DOI: 10.7860/JCDR/2023/62351.17826

Original Article

Paediatrics Section

Prevalence and Aetiological Profile of Short Stature in School Children between 6-11 Years of Age- A Community Based Prospective Observational Study

JASMINE KANDAGAL[1], SUMAN RATH[2], MADHURI MAGANTI[3], CAROLINE ELIZABETH GEORGE[4]

ABSTRACT

Introduction: Growth is a complex process influenced by genetic background, different functions of the endocrine system, nutrition, the effect of any chronic disease, and the level of individual physical activity. Regular height measurement is one method to evaluate growth. Short stature might be the first sign of various pathological conditions. Early recognition of short stature allows early intervention, optimising the possibility of achieving good health and normal adult height. Community based studies utilising standard protocols are less common in India, as many studies are limited to children visiting tertiary care centres with complaints of short stature.

Aim: The present study aimed to assess the prevalence and aetiological profile of short stature in urban school children of Bangalore.

Materials and Methods: This prospective observational study was conducted among five schools in Devarajevanahalli, Bangalore, from November 2015 to January 2017. Written informed consent was taken from the principal. Children from 6-11 years were recruited into this study until the sample size was reached. A total of 1128 children were chosen for the study. Anthropometric measurements like height, weight, and Body Mass Index (BMI) were taken. Height was plotted on Indian Academy of Pediatrics (IAP) growth charts. Those with height <3rd centile were considered to have short stature. Children with short stature were followed after one year to see their height velocity. Children with height velocity of <25th centile were evaluated. A detailed history focussing on nutrition and a complete physical examination, along with relevant investigations, were done. The cause of short stature was assessed and grouped into physiological and pathological short stature. Continuous variables like height, weight, and BMI were presented as mean [standard deviation (SD)] and were compared using unpaired t-test. Categorical variables like gender and height velocity were expressed as actual numbers and percentages, and association was done using the Chi-square test. Height between age categories among boys and girls was compared using ANOVA test.

Results: Out of 1128 school children, 62 were found to be short. The prevalence of short stature was 5.50%. Among the 62 children, 31 remained short after one year. Out of the 31, only 22 children were investigated, as the remaining were not willing to undergo investigations. Out of the 22 children, pathological short stature was found in 13 (59.1%) and physiological short stature in nine (40.9%). In pathological short stature, chronic malnutrition with Iron Deficiency Anaemia (IDA) was present in 10 (45.5%). Hypothyroidism, idiopathic short stature, and uncontrolled asthma were seen in one case each (4.5%). In physiological short stature, familial short stature was found in 6 (27.3%) and constitutional delay of growth and puberty in 3 (13.6%).

Conclusion: The overall prevalence of short stature was 5.50%, representing a significant percentage of our society that needs proper attention. Chronic malnutrition with IDA was the most common cause of short stature in this study. As a significant percentage of children had treatable causes, growth monitoring with standard growth charts should be mandatory in all schools.

Keywords: Growth charts, Growth velocity, Idiopathic short stature, Pathological short stature, Physiological short stature

INTRODUCTION

Growth is a complex process influenced by genetic back ground, different functions of the endocrine system, nutrition, the effect of any chronic disease, and the level of individual physical activity [1]. Regular height measurement is one method to evaluate growth. Short stature might be the first sign of various pathological conditions. Early recognition of short stature allows early intervention, optimising the possibility of achieving good health and normal adult height [2].

Short stature is a condition in which the height of an individual is below the 3rd centile or more than 2 standard deviations below the corresponding mean height for a given age and gender [3]. Approximately 3% of children in any population will be short, among which half will be physiological and half will be pathological [4]. Physiological causes are familial short stature and constitutional delay in growth and puberty. These are normal variants of growth and need no medical treatment; however, emotional factors associated with them should be considered [5]. Pathological causes can be undernutrition, chronic diseases (e.g., chronic anaemia, chronic renal failure, congenital heart disease, celiac disease, etc.), chromosomal abnormalities (e.g., Turner's syndrome, Down's syndrome), and endocrine causes (e.g., hypothyroidism, growth hormone deficiency, hypopituitarism) [6]. A child with short stature in whom no specific cause is identified may be diagnosed with idiopathic short stature [7].

