

**ASSESSMENT OF NUTRITIONAL STATUS AND PREVALENCE OF MALNUTRITION AMONG SCHOOL GOING ADOLESCENT GIRLS IN URBAN AREA OF IMPHAL: A PROSPECTIVE CROSS SECTIONAL STUDY****Dr. Brah-macharimayum Sarita Devi**

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ABSTRACT

Background: Adolescent period is a period of rapid and extensive human development when child is transformed into adulthood. Nutritional requirement increases to a great extent during this period. Adolescence may represent a window of opportunity to prepare nutritionally for healthy adult life. The present study was intended to assess the nutritional status and prevalence of malnutrition among school going adolescent girls. **Materials and Methods:** This two-year prospective cross-sectional study was conducted in private schools in urban areas of Imphal among 600 adolescent girls of 11 -16 years. Data was collected using pre structured proforma including variables such as age, weight for age, height for age and BMI and also assess nutritional deficiency signs such as pallor, angular stomatitis and depigmented hairs. We also estimate Hb by Sahli's method after taking informed consent. Data analysis was done using IBM SPSS version 21. The results were summarised in mean, frequency and percentages. For the association between variables, sample t test was used. **Results:** As per WHO criteria, 77.3% were found undernourished (BMI<18.5Kg/m²), 33% had BMI <16, 15.8% had BMI 16-16.99Kg/m², 28.5% had BMI 17-18.49Kg/m² indicating that girls were having severe, moderate and mild thinness respectively. The major morbidities were pallor (32.3%), angular stomatitis (25.8%) and depigmented hair (26.6%). **Conclusion:** The present study recommends that efforts should be made to reduce the malnutrition status in school going adolescent girls and for this regular health check-ups should be done at schools with the help of school teachers and authorities and hospitals.

KEYWORDS : Adolescent girls, BMI, malnutrition, thinness**INTRODUCTION**

Adolescence is a period when child is transformed into adult man or woman. It encompasses physical, emotional, cognitive social growth, and development aspects bridging childhood and adulthood [1]. It is the process of developing from childhood to adulthood or more narrowly the years between the onset of puberty and attainment of maturity. It is a period of rapid and extensive series of anatomical, biochemical, emotional and psychosocial changes, encompassing the age range of 10-20 years [4,5].

The global adolescent population aged (10-19 years) is currently largest in recorded human history, with approximately 90% residing in low and middle-income countries (LMIC) [12]. Over 1.5 million adolescents and young adults aged 10-24 years died in 2021, about 4500 every day. Young adolescents aged 10-14 years have the lowest risk of death among all age groups [18]. Half of all mental disorders in adulthood appear to start by age 14, but most cases are undetected and untreated [2]. This data from the World health organization underlines the dismal situation of adolescent health affecting the world today.

One in 6 people are aged 10-19 years. Most are healthy, but there is still significant death, illness and diseases among adolescents. Illnesses can hinder their ability to grow and develop to their full potential. Alcohol or tobacco use, lack of physical activity, unprotected sex and / or exposure to violence can jeopardize not only their current health, but often their health for years to come [3]. This segment of age group and its welfare activities are often the most neglected segment of our society today.

The female segment of this group, being the weaker sex suffers from additional dangers of unwanted pregnancies, early marriage, poor social status, violence and discriminatory behaviour in the family. Vijaya Raghavan et al demonstrated that growth pattern of all girls are significant up to around 12.5 years, however, thereafter, shows significant deviation in economically deprived girls [6].

In adolescent and children, body mass index (BMI) is used to assess underweight, overweight and obesity. BMI is predictive for adult obesity related morbidity and mortality. Reduced BMI is indication of chronic energy deficiency (CED) or thinness which is common in

developing countries. The nutritional status of adolescents is often measured in terms of weight for height expressed as BMI.

This study was planned to study the prevalence of nutritional deficiency among this adolescent population (11-16 years) based on various clinical and anthropometrical criteria. We intend to use this data as a basis of a subsequent school education program planned for spreading awareness about nutritional deficiencies among school going girls and correction of faulty eating habits.

