Original Research Article

The Prevalence of Dietary Imbalance-Related Co-Morbidities in Adolescent Girls from North India

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Abstract:

Background: Common nutritional problems in adolescents are anemia, growth retardation, protein deficiency-related infections, and obesity. Adolescent females are often affected by tuberculosis, scabies, thyrotoxicosis, conjunctivitis, ear disease, asthma, and oral diseases.

Objectives: The objective is to investigate the nutritional status and co-morbidities in adolescent females.

Methods: A study was conducted in Saharanpur, North India to assess the health of 400 females aged 10-19 years. The study collected detailed information on protein intake, iron-rich intake, milk intake, and calorie intake using a pre-designed and pre-tested questionnaire is a set of questions that have been created and evaluated beforehand to ensure their effectiveness. Physical examination using ICD-11 was also carried out. The BMIs of the participants were evaluated and the chi-square test was used to compare the protein, iron-rich, milk, and calorie intake between those with BMIs below 18.5, between 18.5 and 24.9, and over 25.

Results: The study found that there were significant associations between certain dietary factors and health conditions among the participants. Girls were more likely to have health issues than boys, with 55.5% of girls experiencing one or more of the conditions studied. The most common condition was pallor, affecting 29.4% of girls, followed by asthma (21.29%), tuberculosis (16.26%), dental caries (16%), thyrotoxicosis (15.7%), external ear disease (12.6%), conjunctivitis (8.37%), and scabies (5.74%).The statistical analysis revealed that protein intake and iron-rich intake were strongly associated with the risk of developing these health conditions, with x^2 values of 38.85 and 106.14 respectively and a P-value of less than 0.001 for both. Type of milk intake was also found to be a significant factor, with a x^2 value of 166.4 and a P-value of less than 0.001. However, calorie intake did not show a significant association with the risk of developing these health conditions, with a x^2 value of 5.87 and a P-value of greater than 0.05.

Conclusions: The study found that teenage girls commonly suffer from health conditions that are caused by a lack of proper nutrition.

Keywords: Adolescent, Nutrition Deficiency, And ICD-11.

Introduction

It has been reported that almost a quarter of adolescent girls suffer from iron deficiency anaemia. To prevent this condition, it is recommended to consume foods that are rich in iron, folic acid, vitamins A, C, and zinc. [1]

The World Health Organization has found that malnourished women may experience stunted growth, which can negatively affect their cognitive function, immune system, and metabolism. Adolescents who suffer from chronic malnutrition may experience stunted growth or being underweight, which puts them at risk of developing infectious diseases and hormonal imbalances.[2,3] Additionally, a lack of consumption of fruits and vegetables can lead to obesity. However, this can be prevented by adjusting the amount and frequency of meals and drinks.

The Minimum Dietary Guidelines for Women of Reproductive Age, as revised by FANTA, recommend including the following foods in your diet: [4]

1. Cereals, white roots, tubers, and plantains
2. Legumes (such as soybeans, peas, and lentils)

3. Dairy products
4. Meat, chicken, fish
5. Fruits
6. Vegetables
7. Snacks
8. Sugar-sweetened beverages (SSBs)

However, it's important to note that the dietary recommendations do not mention nuts & seeds, eggs, oils and fats, food and clothing, green leafy vegetables, vitamin A-rich fruits and vegetables, and other beverage groups. Therefore, you should include them in your diet as well.

Snacks can be categorized into sugary foods (desserts) and sweet and fatty fried foods. Fast food, such as burgers (including chicken burgers), fried chicken, fries, and pizza, is commonly referred to as junk or fat food.

The World Health Organization recommends consuming adequate amounts of fruits and vegetables. General guidelines recommend the consumption of two servings of fruit and 400 g of vegetables per day (5 servings of 80 g per day).[5]

The following information provides data on the intake of macronutrients and energy, measured in grams and kilocalories per day. The data is collected from different geographic regions and is categorized by urban and rural areas. The adequacy of energy and macronutrient intake is determined by the organization of the drug.