Early diagnosis and treatment can be useful in restoring the normal growth pattern and prevent the psychogenic and other problems associated with pathological causes of short stature [8]. Aetiological profile and prevalence will vary at community level hospital compared to tertiary center. A large number of children may go undiagnosed in the rural and lower socioeconomic strata [9]. Overall, the number

of patients seeking medical attention for short stature are less compared to the actual number [8]. There are few hospital based data on prevalence of short stature and its causes but there are no reports of recent Indian studies on screening of school children for short stature and its aetiology [10]. Present study plans to screen school children of some of the urban schools in Bangalore and study their aetiological profile.

MATERIALS AND METHODS

This prospective observational study was conducted among five schools of Devarajevanahalli area of Bangalore from November 2015 to January 2017. Five schools were randomly selected from urban areas in Bangalore. Study was approved by institutional ethical committee (PROTOCOL NUMBER: PAE/97/2015). Concerned school authorities were informed about the study and written consent was taken from the Principal for the same. All primary school children of 1st to 7th standard between 6 to 11 years from five urban schools were recruited for the study by screening for short stature by measuring the height and those with joint deformity and kyposcoliosis were excluded from the study. Early detection of short stature helps in treating underlying cause before epiphyseal fusion, hence primary school children with age group 6-11 years were chosen. Height was measured to the nearest 0.1 cm using a stadiometer with the child standing straight with head held in Frankfurt horizontal plane. Children with height less than 3rd centile in the IAP growth chart were recorded. Parents were informed regarding short stature and informed consent was taken regarding the need of investigations and a visit to hospital for evaluation of short stature if required.

Detail history focusing on nutritional and chronic diseases and endocrinal disorder and complete physical examination including anthropometric data was taken. Anthropometric parameters like height, weight, BMI, height velocity were measured. Parent's height was checked for mid parental height. Children were followed-up after 12 months to check height velocity and target height range was calculated. Bone age was calculated using X-ray of left wrist. Greulich Pyle method of estimation was used for bone age calculation. Chronological age was calculated according to the date of birth as provided in the school data. Other parameters like investigations if required, in children below the target height range were done- Complete blood count, calcium, phosphorus, alkaline phosphatase, serum creatinine, stool ova, urine routine, liver function test, bone age X-ray, thyroid function tests. Additional tests like growth hormone stimulation, karyotyping, antibody for tissue transglutaminase were performed if screening tests did not reveal any cause of short stature.

Diagnosis of growth aberrations were grouped as normal variations of growth/physiological short stature (normal height velocity) and pathological short stature (low height velocity) [11].

Physiological short stature was considered in children in whom no underlying pathological cause was found and height velocity was normal.

Pathological short stature was considered in children in whom definite underlying pathological cause was found with low height velocity.

Idiopathic short stature was considered in children with normal physical examination, normal investigations including growth hormone stimulation test but low growth velocity [11].

Bone age and chronological age was compared in all children. Bone age was delayed compared to chronological age in constitutional delay of growth and puberty. In familial short stature, bone age was equal to chronological age [Table/Fig-1].

Hypothesised prevalence of short stature in the population (p):	**7%±1.5 [12]**
Confidence limits as % of 100(absolute±%)(d):	1.5%
Design effect (for cluster surveys-DEFF):	1

Aetiology	Total	Bone age		Predicted adult height		Height velocity	
		BA=CA	B<CA	Within target height range	Below target height range	Normal	Low
Constitutional delay of puberty	3	0	3	3	0	3	0
Familial short stature	6	6	0	6	0	6	0
Hypothyroidism	1	0	1	0	1	0	1
Iron Deficiency Anaemia (IDA)	10	2	8	0	10	0	10
Idiopathic short stature	1	1	0	0	1	0	1
Uncontrolled asthma	1	0	1	0	1	0	1
Total	22	9	13	9	13	9	13

[Table/Fig-1]: Bone age, predicted adult height, height velocity in each group of short stature.
BA: Bone age; CA: Chronological age

Sample Size (n) for various confidence levels

Confidence	Level(%)	Sample Size
	95%	1111

Formula for sample size calculation was $n=\frac{Z^2 \times P\ (1-P)\ (DEFF)}{d^2}$

$n=\frac{(1.96)^2 \times 7\ (100-7)(1)}{(1.52)^2}=1111$

Z=1.96 (constant)

P=prevalence

d=confidence limit

Five schools were randomly selected from Devarajeevanahalli area of Bangalore city. Age was taken as per school records and all children with age group of 6 to 11 years from five schools were recruited into this study. A total of 1128 children were included which was slightly more than the sample size. Reason for selecting this particular age group was to maintain uniformity and also early detection of short stature before the onset of puberty helps in treating the underlying cause before epiphyseal fusion.