The study assesses the nutritional status of school going adolescent girls of 11-16 years of age of private schools at Imphal and also to find the prevalence of malnutrition among them in relation to BMI.

MATERIALS AND METHODS

This is a Prospective Cross Sectional Randomised Control Study conducted in selected private schools in the urban area of Imphal city over a period of two years from January 2023- January 2025. A total of 600 adolescent girls aged 11-16 years of any ethnic group were enrolled in our study. Those refusing written consent by parents and those girls having chronic diseases such as TB, DM, Nephrotic Syndrome, congenital defects and any other chronic illness were excluded from the study. A carefully planned Structured Proforma was used for collection of data including the variables such as age, weight for age, height for age, BMI using the formula (weight in Kg / height in m²) and assess signs of nutritional deficiency such as pallor, angular stomatitis and depigmented hairs. To avoid individual error, all measurements were taken by the principal investigator. DETECTO platform type beam balance measuring in kilograms with exact accuracy with zero error eliminated was used for measuring weight. Height was measured using an anthropometer having wooden platform 24"x 18" to which 10" wide vertical plane with 200 cm long steel measuring tape was fixed which could measure upto tenth of a centimeter. General physical examinations was done to see for the pallor, angular stomatitis and depigmented hair in all the girls. Estimation of hemoglobin was done under strict aseptic precaution by collecting blood by finger prick by Sahli's method. A systematic sampling method was used to identify the sample population after the male students made leave the classrooms. Sample size was calculated assuming 95% confidence level, 50% high risk prevalence (for the

sake of having larger sample size, it was considered taking 50% as appropriate) and acceptable difference of 4%. Assuming a nonresponse rate of 10%, the total sample size stood at 622. Only 600 of the female students were included in the final analysis, partly because many of the girls did not report their exact date of births. The data was entered in MS Excel sheet 2010 and analysis was done using IBM Statistical Package for Social sciences (SPSS) Version 21. The results were summarised in mean, SD, frequency and percentages. For the association between variables and malnutrition, sample t test was used. P value < 0.05 has been considered as significant. Ethical clearance was obtained from Institutional Ethics Committee.

RESULTS

A total of 600 school going adolescent girls aged 11-16 years were enrolled in our study. According to the age, we divided into 6 groups such as 11+, 12+, 13+, 14+, 15+, 16+. The mean weight in kg and SD being (28.64 ± 3.60), (31.69 ± 3.51), (35.13 ± 3.60), (38.29 ± 4.19), (41.57 ± 3.69), (41.89 ± 4.20) respectively in each age group (Table 1). The 50th and 3rd percentiles for the present study for each age group were (28.10 and 24.10) kg; (31.00 and 27.01) kg; (35.30 and 26.07) kg; (39.00 and 28.6) kg; (42.00 and 30.10) kg and (42.10 and 30.10) kg respectively. The 50th percentile for weight of the present study was significantly lower than corresponding 50th percentile of NCHS growth chart in all age groups. The 50th percentile value for weight in 11-15 years of age group of present study fall in between 5th -10th percentile of NCHS growth charts and 16 years age group fall below 3rd percentile of NCHS growth charts. (Table 1, Fig. 5)

The 3rd percentile for present study fall in between 3rd and 10th percentile in NCHS chart for age groups 11+ to 12+ years but found to be significantly lower in age group 13+ to 16+ and fall below 3rd percentile in NCHS growth chart. (Fig. 6)

Table 1: (Weight, Height and BMI and SD)

Sl No.	Age Group	Weight (Kg)		Height (cm)		BMI (Kg/m ²)	
		Mean	SD	Mean	SD	Mean	SD
1	11+	28.64	3.60	136.86	4.72	15.24	1.21
2	12+	31.69	3.51	140.92	5.20	15.93	1.13
3	13+	35.13	3.60	145.80	4.58	16.63	1.38
4	14+	38.57	4.19	149.80	3.27	17.04	1.56
5	15+	41.57	3.69	150.06	3.65	18.44	1.23
6	16+	41.89	4.20	150.86	4.02	18.37	1.36