For girls aged 10-17 years, the mean daily nutrient intake is as follows: [6]

Carbohydrates -130 Grams, Proteins - 57-63 Grams, Fat -22 Grams, Energy - 1970-2060 Kilocalories, Calcium-600 Grams, Phosphorus-500-600 Milligrams, Iron-19-30 Milligrams, Vitamin A-600 Micrograms, Thiamine- 1.0 Milligram, Riboflavin-1.2 Milligrams, Niacin -13-14 Milligrams, Vitamin C-40 Milligrams, Folic Acid 70-100 Micrograms.

Currently, there is no established adequate intake (AI), estimated average requirement (EAR), or recommended dietary allowance (RDA) for fat intake. However, the acceptable macronutrient distribution range (AMDR) for young people aged 10-18 is 25-35% of total energy from fat. [6]

Material and Methods

From September 2022 to July 2023, a cross-sectional study was conducted in the population registered at Rural Health Training Centre, Sarsawa, which is the Field Practice area of the Department of Community Medicine, SMMH GMC, Saharanpur in North India. The study included families belonging to the localities registered at the centre.

To calculate the sample size, the average prevalence of malnutrition was taken as 50% due to non-availability of data regarding the prevalence of malnutrition in adolescent girls and varying prevalence of different nutritional disorders. Therefore, by taking the prevalence of malnutrition as 50% for a confidence level of 95% with a relative precision of 10%, the formula yielded an appropriate sample size of n = 400 for the study.

$$n = \frac{SD^2 \times P \times Q \times DEFF}{d^2} = 400$$

To ensure effective completion of the study, the research team conducted a house-to-house survey covering various localities to achieve the desired sample size. During the home visits, the research team collected demographic information about each family and conducted interviews and physical examinations of adolescent girls aged 10-19 years. All adolescent girls belonging to alternate families were interviewed. The team collected detailed information on socio-economic status, anthropometric and nutritional status using a pre-designed and pre-tested proforma. Both oral questionnaire methods and physical examination using ICD-11 were employed to collect data.

Families were grouped in following groups according to the criteria-[7]

Family income-	score
≥52,734-26,355	12
52,733-19,759	10
26,354-13,161	6
19,758-7,887	4
13,160-2,641	2
≤2,640	1

The height was measured while the adolescent girls was standing by the side of a wall upright with heels close to each other and arm hanging by the side with an ordinary measuring tape with the subject standing erect without wearing shoes and his/her back against a wall and looking straight ahead. Body weight was taken by the help of manual weighing machine and the weight was accurately calculated by subtracting the error in it. Subsequently Body Mass Index was calculated as (weight in kg/height in m^2).

Individuals were grouped in following groups according to the criteria-[8]

>30kg/m^2	Obese
>25-30kg/m^2	Overweight
18.5-25kg/m^2	Normal
<18.5 kg/m^2	Underweight

The study classified dietary habits into two groups: Vegetarians, who never consume animal products except for dairy milk products, and Non-vegetarians, who consume animal products at least occasionally.

The participants were asked about the nature and quantity of food they had consumed in the last 48 hours through an oral questionnaire. A deviation of 5% from the recommended daily allowance of protein and calories was considered nearly normal. The Institutional Ethics Committee of S.M.M. Government Medical College, Saharanpur issued a letter, bearing code no. RMCS/IEC/2022/29, on 24/9/2022, outlining the study's code of conduct.

Inclusion criteria: Females aged between 10 and 19 years old.

Exclusion criteria: Females with any physiological or psychological deformities.

Statistical analysis: The statistical analysis will involve the transfer of anthropometric and nutritional data onto a master chart in an Excel sheet. The evaluation of food and food habits will be analyzed using the Chi square test. Additionally, the prevalence of diseases among subjects will be charged with a percentage.

Results

This cross-sectional study was conducted in a rural population of Saharanpur to assess the nutritional status of adolescent girls in relation to various co-morbidity factors. The study involved interviewing a total of 400 adolescent girls aged between 10-19 years. Table 1 presents the percentage of girls suffering from under-nutrition across different age groups. The results showed that among 10-year-olds, 13.9% were affected, while 18.2% of 11-year-olds, 16.7% of 12-year-olds, 12.8% of 13-year-olds, 21.7% of 14-year-olds, 22.2% of 15-year-olds, 33.3% of 16-year-olds, 24.3% of 17-year-olds, 22.4% of 18-year-olds, and 23.1% of 19-year-

olds were found to be suffering from under nutrition. The overall prevalence of under nutrition (BMI<18.5) was 21.0%, and that of over nutrition (BMI>25) was 7.0%.

