DOI: 10.7860/JCDR/2022/55079.16117

Original Article

Paediatrics Section

Prevalence of Stunting and Thinness among School Going Early and Mid-adolescents of Idukki District in Rural Kerala: A Cross-sectional Study

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ABSTRACT

Introduction: Adolescence is a period characterised by dramatic changes both physically and mentally. Under nutrition is a growing concern worldwide especially in developing countries like India. It has both short-term and long term concerns.

Aim: To estimate the prevalence of thinness and stunting among school going early and mid-adolescents of Idukki district in rural Kerala, India.

Materials and Methods: The present cross-sectional study which was conducted from June to October 2020 on 1005 subjects aged 10-16 years from four schools- two government and two private sector, selected by simple random sampling. Age group 10-13 years were grouped as early adolescents and 14-16 years were grouped as middle adolescents. After obtaining informed consent from the parents and school authorities, anthropometric measurements such as weight and height were recorded by standard technique. Body Mass Index (BMI) was calculated from height and weight measurements using the formula weight (kg)/ height^2 (metre^2). The values were then plotted on age specific World Health Organisation (WHO) charts for height and BMI. The degree of stunting and thinness was categorised according to the position of the plot. Data was entered into excel sheet and analysed using Statistical Package for the Social Sciences (SPSS) 16.0. Statistical analysis was done using Chi-square test, to test the association between anthropometric data and age group and gender. A p-value <0.05 was taken as significant.

Results: A 84 (8.4%) adolescents were stunted with equal prevalence in early 38 (8.5%) and mid-adolescents 46 (8.2%). There was no difference in the prevalence of stunting in males 44 (8.9%) and females 40 (7.9%). The overall prevalence of thinness among adolescents was 23.7%.with more thinness in early adolescents (27.4%) than mid-adolescents (20.7%). It was also found that males were thinner than girls especially among middle adolescents.

Conclusion: Adolescent undernutrition continues to be an important public health problem in India. Hence, it will be prudent to give high emphasis on nutrition education programmes for adolescents.

Keywords: Anthropometry, Malnutrition, Nutritional status, Rural area, School going children, Thinning

INTRODUCTION

Adolescence is the period of transition from childhood to adulthood [1]. Around 1.2 billion in the world are adolescents which contribute to 16% of world's population [2]. About 21% of India's population are adolescents [3]. Generally, 10-19 years age group is taken as the period of adolescence. It is divided into three phases early (10-13 years), middle adolescents (14-16 years) and late adolescence (17-19 years) [1]. The three periods of adolescence are different with respect to their needs and requirements.

The first 1000 days of life are the most critical determinant in growth during adolescence and height and weight in adulthood [4]. Adolescence is a period characterised by dramatic changes not only in physical appearance marked by the growth spurt and sexual maturation, but also in cognitive and psychosocial abilities [5]. Adequate nutrition is one of the fundamental requisites for the development of adolescents. Malnutrition which includes both undernutrition and over nutrition, has a deleterious effect on the health of adolescents. Undernutrition leads onto growth problems like stunting, wasting, underweight and other nutritional deficiencies like nutritional anaemia, micronutrient deficiencies, etc., Over nutrition leads onto overweight and obesity. Height for age and BMI are good ways to detect chronic and acute malnutrition respectively [6]. Gender and age specific WHO graphs are commonly used in paediatric population to define malnutrition [7]. The identified undernourished and over nourished children can be given targeted counselling and advice.