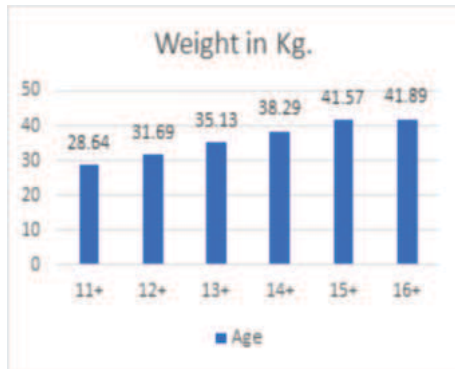


Fig.1 Mean Weight For Each Age Group

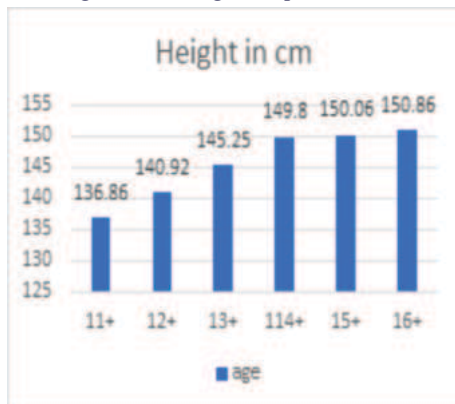


Fig. 2 Mean Height For Each Age Group

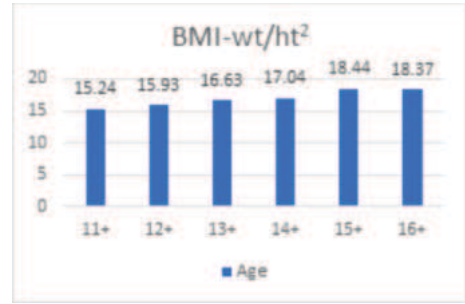


Fig.3 Mean BMI For Each Age Group

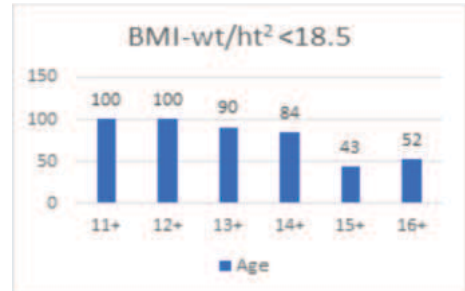


Fig. 4 Total No. of Cases with BMI < 18.5 kg/m² Each Age Group

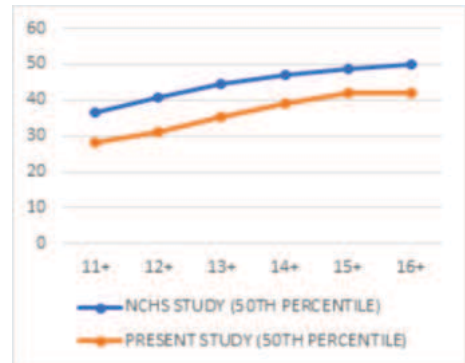


Fig. 5 50th Percentile Weight of Present Study Compared with 50th Percentile of NCHS

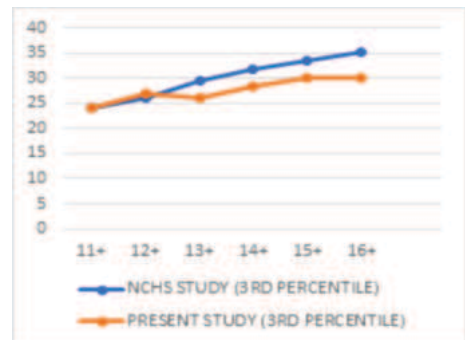


Fig. 6 3rd Percentile Weight of Presnt Study Compared with 3rd Percentile of NCHS

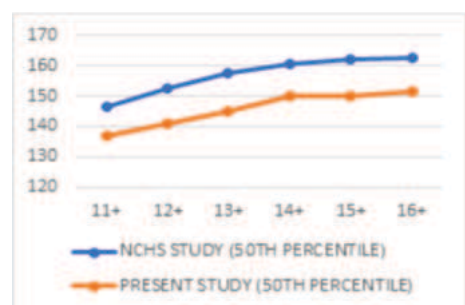


Fig. 7 50th Percentile Height of Present Study Compared with 50th Percentile of NCHS

