. Thus, calcium is crucially important micronutrient required for growth and bone formation. Calcium requirement is higher during early adolescence (600 mg/day) than in late adolescence (500 mg/day). However, adolescents consumed milk in small quantity generally in the form of tea. Further their diet consisted insufficient amount of vegetables.

Iron

As seen earlier, about one litre of blood is increased during adolescence placing higher demands on body for iron. Thus, RDA calculated to meet iron needs of adolescents, is expected to fulfill his/her basal iron needs, requirements for increased blood volume and make up for menstrual losses in girls. However, studies have shown that adolescents consumed inadequate quantity of iron rich foods and also frequency was less. Food frequency surveys in this department showed that adolescents did not like GLVs. To a large extent, pulses served as a substitute for vegetables in their daily diet or vice versa. Inclusion of these foods as complementary foods in their diet was infrequent. In addition, on one hand their diet lacked iron promoters and on the other hand, it was rich in iron inhibitors resulting in poor absorption of iron.

Studies conducted on urban poor adolescent boys and girls in Vadodara city demonstrated that their iron intake was below 50 % (Kanani and Zararia 1996, Kanani 1984, Kanani et al 1998, Kanani and Mutreja 1998, Kanani and Ghanekar 1998, Kanani and Sinha 1994). In tribal parts of Rajasthan, iron intake was slightly more than 50 % in boys but in girls, it was less than 50 % (Sarupriya and Mathew 1988). But among affluent boys of Vadodara city, iron intake was much above the RDA – 146 % and in girls - between 81% and 93%, which was much higher than their poor counter parts (Kanani and Bhargava 1992, Kanani and Sanghani 1992, Gopaldas and Capoor 1981).

Vitamin A

Vitamin A is essential for normal vision, integrity of epithelial tissues and for a wide variety of metabolic functions. Vitamin A requirement of adolescents is calculated using body weight of well-to-do children and growth. An adolescent is expected to ingest 600 µg retinol or 2400 µg β – carotene daily. However, diets of Indian adolescents have exhibited large vitamin A deficits in research reported. Yet overt vitamin A deficiency is uncommon.

In Vadodara city, vitamin A intake of urban poor adolescent boys and girls was below 20 % RDA (Kanani and Zararia 1996, Kanani 1984, Kanani et al 1998, Kanani and Mutreja 1998, Kanani and Ghanekar 1995). This was not surprising as consumption of vitamin A rich foods viz., milk, GLVs and fruits was very low in poor sections. But among affluent group, vitamin A intake was almost one and half times RDA : 141 % (Gopaldas and Capoor 1981).

Vitamin C

Vitamin C plays a significant role in synthesis of collagen, hormones, iron absorption, carbohydrate and amino acid metabolism. Low bio - availability of iron is one of the important factors causing anaemia among adolescents.

Vitamin C intake among urban poor adolescent boys was surprisingly adequate whereas that of affluent boys fell short by 25 % (Kanani and Zararia 1996, Gopaldas and Capoor 1981). This could be because of higher intake of local berries or fruits like amla, wood apple in poor sections. As it was observed that urban poor adolescents had a liking for these items and during recess time purchased these foods from vendors. However, vitamin C intake of urban poor girls was less than RDA by 40 % to 65 % (Kanani et al 1998, Kanani and Mutreja 1998).

The above discussions illustrate that adolescents do not get adequate nutrition and the reasons could be many. One of the most influential factors for inadequate nutrition considered is, cultural and traditional food behaviour. These practices have

been observed to lead to differential/preferential distribution of food within a family. Intra - household food distribution (IHFD) studies have brought out gender discrimination occurring during IHFD process. This is stated to be culturally inbuilt which has led to malnutrition in young children specifically girl child. Salient findings of these studies are discussed below.