The present scenario of the nutritional status of the school age children in India is unsatisfactory. National Family Health Survey 5 (NFHS-5) data for under 5 children shows that stunting and wasting is at 35.5% and 19.3%, respectively [8]. The percentage of women (15-49 years) and men (15-49 years) who are having a BMI <18.8 kg/m^2 are 21.2% and 17.8%, respectively [8]. This is alarming statistics for a nation of India's size. Srivastava A et al., found that 19.9% were found to be stunted and 33.3% were found to be wasted among children 4-14 years in the urban slums of Bareilly, Uttar Pradesh (UP), India [9]. A study conducted by Department of Community Medicine at Lala Lajpat Rai Memorial Medical College, Meerut found that 12% were stunted and 22% were thin among children aged 8-12 years in private schools [10]. Kerala, in spite of having much higher health and social development indicators has 23.4% stunting and 15.8% wasting among under five children. The percentage of women (15-49 years) and men (15-49 years) whose BMI is below normal (BMI<18.8 kg/m^2) in rural areas are 10.4% and 12.7%, respectively [8].

A large study on the prevalence of obesity done in Ernakulam district, Kerala in 2005 found prevalence of obesity was around 7% [11]. Kumar P et al., in a study done in Uttar Pradesh provided an understanding that stunting and thinness is a significant public health concern among adolescents [12]. Majority of the studies were done in adolescents, are focused on obesity and lifestyle diseases. Moreover, there is paucity of studies which deals exclusively with the prevalence of stunting and thinness in early and mid-adolescents. Therefore, this study was undertaken to know the prevalence

of stunting and thinness among school going early and middle adolescents of Idukki district in rural Kerala, India.

MATERIALS AND METHODS

This cross-sectional study among school going early and mid-adolescents was conducted in over a period of five months from June to October 2020. This study was conducted by the Department of Paediatrics, Al-Azhar Medical College, Idukki district of rural Kerala, India. For this study four schools were selected by random sampling which included two government schools and two private schools. Ethical clearance was obtained from the Institute Ethics Committee (IEC) (AAMC/IEC/2019/03/14/9). School authorities' and parents' consents were also obtained.

Sample size calculation: The sample size of 979 was calculated by the formula: n=(z2pq)/d2, where z=1.96, 'p' is the prevalence of malnutrition (29%) in children and adolescents, 'q'=1-p relative precision, d=10% and 95% confidence interval [9].

Inclusion criteria: Children aged 10-16 years who were present on the day of visit were included in this study.

Exclusion criteria: Those children who were absent on the day of survey and those with chronic illnesses were excluded from the study.

Data Collection

A total of 1005 children were included into the study. They were divided into two groups- early adolescents (10-13 years) and middle adolescents (14-16 years). Weight and height of the children was measured in the metric system. Weight was measured in kilograms using electronic weighing machine with minimum error of 100 grams. Children were instructed to stand on the balance with light clothing and without foot wear with head in the neutral position, looking straight. Height was measured using stadiometer (measuring rod) with minimum error of 0.1 cm. Children were made to stand on the stadiometer without footwear, and with heels, buttocks, shoulders and occiput touching the upright rod. The child was asked to look straight with lower border of orbit of the eye in the same horizontal plane as the external auditory canal. Head piece of the stadiometer was lowered to make contact with the head and height was recorded from the vertical measuring rod [13].

Body mass index was calculated from height and weight measurements using the formula weight (kg)/height^2 (m^2). The values were then plotted on age specific WHO charts for height and BMI. They were categorised according to the position of the plot as between the major standard deviation lines namely 3 SD, 2 SD, 1SD, -1 SD, -2 SD and -3 SD. The height for age data were categorised as tall for age, normal, moderate stunting and severe stunting if the plots are above 2SD, between -1 to 2, between -2 and -3 and below -3 SD respectively [6,7]. The BMI for age is categorised as obese, overweight, normal, thinness and severe thinness if the plots are above 3SD, between 2 and 3, between -1 to 2, between -2 and -3 and below -3 SD respectively [14].

STATISTICAL ANALYSIS

Data was entered into an excel sheet and the results were analysed using SPSS 16.0. Statistical analysis was done using Chi-square test to test the association between anthropometric data and age group and gender. A p-value <0.05 was taken as significant.