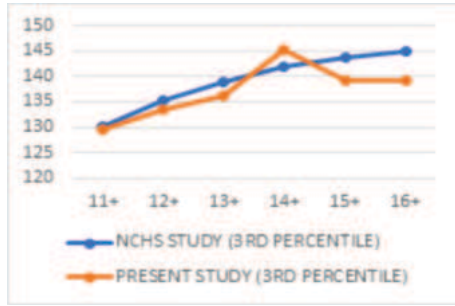


Fig. 8 3rd Percentile Height of Present Study Compared with 3rd Percentile of NCHS

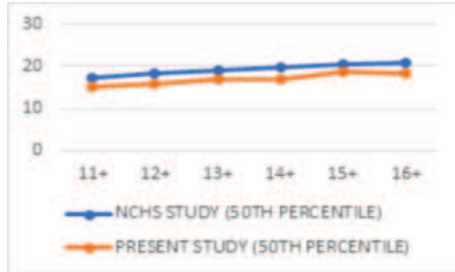


Fig. 9 50th Percentile BMI of Present Study Compared with 50th Percentile of NCHS

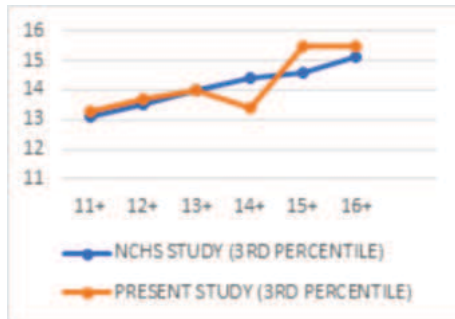


Fig.10 3rd Percentile BMI of Present Study Compared with 3rd Percentile of NCHS

Table 2. Total No. of Cases With BMI <18.5 in Each Age Group

SL NO	AGE GROUP	NO OF GIRLS WITH BMI<18.5 (n)	PERCENTAGE
1	11+	100	100%
2	12+	100	100%
3	13+	90	90%
4	14+	84	84%
5	15+	43	43%
6	16+	52	52%

Table 3. Distribution of Girls According to Grades of BMI

BMI-WT/HT2	NO. OF CASES (n)	PERCENT (%)
<16 (grade-3 thinness)	198	33
16-16.99- (grade 2 thinness)	95	15.8
17-18.49 (grade – 1 thinness)	171	28.5
18.5-24.99 (normal)	136	22.7
Total	600	100

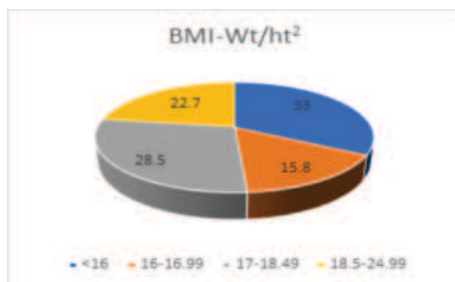


Figure 11. Distribution of Girls According to Grades of BMI
(P value 0.014)

Table 4. Mean HB in Relation to BMI

BMI – wt/ht2	Mean Hb
<16	12.08
16-18.49	11.72
>= 18.5	11.85
Total	11.87

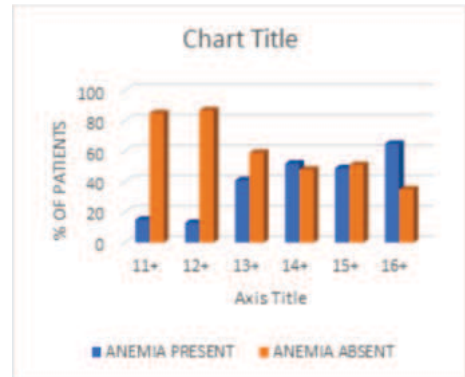


Fig 12. Percentage of Anemia in Each Group
(P value <0.001)