Table 2 presents the following results: 60.5% of girls consumed protein at a normal level, while 39.5% consumed less than normal. Girls with less than normal protein intake had a higher prevalence of undernourishment (36.7%) compared to those with near normal protein intake (10.7%).

This difference is significant (p<.001). In addition, 61.8% of girls had a near normal calorie intake, while 27.5% consumed less than normal and 10.8% consumed more than normal. Girls with low calorie intake had a higher prevalence of undernourishment (63.6%) compared to those with normal calorie intake (5.3%) and those with excess calorie intake (2.3%).

This difference is also significant (p<.001). Furthermore, girls who consumed excess calories had higher rates of over nutrition (51.2%) compared to those who consumed fewer calories (2.4%).

In terms of iron-rich diets, 74.5% of girls were found to be consuming them regularly while 25.5% were not. The prevalence of undernourishment among girls who consumed iron-rich diets was found to be 8.7%, while it was 56.9% for girls who did not. This difference was found to be significant with a p-value of less than .001. As for milk intake, 74.5% of girls were drinking full cream milk, 25.5% were drinking skimmed milk, and 7% were drinking toned milk. The prevalence of undernourishment was found to be 23.1% in girls who drank full cream milk, 11.8% in those who drank skimmed milk, and 7.1% in those who drank toned milk. However, the difference in prevalence with milk intake was not found to be significant with a p-value greater than 0.05.

Table 1: Distribution of girls according to BMI for age(n=400)

Population	BMI							
Age in Years	<18.5		18.5-24.9		>25		Total	
	No.	Perc.	No.	Prec.	No.	Perc.	No.	Perc.
10	6	13.9	34	79.1	3	6.9	43	10.8
11	4	18.2	14	63.6	4	18.2	22	5.5
12	5	16.7	22	73.3	3	3.3	30	7.5
13	6	12.8	38	80.9	3	6.4	47	11.7

14	5	21.7	15	65.2	3	13.0	23	5.7
15	8	22.2	26	72.2	2	5.6	36	9.0
16	13	33.3	24	76.9	2	5.1	39	9.7
17	9	24.3	25	67.6	3	8.1	37	9.3
18	13	22.4	43	74.1	2	3.5	58	14.5
19	15	23.1	47	72.3	3	4.6	65	16.3
Total	84	21.0	288	72.0	28	7.0	400	100

Table 2: Evaluation of food habit of adolescent girl (n=400)

Food Habit	Population N (%)	BMI N (%)			P value
		<18.5	18.5-24.9	>25	
Protein intake					x^2=38.85; df=1; P<0.001
Near normal	242(60.5)	26(10.7)	188(77.7)	28(11.6)	
Less than Normal	158(39.5)	58(36.7)	100(63.3)	0(0.0)	
Iron rich intake					
Present	298(74.5)	26(8.7)	251(84.2)	21(7.1)	x^2=106.14; df=1; P<0.001
Absent	102(25.5)	58(56.9)	37(36.3)	7(6.9)	
Milk intake					
Full cream	338(74.5)	78(23.1)	243(71.9)	17(5.0)	x^2=166.4; df=2; P<0.001
Skimmed milk	34(25.5)	4(11.8)	26(76.4)	4(11.8)	
Toned milk	28(7.0)	2(7.1)	19(67.9)	7(25.0)	
Calorie intake					
Near normal	247(61.8)	13(5.3)	228(92.3)	6(2.4)	x^2=5.87; df=2; p>0.05
Less than normal	110(27.5)	70(63.6)	40(36.4)	0(0.0)	
More than normal	43(10.8)	1(2.3)	20(46.5)	22(51.2)	

On average, 65.63% of girls were found to have one or more morbid conditions. The maximum number of girls (n=123, which is 29.4%) had pallor, followed by asthma (n=89, which is 21.29%), tuberculosis (n=68, which is 16.26%), dental caries (n=67, which is 16%), thyrotoxicosis (n=66, which is 15.7%), external ear disease (n=53, which is 12.6%), conjunctivitis (n=35, which is 8.37%), and scabies (n=24, which is 5.74%).