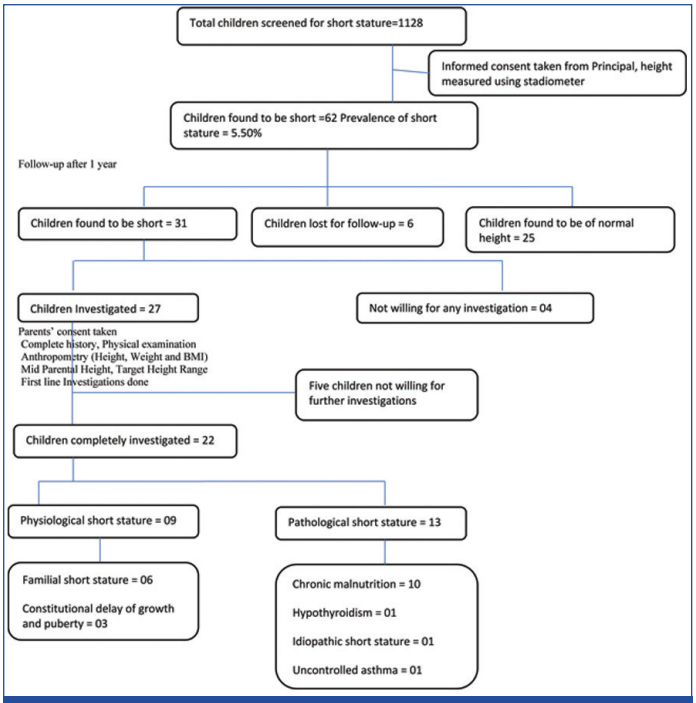
The minimum number of subjects required for reliable estimate and assessment was calculated utilising the standard sample size estimation procedures [13]. In this method, the anticipated population proportion of 7%, absolute precision of 1.5% and confidence interval of 95% was considered. Hence, the minimum sample size in this study was estimated to be 1111 subjects, however 1128 children were included in this study.

STATISTICAL ANALYSIS

Data was entered into Microsoft Excel. Continuous variables like height, weight, BMI were presented as means (Standard Deviation (SD), they were compared using Unpaired t-test. Categorical variable like gender, height velocity were expressed as actual numbers and percentages and association was done using Chi-square test. Height between age categories among boys and girls was compared using ANOVA test. Statistical analysis was performed using the Statistics Package for Social Scientists (SPSS; Windows version 16.0). The p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 1128 children, between age group of 6-11 years were screened for short stature in five urban schools of Bangalore. Out of 1128, 62 children were found to be short. Prevalence of short stature was 5.50%. One out of 1128 children was found to have idiopathic short stature [Table/Fig-2].



[Table/Fig-2]: Flow chart.

Prevalence of idiopathic short stature was 0.08%.

Out of 62 children, 32 (51.6%) were female and 30 were male (48.4%). Male:Female ratio was 0.93.

Among 62, follow-up height after one year was normal in 25 children and six were lost for follow-up. Thirty one children (50%) who were short during first visit remained short after one year [Table/Fig-2].

Among 31, four children were not willing for any investigation. Among these four children, one girl had clinical features of Turner syndrome (wide carrying angle, loose fold of skin at nape of neck) but she was not investigated as parents were not willing. In 27 children, detailed history and physical examination including mid parental height was done and they were investigated with first line tests [Table/Fig-2].

Out of 27, aetiology was identified in 22 children. In remaining five children, aetiology was not identified as they were not willing for second set of investigations. Overall 15 children were lost to follow-up at different stages.

Out of 22 children who were screened, mean age of girls was 8.64 years, mean age of boys was 8.53 years. Mean height-1 (height measured during 1st visit) in girls was 112.56 cm, mean height-1 in boys was 113.76 cm. Mean height-2 height measured during follow-up after one year) in boys was 121.64 cm. Mean height-2 in girls was 121.63 cm [Table/Fig-3]. Most common age group affected with short stature was 8.1-10 years [Table/Fig-4].