Intra - Household Food Distribution (IHFD)

The distribution of food within a household has both physiological and socio-cultural basis (Hartog 1972). Food distribution (FD) within a family may not commensurate with meeting recommended allowances of individual members. Unequal FD could be intentional or unintentional owing to cultural or traditional practices. den Hartog (1972) while reviewing studies on food distribution patterns conducted across the world, commented that to a certain extent food behaviour is attuned to the physical requirements of men by giving them the best portions of the available food. It was observed that adult male - head of the family received the lion's share from family pot. These studies have shown a relationship between IHFD and nutritional status of children and women - girl child in particular.

What is IHFD ?

Before consuming food, the process of food purchase and its preparation at the household level takes place. Between its preparation and consumption, the process of food distribution within the family - termed as intra household food distribution (IHFD) occurs. In other words, IHFD refers to a pattern of eating and feeding that takes place in a household (Piwaoz and Viteri 1985). IHFD follows norms, which includes assumptions about the quantity, type and quality of food given to the member of the family generally depending upon their status, power and preferences (Rizvi 1978, Wheeler and Abdullah 1988). IHFD involves measurement of food intake of each member of family and analysis of household member's shares from family pool. Wheeler (1991) labeled IHFD as one of the household's survival strategies.

However, statements indicating discrimination for food within family have not been adequately backed by quantitative measurements of food intake (Wheeler 1991). Chimwaza (1982) observed that more food was served to head as a token of respect and appreciation. Since then it has been postulated and to a certain extent validated that the relative share of family food received by men, women and children has an impact on their nutritional state. Hence IHFD not only ascertains which age group and sex suffers most from malnutrition but also illuminates the process by which observed malnutrition occurs (Wheeler 1991). It attempts partly to answer the question : to what extent one age group and sex receives less of a food or nutrient and how much difference this makes to the satisfaction of nutrient requirements.

Wheeler (1991) in her review of studies carried out on IHFD in South Asian and African Countries noticed that in Bangladesh, meat was preferentially allocated to elders generally and to men, whereas women and children got a higher share of green vegetables. Specially large and fine portions of meat, fish and nicest looking fruits would be reserved for older men in the family as well as the men who were served first. Cantor and associates (1979) based on their observations hypothesized that food allocation process was influenced by a perception either of linear size or of productivity. In another study on farm families in Rajasthan, Sharma (1983) reported that foods were distributed on the basis of availability and preferences. If milk - milk products (ghee), vegetables, pulse were available in adequate amounts, they were served to all the members on the basis of their demand. If these items were available in small amounts, the major portion was served to the male and if it was left over then those foods were served to women and children. It was further stated that among 30 % of the study families where milk - ghee were inadequately available, these food were served only to the male. If a small amount was left then it was served to children. The females did not get these foods even if available. To conclude, bias in allocating meat, milk, fruits, vegetables, pulses and fats to males in societies which rely on cereal staples was common, resulting in dietary deficiencies of vitamin A, iron and folic acid.

Another study carried out on IHFD in a tribal population of Gujarat has discussed adequacy of nutrient intake among different age groups in relation to family head. As

is evident from Table 2.12, comparatively, the adolescent group (13 - 18 years) received a higher proportion of all the nutrients except calcium and vitamin C. Calcium and vitamin C intakes were highest in lactating mothers. This study did not show whether within each age group any gender difference among adolescents and children existed (Gopaldas et al 1983). But a study carried out in Philippines revealed that female adolescents consumed the least adequate diet, while fathers had better diets than the rest of the family (Valenzuela et al 1979).