Table 3: Percentages of clinical conditions among adolescent girls (n=400)

Code in ICD-11	Name of Diseases	Cases	Percentage (%)
1B10-1B1Z	Tuberculosis	68	16.26
1G04	Scabies	24	5.74
MC16, ME64.2	Pallor	123	29.4
5A02-5A02.Z	Thyrotoxicosis	66	15.7
IC20, 1D84, 1A02.2, 9A60	Conjuctivitis	35	8.37
AA00-AACZ	External ear disease	53	12.6
CA23, CB02.0	Asthma	89	21.29
1E82, 2B60-2BCZ, NA00.4, XA1WN1	Oral cavity disease	67	16

Discussion

A cross-sectional study was conducted in Sarsawa, Saharanpur district, North India. The majority of researchers consider Body Mass Index (BMI) as a reliable indicator of nutritional status. The study revealed that 21% of participants were undernourished (BMI<18.5). However, a higher prevalence of undernutrition was reported by Anand et al, which was 30.1% in Haryana. [9] In contrast, only 7% of the subjects were found to be overweight (BMI>25) in the present study. Kapoor and Aneja reported an obesity prevalence of 3.1% among girls belonging to the high socioeconomic status of Delhi.[10]   The study found a statistically significant proportion of girls having BMI<18.5 (undernutrition), with 15.8% in the age group of 10-14 years and 24.7% in the age group of 15-19 years. This is in contrast to the findings of Acharya et al.[11]

A study was conducted to investigate the relationship between protein and calorie intake and undernutrition among adolescent girls. The study found that 10.7% of girls who had a near normal protein intake suffered from undernutrition, while 36.7% of those who had a protein intake less than normal experienced the same. The difference was statistically significant (P<0.001). In contrast, another study showed that subjects with a protein

intake of 80% and 80.1-100% were more likely to be undernourished, while those with a protein intake greater than 100% did not show a significant difference.[12]

In terms of calorie intake, the study found that 5.3% of girls with normal calorie intake suffered from undernutrition, while 63.6% of girls with low calorie intake and 2.3% of those with excess calorie intake experienced the same. Furthermore, overnutrition was more prevalent in girls with excess calorie intake (51.2%) compared to those with less calorie intake (2.4%). These findings contradict a study done in adolescent girls in the rural area of Varanasi, which showed that negative and positive energy balance were associated with undernutrition in 70.21% and 64.63% of subjects, respectively.[12]

In this study, it was found that adolescent girls who consumed an iron-rich diet had a lower undernourishment rate of 8.7%, while those who did not consume an iron-rich diet had a higher undernourishment rate of 56.9% (P<0.001). Unfortunately, there are no similar studies available to compare these findings with.

Regarding milk consumption, the prevalence of undernutrition was 23.1% among adolescent girls who drank full cream milk, while those who drank skimmed milk had an undernutrition rate of 11.8%, and girls who drank toned milk had an undernutrition rate of 7.1% (P>0.05). Since there are no comparable studies, it is not possible to make a comparison.

In the current study, it was found that 55.5% of girls had one or more morbid conditions. The most common condition observed was pallor, which affected 29.4% of the girls, followed by asthma (21.29%), tuberculosis (16.26%), dental caries (16%), thyrotoxicosis (15.7%), external ear disease (12.6%), conjunctivitis (8.37%), and scabies (5.74%).

In a study conducted by Singh et al. in Lucknow, it was reported that inadequate oral hygiene (55.4%), pediculosis (39.2%), cold & cough (25.8%), lymphadenopathy (22.2%), scabies (16.2%), inflamed tonsils (7.8%), fever (7.5%), and ear discharge (7%) were prevalent among adolescent girls.[13] Another study by Srinivasan et al. in Tirupati reported that 94.5% of girls had one or more morbid conditions, with pediculosis (87.5%), dental caries, and skin disorders (50% each), worm infestation (18.3%), ENT disorders (17.5%), clinical anaemia (5.8%), and defective vision (4.7%). [14]

Conclusion

An adolescent girl with low body mass index has a nutritional deficiency that could lead to various health conditions, including tuberculosis, scabies, pallor, thyrotoxicosis, conjunctivitis, diseases of the external auditory canal, asthma, and oral diseases.

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