RESULTS

The mean height, weight and BMI in the total study population of 1005 children was 150.90±10.85 cm, 40.16±11.29 kg and 17.59±8.8 kg/m^2, respectively. A total of 444 (44.2%) were early adolescents belonging to 10-13 year age group and 561 (55.8%) were mid-adolescents belonging to 14-16 year age group. Among 1005 children, 497 (49.5%) were males and 508 (50.5%) were females. The mean age, height, weight and BMI of both age groups and sex was found to be similar among both groups and is summarised in [Table/Fig-1].

Age group	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)
Early adolescents	11.74±0.87	143.35± 8.86	33.45±8.55 kg	16.52±9.31
Mid adolescents	14.27±0.65	156.87± 8.25	45.46±10.33	18.44±7.87
Boys	13.66±0.76	151.93±11.86	39.98±11.82	17.64±11.61
Girls	12.88±0.68	149.79±9.74	40.33±10.74	17.55±3.73

[Table/Fig-1]: Mean and standard deviation of age, height, weight and BMI of two groups and sex.

Among 1005 children, 921 (91.6%) had normal height. A 72 (7.2%) were having moderate stunting with Z score between -2 and -3 SD whereas 12 (1.2%) had severe stunting with Z score < -3 SD. Thus, a total of 84 (8.4%) children were stunted in the study population. None of the adolescents were tall who had SD >2 SD. There were no significant differences in stunting between early and mid-adolescents as shown in [Table/Fig-2].

Age group	Height/age					
	Normal n (%)	Moderate stunting n (%)	Severe stunting n (%)	Total n (%)	Chi-square value	p-value
Early adolescents	406 (91.4)	35 (7.9)	3 (0.7)	444 (100)	2.367	0.308
Mid adolescents	515 (91.8)	37 (6.6)	9 (1.6)	561 (100)		
Total	921 (91.6)	72 (7.2)	12 (1.2)	1005 (100)		

[Table/Fig-2]: Height/age in two age groups.

Among 497 boys, 453 (91.2%) had normal height, 37 (7.4%) had moderate stunting, whereas 7 (1.4%) had severe stunting thus accounting to a total of 44 (8.9%) boys who were stunted. Among the 508 girls, 468 (92.1%) had normal height. A total of 35 (6.9%) had moderate stunting, whereas 5 (1.0%) had severe stunting thus accounting to a total of 40 (7.9%) girls who were stunted. There were no statistically significant differences between the boys and girls in stunting as shown in [Table/Fig-3].

Gender	Height/age					
	Normal n (%)	Moderate stunting n (%)	Severe stunting n (%)	Total	Chi-square value	p-value
Males	453 (91.2)	37 (7.4)	7 (1.4)	497 (100)	0.513	0.767
Females	468 (92.1)	35 (6.9)	5 (1)	508 (100)		
Total	921 (91.6)	72 (7.2)	12 (1.2)	1005 (100)		

[Table/Fig-3]: Height/age in genders.

Of the total 497 boys, 217 (43.7%) belonged to early adolescents (10-13 years) whereas 280 (56.3%) belonged to mid adolescents (14-16 years). Of the total 508 girls, 227 (44.7%) belonged to early adolescents (10-13 years) whereas 281 (55.3%) belonged to mid adolescents (14-16 years). There was no statistically significant difference between males and females with regard to stunting both in early and mid-adolescents as in [Table/Fig-4].

Among 1005 children, 705 (70.1%) were having normal weight. A total of 157 (15.6%) were having moderate thinness with BMI Z score between -2 and -3 SD whereas 81 (8.1%) had severe thinness with BMI Z score <-3 SD thus accounting to a total of 238 (23.7%) children who were thin. A 52 (5.2%) had overweight with Z score between 2 and 3 and 10 (1%) had obesity with a BMI >3 SD. Thus, a total of 62 (6.2%) were having a BMI >2 SD. Among the 444 early adolescents, 122 (27.4%) were thin whereas 116 (20.7%) were thin among the 561 mid-adolescents and the overall prevalence was 23.7%. The prevalence of overweight/obesity was 33 (7.4%) were among early adolescents 29 (5.2%) among late adolescents. There was a significant difference in thinness between early and mid-adolescents