Variables	Summary	Boys (n=32)	Girls (n=30)	Total	t-value	p-value
Age	Mean	8.53	8.64	8.58	-0.3104	0.7573
	SD	1.40	1.52	1.45		
Weight (kg)	Mean	22.34	21.67	22.02	0.7605	0.4499
	SD	3.54	3.46	3.49		
Height-1 (cm)	Mean	113.76	112.56	113.18	0.7011	0.4859
	SD	6.09	7.36	6.70		
Height-2 (cm)	Mean	121.64	121.63	121.64	0.0070	0.9944
	SD	6.83	8.05	7.33		
BMI	Mean	17.30	17.17	17.23	0.1977	0.8439
	SD	2.55	2.68	2.59		

[Table/Fig- 3]: Mean and SD of age and BMI in boys and girls by unpaired t-test.
Height-1: Height measured during 1st visit. Height-2: Height measured after one year follow-up

Gender	Age groups	N	Height-1 (cm)		Height-2 (cm)	
			Mean	SD	Mean	SD
Boys	6-8 y	5	109.18	2.53	113.94	2.69
	8.1-10 y	6	116.66	1.01	121.50	1.19
	10.1-11 y	3	121.00	1.41	126.45	2.19
	Total	14	114.27	5.05	119.18	5.30
	p-value		0.0090*		0.0090*	
Girls	6-8 y	1	107.00	-	110.50	-
	8.1-10 y	5	111.72	2.99	116.25	3.19
	10.1-11 y	2	120.33	3.88	125.50	2.50
	Total	8	113.83	5.53	118.45	5.82
	p-value		0.0389*		0.0282*	

[Table/Fig-4]: Comparison of age groups with height in boys and girl samples by ANOVA test.
*p<0.05

Wasting was seen in 84.62% of children with pathological short stature whereas in physiological short stature, it was 15.38% [Table/Fig-5].

Demographic profile	Pathological	%	Physiological	%	Total	%	p-value
Age groups							
6-8 y	2	33.33	4	66.67	6	27.27	0.2660
8.1-10 y	7	63.64	4	36.36	11	50.00	
10.1-11 y	4	80.00	1	20.00	5	22.73	
Gender							
Boys	6	40.00	8	53.33	15	68.18	0.0400*
Girls	7	100.00	1	14.29	7	31.82	
Height velocity							
Normal	0	0.00	9	100.00	9	40.91	0.0001*
Low	13	100.00	0	0.00	13	59.09	
Weight velocity							
Normal	2	22.22	7	77.78	9	40.91	0.0030*
Wasting	11	84.62	2	15.38	13	59.09	
Total	13	59.09	9	40.91	22	100.00	

[Table/Fig-5]: Association between demographic characteristics of children with physiological short stature and pathological short stature by Chi-square test.
*p<0.05

In this study out of 22 children, pathological short stature was found in 13 (59.10%) and physiological short stature in 9 (40.9%). The most common causes of short stature in this study was chronic malnutrition with IDA in 10 children (45.5%), followed by familial short stature in six (27.3%), constitutional delay of growth and puberty in three (13.6%), hypothyroidism in one (4.5%), uncontrolled asthma in one (4.5%), idiopathic short stature in 1 (4.5%) [Table/Fig-6].

Physiological short stature	Male	Female	Total
1. Familial short stature	5 (22.7%)	1 (4.5%)	6 (27.30%)
2. Constitutional delay of growth and puberty	3 (13.6%)	0 (0%)	3 (13.60%)
Total	8 (36.3%)	1 (4.5%)	9 (40.90%)
Pathological short stature	**Male**	**Female**	**Total**
1. Chronic malnutrition with Iron Deficiency Anaemia (IDA)	4 (18.18%)	6 (27.27%)	10 (45.50%)
2. Endocrine (Hypothyroidism)	0 (0%)	1 (4.5%)	1 (4.50%)
3. Idiopathic short stature	1 (4.5%)	0 (0%)	1 (4.50%)
4. Uncontrolled asthma	1 (4.5%)	0 (0%)	1 (4.50%)
Total	6 (27.27%)	7 (31.8%)	13 (59.10%)
N=22 (100%)			

[Table/Fig-6]: Classification of aetiology of short stature [10].

In physiological short stature, out of nine children, 6 (27.3%) had familial short stature as their midparental height was within target height range with normal investigations and growth velocity. Out of six children, five were male, one was female. Three (13.5%) boys had delayed bone age with normal growth velocity and investigations with family history of delayed puberty in parent were diagnosed as constitutional delay of growth and puberty [Table/Fig-6].