Table 5. Percentage of Cases of Anemia Accoring to Grades of BMI

	BMI – wt/ht2			
Anemia	<16	16-18.49	>= 18.5	Total(n)
PRESENT	50 (25.3)	121 (45.5)	64 (47.1)	235(39.2)
ABSENT	148 (74.7)	145 (54.5)	72 (52.9)	365(60.8)
TOTAL	198 (100)	266 (100)	136 (100)	600 (100)

Table 6. Signs of Nutritional Deficiency

SL NO	AGE GROUP	PALLOR (%)	ANGULAR STOMATITIS (%)	DEPIGMENTED HAIR(%)
1	11+	16%	24%	18%
2	12+	15%	25%	30%
3	13+	29%	25%	21%
4	14+	33%	24%	25%
5	15+	42%	33%	34%
6	16+	59%	24%	32%
	TOTAL	32.3%	25.8%	26.6%

Table 7. Statistical Data of Factors Deciding Malnutrition in Present Study in Comparison with Standard Charts

Age	P(%)	a.s (%)	dh (%)	Wt (NCHS)	Ht (NCHS)	BMI (NCHS)
11+	16	24	18	5th -10th	5th -10th	5th -10th
12+	15	25	30	5th -10th	3rd -5th	5th -10th
13+	29	25	21	5th -10th	3rd-5th	10th- 25th
14+	33	24	25	5th -10th	5th- 10th	5th -10th
15+	42	33	34	5th -10th	5th	10th- 25th
16+	59	24	32	Below 3rd	3rd- 5th	10th- 25th

(p= pallor; a.s= angular stomatitis, dh= depigmented hairs, wt= weight; ht= height, BMI= body mass index)

The mean height (in cm) and SD for the present study from 11-16 years age groups were (136.86 ± 4.72), (140.92 ± 5.20), (145.25 ± 4.58), (149.80 ± 3.27), (150.06 ± 3.65) and (150.86 ± 4.02) respectively in each age groups. (Table1)

The 50th and 3rd percentiles for the present study for each age group were (137.05 and 129.40) cm; (141.05 and 133.50) cm; (145.10 and 136.16) cm; (150.00 and 145.10) cm; (150.10 and 139.30) cm and (151.30 and 139.30) cm respectively.

The 50th percentile for height of the present study was significantly lower than corresponding 50th percentile of NCHS growth chart in all age groups.

The 50th percentile for height of present study of 11⁺ and 14⁺ years age group showed to be between the 5th - 10th percentile of NCHS growth chart and 50th percentile of 12⁺, 13⁺ and 16⁺ years age groups in between 3rd and 5th percentile of NCHS growth chart and for 15⁺ years age group fall on 5th percentile of NCHS growth chart. (Fig.7)

The 3rd percentile for height of the present study of age group 11⁺, 12⁺, 13⁺, 15⁺, 16⁺ were lower than 3rd percentile of NCHS growth chart, while 3rd percentile for 14⁺ age group of present study showed to be in between 3rd and 5th percentile in NCHS growth chart. (Fig. 8)

The mean values and SD of BMI (Kg/m²) of the present study for 11⁺-16⁺ years of age group were (15.24 ± 1.21); (15.93 ± 1.13); (16.63 ± 1.38); (17.04 ± 1.56); (18.44 ± 1.23) and (18.37 ± 1.36). The 50th percentile for BMI of the present study were significantly lower than corresponding 50th percentile of NCHS. The 50th percentile of BMI of present study group from 11⁺, 12⁺ and 14⁺ years were found to fall in between the 5th and 10th percentiles of NCHS BMI chart and for age group 13⁺, 15⁺ and 16⁺, its 50th percentile was in between 10th and 25th percentile of NCHS chart. The 3rd percentile for the present study for age group 11⁺, 12⁺, 13⁺ fall on 3rd percentile of NCHS and for the age group 14⁺, it lie below 3rd percentile on NCHS chart and for age groups 15⁺ and 16⁺, it fall on 3rd-5th percentile on NCHS. (Table 1, Fig. 9, 10)