Age group	Gender	Height/age					
		Normal, n (%)	Moderate stunting, n (%)	Severe stunting, n (%)	Total	Chi-square	p-value
Early adolescents	Males	203 (20.2)	14 (1.4)	0	217 (21.6)	4.177	0.121
	Females	203 (20.2)	21 (2.1)	3 (0.3)	227 (22.6)		
Mid adolescents	Males	250 (24.9)	23 (2.3)	7 (0.7)	280 (27.8)	5.402	0.074
	Females	265 (26.4)	14 (1.4)	2 (0.2)	281 (28)		
Total		921 (91.6)	72 (7.2)	12 (1.2)	1005 (100)		

[Table/Fig-4]: Height/age in different age groups and gender.

with prevalence of thinness more in early adolescents (p-value <0.05) as shown in [Table/Fig-5].

Of the 497 males, 325 (65.4%) had a normal BMI, 89 (17.9%) had moderate thinness and 52 (10.5%) had severe thinness, 26 (5.2%) had overweight and 5 (1%) had obesity. Thus, among the boys a total of 141 (28.4%) were thin and 31 (6.2%) were overweight/obese. Of the 508 girls, 380 (74.8%) had a normal BMI, 68 (13.4%) had moderate thinness and 29 (5.7%) had severe thinness, 26 (5.1%) had overweight and 5 (1%) had obesity. Thus, among the girls a total of 97 (19.1%) were thin and a total of 31 (6.1%) were overweight/obese. It was found that males were thinner than girls with a statistically significant p-value of 0.008 as shown in [Table/Fig-6].

On further analysis, it was found that there was no difference between males and females with regard to thinness in early adolescents, but there was highly statistically significant thinness with p-value <0.001 among males than females in mid-adolescents. Results are depicted as shown in [Table/Fig-7].

A cross tabulation between height and BMI was done. 3.9% children were both stunted and wasted. Only 1 (0.09%) was stunted and overweight. Stunting and thinness co-exist. There was highly statistically significant relation between height and BMI as depicted by a p-value of <0.001 as shown in [Table/Fig-8].

DISCUSSION

Anthropometric surveys are an effective low cost method to understand the extent of malnutrition in the country. It yields very useful data for program implementation. India has one of the largest adolescent population in the world. Malnutrition in adolescence can disrupt normal growth and development in adolescence and may have long term impact [15].

The prevalence of stunting found in this study was 8.5% among early adolescents and 8.3% among middle adolescents. Overall, the prevalence of stunting in the study population of adolescents was 8.4%. This was in concordance with the study done by Engidaw MT and Gebremariam AD in which they found the overall prevalence of

Age group	BMI/age							
	Severe thinness n (%)	Moderate thinness n (%)	Normal N (%)	Overweight N (%)	Obese N (%)	Total N (%)	Chi-square	p-value
Early adolescents	47 (10.6)	75 (16.9)	289 (65.1)	27 (6.1)	6 (1.4)	444 (100)	12.299	0.014
Mid adolescents	34 (6.1)	82 (14.6)	416 (74.2)	25 (4.5)	4 (0.7)	561 (100)		
Total	81 (8.1)	157 (15.6)	705 (70.1)	52 (5.2)	10 (1)	1005 (100)		

[Table/Fig-5]: Body Mass Index for age (BMI/Age) in early and mid-adolescents.

Gender	BMI/age							
	Severe thinness n (%)	Moderate thinness n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	Total n (%)	Chi-square	p-value
Males	52 (10.5)	89 (17.9)	325 (65.4)	26 (5.2)	5 (1)	497 (100)	13.512	0.008
Females	29 (5.7)	68 (13.4)	380 (74.8)	26 (5.1)	5 (1)	508 (100)		
Total	81 (8.1)	157 (15.6)	705 (70.1)	52 (5.2)	10 (1)	1005		

[Table/Fig-6]: Body Mass Index for age (BMI/age) in males and females.