Table 2.12 : Intra - House Hold Food Distribution in an average House Hold (Gopaldas 1983)

Age Group	Calorie	Protein	Calcium	Iron	Vitamin A	Vitamin C
Family Head (as % RDA)	90*	183*	105*	152*	29*	62*
	In proportion to Head - Male					
1 - 3 Years	< 0.5	0.33	0.5 - 0.67	0.33		0.5 – 0.67
7 - 12 Years	0.5	0.4	0.33	0.5	0.33	0.5
13 - 18 Years	0.9	0.8	1.14	0.9	0.9	0.9
Pregnant Women	0.83		1.11	0.89	0.52	0.74
Lactating Women	0.78	0.66	1.9	0.76	0.69	1.96
Elderly (> 55 years)	0.79	0.71	1.01	0.79	0.77	0.80

2.2.2 Distal Factors

"When under-ntutrition is rampant, the problem becomes more than one of medicine and public health and becomes a social, economic and political problem requiring extensive collaborative solution" (Goldsmith 1972)

Satyanarayan (1988) has stated that besides nutrition, available physical and physiological capabilities, the impact of economic and social placement, resource sharing position of the family and host of other factors on nutrition health status should not be disregarded. Research has shown secular trends in adolescent growth corresponding with the improvement in socio - economic status, illuminating a relationship between socio - economic variables and nutritional status. Singhania

(1987) investigated a correlation between income, occupation and parental education on child's growth and scholastic performance. The study revealed a positive association between these variables with child's growth and scholastic performance, that is, higher the income and parents education better was the growth.

Another study by Mukhopadhyay et al (1993) explored the relationship between health status of the community and environmental sanitation services. It was observed that percent prevalence of morbidity was significantly higher among slum dwellers in all ages and sex groups as compared to those living in pucca houses. Also, data pooled for all the ages illustrated higher morbidity prevalence among females than males residing in slums.

Engle (1993) studied the correlation between income of both parents and nutritional status of 8 - 47 month old children. The findings showed that in addition to total family income and total family expenses, income of mother and father, and contribution and percentage of total family income utilized were related to height for age and weight for age.

In Vietnam, the type of mother's occupation influenced height of 7 - 11 years old girls. In terms of height, weight and BMI, the girls whose mothers were workers and farmers were significantly shorter, lighter and had lower BMI values than girls whose mothers belonged to government staff group (Aurelius et al 1996).

Vali and Ali (1998) reported a positive association between income and weight of 12 - 15 year old school going girls in Nagpur. But another study on 13 - 15 year old girls in the same city - Nagpur observed that the diet was deficient in calorie , protein and iron even among the higher income group viz,. Rs 10,000 - 14,000 (Ghate and Vaidya 1998). The study however did not state a clear relationship between income and weight.

A study in this department investigated the association between variables such as anaemia, dietary intake, nutritional status and socio – economic variables in 8 – 13 year old school going girls. A significant relation ship was observed with occupation

of father and weight for age and percent prevalence of stunting with calorie, protein and calcium intake. Calcium intake was also significantly associated with weight for age and height for age. Multiple regression illustrated association between weight for age and height for age with educational and occupational status of mother. BMI was correlated with age of the subjects and haemoglobin levels of the girls. Further, mean values for height for age, weight for age and BMI tended to be higher in non - anaemic girls compared with anaemic girls. The study further stated that intake of calorie, calcium, iron and vitamin C was relatively higher in non - anaemic girls than anaemic girls. But no association was evident between socio – economic status and anaemia (Agarwal and Kanani 1998).

In sum, previous research has shown a positive relation between dietary factors and nutritional status in some studies whereas no clear trend was evident in other studies. Most research however, is reported on children. Studies on factors highlighting adolescent nutritional status in particular gender studies including both boys and girls are scarce.

2.3 Perceptions of Adolescent Boys and Girls Regarding Health, Nutrition, Anaemia and Maternal Child Care

Cannan (1996) stated that perceptions of girls about their own growth and development, dietary needs and maternal child health care are likely to influence health care practices in their own families in future. Most of the perception studies have elicited information from adolescent girls and data on perceptions of boys are scarce. The findings are discussed below.