In the present study, signs of nutritional deficiency like pallor, angular stomatitis and depigmented hairs were studied. The prevalence of pallor suggestive of anaemia was high after 14 years old age group. 16%, 15%, 29%, 33%, 42% and 59% of girls in respective age group (11⁺-16⁺ years) had pallor. Signs of Vitamin B complex deficiency were evidenced by angular stomatitis, glossitis and c/o hair fall given by girls. 24%, 25%, 25%, 24%, 33% and 24% of girls in each respective age groups had angular stomatitis. 18%, 30%, 21%, 25%, 34% and 32% in each respective group had depigmented hair. (Table 6, 7)

We also found that 11⁺ and 12⁺ age groups had BMI < 18.5 Kg/m² in all 100 cases each and 90%, 84%, 43% and 52% had BMI < 18.5 Kg/m² in 13⁺, 14⁺, 15⁺ and 16⁺ respectively (Table 2)

We studied the distribution of girls according to various grades of BMI. 77.3% were found undernourished (BMI < 18.5 Kg/m²), 33% had BMI < 16, 15.8% had BMI 16-16.99 Kg/m², 28.5% had BMI 17-18.49 Kg/m² indicating that girls were having severe, moderate and mild thinness respectively (Table 3, Figure 11). Out of 600 girls studied, none were overweight and obese.

The present study analysed mean Hb (haemoglobin) in different grades of BMI as a measure of nutritional status. Mean Hb in girls with BMI < 16, 16-18.49 and ≥ 18.5 were 12.08, 11.72 and 11.85 g/dl respectively and was found to be statistically significant (P value 0.014) (Table 4, Figure 12)

We compared anaemia in relation to BMI. 25.3% of adolescent girls of age group 11-16 years were anaemic with BMI < 16 Kg/m² (severe thinness); 45.5% were anaemic with BMI 16-18.49 (thinness) and 47.1% with BMI ≥ 18.5 Kg/m² was found to be statistically significant (P value < 0.001) (Table 5).

DISCUSSION

A similar study by Rani D et al [16] in Varanasi reported mean weight (40.27 ± 8.37) kg and mean height (150.87 ± 8.5) cm, and per WHO criteria of BMI, 0.42% were in the category of severe thinness and 38.7% were in thinness category and Phuljhale et al [13] in Chhattisgarh reported mean weight of (41.64 ± 7.26) kg and mean height of (147 ± 3.75) cm, mean BMI of (19.25 ± 3.44) kg/m² which were found to be higher than our present study of mean weight (36.2 ± 3.79) kg and mean BMI (16.9 ± 1.31) Kg/m² whereas mean height of (145.6 ± 4.24) cm in our present study was similar to study done by Phuljhale et al [13].

The mean weight gain during adolescent growth period in the present study was about 13.25 kg. Similar results have also been reported by V. Gupta and K.N Agarwal [11] in a study of rural girls of Varanasi. A weight gain of 13.5, 13.7, 13.1 Kg were reported from similar studies in Delhi [7] and Jabalpur [8] regions. In the present study, maximum weight gain was seen in 13-14 years of age. This is a period of catchup growth due to adolescent growth spurt. Thus, if we improve nutritional intake in this stage, we are likely to succeed in attaining a good weight gain till 18 years of age.

Mean values for weight in all groups were found to be higher in comparison to Chaturvedi et al [9] study done on girls of poor socioeconomic states of Rajasthan. This suggests that weight of adolescents is increasing now a days, suggestive of secular trend.

The peak gain in height in present study was seen between 12-14 years old age groups. After 14 years, the gain in height is probably due to (delayed spurt) adolescent growth spurt. But if we provide these girls with better nutrition and educate them about nutritional values, we are likely to achieve a good height.

A height gain of 14 cm was seen from 11-16 years of age in our present study. Kaul et al [8] reported a height gain of 18.6 cm in USES girls of Jabalpur, whereas for USES girls of Delhi, the total gain was 17.3 cm. Sathyavati et al [10] reported a gain of 17.5 cm in urban and 15 cm for rural girls. In the study of rural girls of Varanasi by Gupta et al [11], a height gain of 15.93 cm was seen, whereas, girls of USES of Varanasi showed a height gain of 16-17 cm and 18.19 cm according to Chaturvedi et al [9].