Age group	Gender	Height/age						Chi-square	p-value
		Severe thinness n (%)	Moderate thinness, n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	Total n (%)		
Early adolescents	Males	26 (2.6)	39 (3.9)	138 (13.7)	11 (1.1)	3 (0.3)	217 (21.6)	1.938	0.748
	Females	21 (2.1)	36 (3.6)	151 (15)	16 (1.6)	3 (0.3)	227 (22.6)		
Mid adolescents	Males	26 (2.6)	50 (5)	187 (18.6)	15 (15)	2 (0.2)	280 (27.8)	18.719	0.001
	Females	8 (0.8)	32 (3.2)	229 (22.8)	10 (0.1)	2 (0.2)	281 (28)		
Total		81 (8.1)	157 (15.6)	705 (70.1)	52 (51.7)	10 (1)	100 (100)		

[Table/Fig-7]: Combined data of BMI versus age group and gender.

Variables		BMI/age						Chi-square	p-value
		Severe thinness n (%)	Moderate thinness n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	Total n (%)		
Height/age	Normal	65 (80.3)	134 (85.4)	661 (93.8)	51 (98.1)	10 (100)	921 (91.6)	36.432	0.001
	Moderate stunting	12 (14.8)	19 (12.1)	41 (5.8)	0	0	72 (7.2)		
	Severe stunting	4 (4.9)	4 (2.5)	3 (0.4)	1 (1.9)	0	12 (1.2)		
	Total	81 (100)	157 (100)	705 (100)	52 (100)	10 (100)	1005 (100)		

[Table/Fig-8]: Body mass index vs height cross tab in total study group.

stunting as 9.7% [16]. Various studies done in various parts of rural India have reported different prevalence of stunting such as 20%, 23%, 34.2% and 50.3% [17-20]. The reason for a low stunting rate in the present study may be because of the better economic and health standards of Kerala as compared to other parts of India.

Among the 84 children who were stunted, 45.2% were early adolescents and 54.8% were mid adolescents. Though, the percentage of stunting was more in mid adolescents than early adolescents, there was no statistically significant difference between the two groups with regard to stunting in the present study (p-value=0.308). Engidaw MT and Gebremariam AD found that the older adolescent girls were more likely to be stunted than the younger ones [16]. Bisai S et al., also found that underweight and stunting was more in late adolescents (15-18 years) than early adolescents (11-14 years) of West Bengal, India [19].

Among the 84 children who were stunted, 44 (52.4%) were boys 40 (47.6%) were girls highlighting the fact that both boys and girls were almost equally getting affected by chronic malnutrition. No statistically significant difference was found between boys and girls with regard to stunting. Many studies had shown that boys and girls were equally affected with stunting. Hilza JN et al., found that among the stunted children 49.6% were girls and 50.4% were boys [21]. Rengma MS et al., found that the prevalence of stunting was more in boys than girls [22]. The overall prevalence of stunting was 8.9% among boys and 7.9% among girls in the present study. Many studies in adolescent girls in North India had a prevalence of stunting as 18.1%, 25.6% and 48.4% [23-25].

Among 1005 children, 23.7% were thin whereas 6.1% were overweight/obese. Prashant K and Shaw C found a lower prevalence of 20.6% [26], whereas Bisai S et al., found a higher prevalence of 28.3% of thinness among rural adolescents of India [19]. Several other studies have reported under nutrition among adolescents [27-29].

The prevalence of thinness from this study was 27.4% among early adolescents as compared to 20.7% among mid-adolescents and the overall prevalence of thinness was. There was a statistically significant difference in thinness in early adolescents as depicted by p-value of <0.05. Kebede D et al., and Mondal N also found that early adolescents are associated with thinness [30,31]. Mengesha DK et al., found that the odds of thinness was 4.81 times more in early adolescents as compared to late adolescents [32]. Maiti S et al., reported prevalence of thinness among the subjects decreased with age [23].