2.3.1 Perceptions of Adolescent Boys and Girls Regarding Their Own Health Status

To assess perceptions regarding their own health status, adolescent boys and girls belonging to poor and affluent sections in Vadodara city were interviewed. At least 60 % of adolescent boys and girls from poor and affluent sections perceived themselves to be healthy (Kanani et al 1998, Zararia and Kanani 1996, Sanghani

and Kanani 1992, Bhargava and Kanani 1992). The reasons reported by boys and girls for feeling healthy were similar. They were – they did not fall sick, did not feel tired, ate properly/adequately or were active. Comparatively, a higher number of poor boys and girls than affluent girls stated themselves to be unhealthy - 40 % boys and 36 % girls from poor section vs. 12 % - 16 % girls from affluent group (Kanani and Zararia 1996, Kanani and Sanghani 1992, Kanani and Bhargava 1992). The proportion of older girls reporting themselves to be unhealthy was six times higher than the younger girls (Kanani et al 1998). According to these they they were not healthy as they felt tired easily, suffered from frequent illnesses and could not work normally such as performing domestic chores. Further probing on how does a healthy boy and girl look like revealed interesting findings. According to boys, a healthy adolescent boy is tall, well built, strong, active, looks good, is happy and does not fall ill often (Kanani and Zararia 1996). As for girls, a healthy girl was described as having more height and weight, active, energetic and capable of doing all types of work. A slight difference with regard to perceptions of "a healthy girl" emerged between younger and older respondents. Younger girls expressed that healthy girl is good and clean, whereas older girls considered a healthy girl to be active, energetic and with more strength (Kanani et al 1998). An unhealthy boy and girl were described as thin, weak, fell sick often and looked unhappy (Kanani and Zararia 1996, Kanani et al 1998).

With respect to their height and weight : more than 75 % of boys believed that their height and weight for age was appropriate, compared to fewer girls : 59 % (Kanani and Zararia 1996, Kanani and Sanghani 1992, Kanani and Bhargava 1992).

2.3.2 Perceptions of Adolescent Boys and Girls Regarding Balanced Diet / Nutritious Foods

Kanani and Zararia (1996) in their study on urban poor boys reported that only 60 % of the boys could respond to what is nutritious food. According to 40 % boys, GLVs are nutritious foods and another 20 % - 28 % of the boys considered fruits, legumes and milk - milk products as nourishing foods. Less than one fifth reported that animal products, other vegetables, cereals and fats - oils are nutritious foods. About 40 % of the boys were not aware of what is nutritious food.

The kinds of nutritious foods stated by at least one third adolescent girls of Vadodara city were similar to those mentioned by the boys (Kanani et al 1998, Kanani and Sanghani 1992). But a study on urban poor girls reported that only 26 % could correctly state that a balanced diet provides all the nutrients in required amounts and about 34 % of the girls could not respond to this question. The remaining 40 % presented either varied definition of balanced diet or names of various food stuffs (Kanani et al 1998).

2.3.3 Perceptions of Adolescent Boys and Girls Regarding Anaemia

What about the boys' views?

Available review has shown that data on this aspect have been collected from girls only. Studies conducted in this department have covered both affluent and poor sections and the findings are discussed here. Kanani et al (1998) in their study on urban poor adolescent girls observed that most of the older adolescent girls (94 %) had heard of anaemia while awareness about anaemia among the younger adolescents was quite low : 44 %. In another study on 10 – 15 years old urban poor school going girls showed that only 31 % of the girls knew about anaemia (Kanani and Sen 2001). But awareness was quite high among younger affluent girls - 71 % (Kanani and Shah 2001). The most common symptoms of anaemia reported by the adolescent girls were weakness (45 % - 51 %) and pale body/hands/nails (26 % - 29 %) Further, only 31 % - 44 % girls could state correct causes of anaemia viz., lack of nutritious food, GLVs or vitamin or iron rich foods in the diet and menstrual loss of iron. Knowledge about causes of anaemia high (91 %) among Delhi affluent girls (Kapil et al 1991). To enhance haemoglobin status, comparatively a higher percentage of affluent girls (76 %) than poor girls (59 %) reported that GLVs should be consumed. Further, to improve haemoglobin status, the affluent girls (29 %) mentioned of taking iron tablets while poor girls (36 %) reported of taking medicines (Kanani and Shah 2001, Kanani and Sen 2001).