A difference of 14 cm of height was seen between 11-16 years but reduced to 0.8 cm after 15 years and there was no height gain after 14 years. This may be due to poor nutritional intake and lack of awareness and ignorance of proper balanced diet leading to chronic under nutrition. When compared with NCHS chart, increase in height was not seen and we can see plateau effect thus indicating chronic under nutrition.

These girls, according to WHO, with height below 5th percentile are suffering from chronic under nutrition (low height for age). If this prevailing under nutrition continues or increases, these girls are likely to become stunted in near future. The mean values for height (cm) were found to be higher in Chaturvedi et al [9] as compared to present study, but height attained by both girls in 14 and 15 years in both the studies are comparable being 149.80 (14⁺ age group) and 150.06 (15⁺ age group) in present study and 151.32 (14⁺) and 152.18 (15⁺) in study of Chaturvedi et al [9].

When values of mean BMI for each age group were compared with that of Chaturvedi et al [9], the values of mean BMI were found to be low in all age groups in comparison to present study group, which suggests that BMI of adolescent is increasing gradually.

In our study, 28.5%, 15.8% and 33% were suffering from mild, moderate and severe thinness respectively which were comparable to Kalhan M [17], where they found 23.6%, 25.7% and 30.1% respectively. Chaturvedi S et al [9] studied the nutritional status and it was found that 8.1%, 6.6% and 78.8% of adolescent girls were suffering from mild, moderate and severe thinness respectively.

The present study showed that 32.3% had pallor, 25.8% had angular stomatitis and 26.6% had depigmented hair and it was similar to study done by Phuljhale et al [13] where 28.12% had pallor but only 1.46% had angular stomatitis and Damhare DG et al [15] reported 38.89% pallor.

The present study analysed mean Hb in different grades of BMI. Mean Hb in girls with BMI < 16, 16-18.49 and ≥ 18.5 were 12.08, 11.72 and 11.85 g/dl respectively and was found to be statistically significant (P value 0.014). (Table 4). Kalhan M found that the mean Hb in girls with BMI < 16, 16-18.49 and ≥ 18.5 were 9.49 ± 1.37, 10.08 ± 1.2 and 10.83 ± 1.83 respectively and the difference between the groups was found to be significant (P value < 0.01) [17]

In our study, 25.3% had anaemia in BMI < 16 (severe thinness), 45.5% were anaemic with BMI 16-18.9 and 47.1% had anaemia in BMI ≥ 18.5 respectively and was found to be statistically significant (P value < 0.001) and in the similar study done by Bhagyalaxmi et al [14], Adolescent girls with thinness i.e., BMI (16-18.9), 88.35% had anaemia and among adolescent girls with severe thinness, i.e BMI (< 16), 72.7% were anaemic. The high in percentage in their study was because the age group included were 18-19 years age group. In rural areas, 63% had moderate and 3.3% had severe anaemia. In urban girls, 63.5% had moderate and 1.9% had severe anaemia.

CONCLUSION

The present study was conducted among school going adolescent girls 11⁺ - 16⁺ age group from private schools in urban areas of Imphal to evaluate their nutritional status and prevalence of malnutrition. Our results provide evidence that undernutrition is still prevalent among the school going adolescent girls who are future mothers. 77.3% of adolescent girls are undernourished with 33% severe thinness and it is necessary to provide them with nutritional education. The nutritional status of adolescent girls contributes to the nutritional status of the

community. As a preventive strategy, there is a need to create awareness by improving knowledge among girls, parents, school teachers and other community members about BMI, nutrition and causes, symptoms and consequences of undernutrition. The present study recommends that efforts should be made to reduce the prevalence of malnutrition among adolescent girls. For this regular health check ups should be done at schools with the help of school authorities and hospitals. All teachers and parents should be given health and nutritional education sessions by the health experts to enforce healthy eating habits among adolescent girls. Parents to be informed about the health status of the children by class teachers during parent- teacher meetings and appropriate measures should be taken to improve the lunch pack including fruits.

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