It was found in the present study that the prevalence of thinness was significantly higher among boys (28.4%) as compared to girls (19.1%). Worldwide the prevalence of thinness is more in boys as compared to girls [22,29]. The preponderance of male stunting can be explained by foetal factors and increased incidence of infections in male malnourished infants and toddlers which sets the tone for the growth in adolescence years. Male foetus has a higher growth rate than female and thus is more affected by maternal malnutrition [33]. Boys have a biological propensity to be thinner and stunted than girls in the same resource constrained environment provided there is no gender bias in child care. Indian subcontinent is unique that girls are more stunted and thinner than boys possibly reflecting a gender bias in nutrition consumption [34].

Various studies were done in the past about prevalence of thinness among adolescent girls. Engidaw MT and Gebremariam AD reported 15.2% thinness among girls in a study done in Ethiopia [16]. Khan MR and Ahmed F found 16.8% thinness among adolescent female workers in urban Bangladesh [35]. Das DK and Biswas R reported much lower 17.8% thinness among early adolescent girls [24]. Maiti S et al., reported a higher prevalence of 58.3% thinness among adolescent girls of West Bengal [23]. Stunting and thinness was found to be more in girls in above studies possibly indicating cultural rather than biological reasons.

There was highly statistically significant increased prevalence of thinness among males than females in mid-adolescent group (p-value of <0.001), but there was no difference between males and females among early adolescents. This study also highlighted the importance of proper nutritional advice to be given to adolescents especially early adolescents as their prevalence of thinness was more compared to mid adolescents.

Stunting was significantly associated with thinness. Children who were stunted and wasted at the 7-10 month window period were the most likely to show stunting and thinness in adolescents. Stunting in later life is thought be due to repeated bouts of wasting before 24 months leading the body to adapt by forming a shorter frame. Therefore, those who are stunted and not thin maybe due to an adaptation of malnutrition. The lack of thinness may not protect them from the deleterious effects of malnutrition. Stunting is a predictor for adult diseases like diabetes and hypertension [36]. This may explain why Kerala has the twin burden of malnutrition and lifestyle diseases like diabetes mellitus and hypertension. Since, stunted and thin adolescent regardless of gender are at a higher risk of developing lifestyle disorders, it is important to provide health education for the same.

Strengths of present study are the large sample size and the use of uniform WHO standards for grading thinness and stunting.

Limitation(s)

Limitations of present study were the lesser number of schools enrolled and the lack of enrollment of late adolescents. A large scale study including many schools can be planned to estimate the prevalence of malnutrition in this post COVID era. Under nutrition continues to be a major problem in Kerala. Since, under five nutrition status is an important determinant of adolescent prevalence of stunting and thinness, it would be prudent that Kerala heightens its surveillance of under five children. More studies on under five nutrition status and adolescent stunting and thinness is required. Adolescent girls who are stunted have higher chance of bad obstetric events. Malnourished girls tend to produce malnourished future children. The enormous health and economic burden of malnutrition can never be overstated.

CONCLUSION(S)

Adolescent undernutrition continues to be an important public health problem in India. The prevalence of thinness is more in early adolescents as compared to mid-adolescents. Boys were thinner than girls especially in mid-adolescents. Stunting was associated with thinness. Hence, it will be prudent to give high emphasis on nutrition education programmes.

Acknowledgement

Authors would like to acknowledge the support received from the Department of Paediatrics and from our statistician Mrs. Neethu for all the help and guidance given for this study.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jan 21, 2022
- Manual Googling: Feb 10, 2022
- iThenticate Software: Fab 28, 2022 (4%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jan 20, 2022**
Date of Peer Review: **Feb 03, 2022**
Date of Acceptance: **Feb 11, 2022**
Date of Publishing: **Mar 01, 2022**