The girls were further asked whether they themselves suffered from anaemia. More than 80 % of girls believed that they did not suffer from anaemia, but in reality anaemia prevalence among these girls ranged between 30 % among affluent girls and 75 % in poor girls (Kanani et al 1998, Kanani and Shah 2001, Kanani and Sen 2001).

2.3.4 Perceptions of Adolescent Girls Regarding Maternal and Child Health Care

Boy's perception?

Pregnancy and Lactation

A study was conducted on adolescent school going affluent girls of Delhi to assess their knowledge about diet during pregnancy and lactation. It was observed that 86 % of the girls had correct knowledge that a pregnant mother should eat more during pregnancy. A few (14 %) adolescent girls believed that a pregnant mother should eat less during pregnancy for smooth delivery. About half (44 %) girls felt that non – vegetarian foods should be avoided and 76 % reported that pulses should not be eaten during later part of pregnancy. About 30 % incorrectly stated that fat and ghee helps in faster recovery during postnatal period (Kapil et al 1991).

Child Feeding Practices

Kanani and Thakore (1989) in their study conducted semi structured interviews to assess knowledge of 10 – 19 years old adolescent girls about infant feeding practices. Out of 124 study girls, only seven percent believed that colostrum is good for child. About 46 % of the girls expressed that colostrum is not good for child and the remaining 47 % could not respond. Further, only half of the girls stated that breast feeding should be continued up to 10 – 12 months of age.

In another study on 10 – 12 years old urban affluent girls, 43 % of the girls stated that exclusive breast feeding should be continued up to 6 months, 23 % indicated 7 – 9 months and 16 % reported 10 – 12 months (Kanani and Bhargava 1992). A study by Kanani and Kak (1990) on 10 –18 years old girls from affluent sections showed that about three fourths expressed that breast feeding should be continued up to 6 - 12 months. The same study further showed that majority of the girls felt that complementary feeding should be initiated between 4 – 6 months. However, among slum dwelling adolescent girls, 16 % believed the same (Kanani and Thakore 1989).

Thus, overall the review indicates that a majority of adolescent girls from poor sections of the population are not adequately aware of correct nutrition concepts and practices which as a distal factor could indirectly influence their nutritional status.

Rationale for the Present Study

The preceding review has revealed that

1. Adoelscent growth is unsatisfactory in both boys and girls. Prevalence of undernutrition is high not only in girls but boys as well. However, comparative studies on adolescent boys and girls living in the same environment do not appear in literature. Research on boys is scarce. Yes.

2. Morbidity prevalence in adolescents is assumed to be lower than children and not much information is available, especially for boys.

3. Adolescents are not adequately informed about their dietary needs, recognition and management of common health disorders like under nutrition, anaemia, importance of adolescent period for future reproductive health and parenthood. There is a need to counsel and guide adolescents to improve their food intake and attain optimal growth and development.

4. Little is known about role played by proximal and distal factors in growth and development of adolescent boys and girls for example, diet, income, education and occupation of parents. Seasonal food intake comparing adolescent boys and girls is not available in literature. IHFD studies are scarce and have not adequately focus on adolescents.

Both adolescent boys and girls are vulnerable groups and need the attention of health programmes. Health of families is influenced by gender roles and responsibilities in the family and differential decision making power of men and women. Neither gender alone can bring uplifment of society. Hence, for the improvement of health and nutritional status of all family members, in particular women and girls, it is necessary to focus on boys and men as well. Yes.

With this background, the present study was conducted and the objectives are described in the Chapte 3.