In pathological short stature, out of 13 children, 10 (45.5%) had chronic malnutrition with nutritional anaemia, as they had weight less than 3rd centile in IAP chart with significant deficit in calorie and protein intake. Out of 10 children, four were male and six were female. One girl had hypothyroidism (4.5%), one boy had uncontrolled asthma (4.5%), idiopathic short stature was considered in one boy (4.5%) who had delayed bone age and decreased height velocity with normal investigations including normal growth hormone response to stimulation test with no apparent medical cause for growth failure [Table/Fig-6].

Mean weight was lowest in IDA with chronic malnutrition (18.35 kg). It was highest in idiopathic short stature (26 kg). Mean height was lowest in constitutional delay of growth and puberty compared to other aetiology. Mean age was lowest in constitutional delay of growth and puberty (7.10 years), it was highest in idiopathic short stature (11.40 years) [Table/Fig-7].

Aetiology	Height-1 (cm)		Height-2 (cm)		Weight (kg)	Age (years)
	Mean	SD	Mean	SD	Mean SD	Mean SD
Constitutional delay of puberty	106.73	0.46	111.13	0.55	18.67 2.08	7.10 0.44
Familial short stature	115.85	5.84	120.15	6.09	21.42 4.12	9.10 1.40
Hypothyroidism	114.30	-	118.00	-	24.50 -	9.80 -
Iron Deficiency Anaemia (IDA)	114.25	4.20	119.64	4.64	18.35 3.06	9.11 1.16
Idiopathic short stature	120.00	-	124.90	-	26 -	11.40 -
Uncontrolled asthma	117.40	-	121.00	-	19.50 -	9.50 -
Total	114.07	5.15	118.85	5.42	19.91 3.64	8.99 1.38

[Table/Fig-7]: Mean weight, Height, Age in each aetiology of short stature.

DISCUSSION

Short stature may be a disability and can be a distress to the victimised child or adolescent [14]. It should be assessed early before epiphyseal fusion to get the opportunity of medical management. It is likely that the children with associated clinical symptoms or severe degrees of short stature will be referred to tertiary care hospital and endocrine clinics but many children with treatable causes of short stature without overt symptoms have been missed for evaluation and treatment due to under referral. Hence, our study emphasises on importance of screening of children at the community level for early diagnosis and intervention.

In present study, overall prevalence of short stature was 5.50%, similar to study conducted by Colaco P et al., where prevalence was 5.6% [15]. Khadgawat R et al., have reported 7% prevalence [12]. However, Garg P et al., reported 13.8% prevalence which is much more than this study [9]. The above three studies are from North India. A study by Velayutham K et al., which is a south Indian study, reported prevalence of 2.86% [10]. Also, study by De Mel T et al., which was conducted in Sri Lanka showed prevalence of 5.3% [Table/Fig-8] [9,10,12,15,16].

In present study, male female ratio was 0.93 (among 62 children, 30 were boys and 32 were girls), which is similar to studies conducted by Phirke S et al., (0.68) and Lashari SK et al., (0.9), in which there

Study name	Prevalence
Present study	5.50%
Garg P et al., [9]	13.8%
Velayutham K et al., [10]	2.86%
Khadgawat R et al., [12]	7%
Colaco P et al., [15]	5.6%
De Mel T et al., [16]	5.3%

[Table/Fig-8]: Comparing prevalence with other studies [9,10.12,15,16].

is female predominance [17,18]. Whereas in studies by Hussein A et al., (1.23), Gutch M et al., (1.6), Moayeri H et al., (1.8), there is male predominance [19-21]. There is female predominance in our study, because it is a community based study where male and female children will be examined equally and there will be no under referral of female children as compared to male.

In study done by Sengupta N et al., most common age group was <5 years which is less than present study [22]. In studies done by Karim M et al., and Rabbani MW et al., the most common age group was 6-11 years [22,23,24]. This difference in age groups compared to present study may be because their studies were conducted in tertiary care centre where children with different age groups were referred.

In studies by Arani KS et al., and Rajput R et al., mean height was 122.91 cm and 127.25 cm respectively which was more than present study [25,26].

In studies by Garg P et al., and Colaco P et al., pathological cause of short stature like chronic malnutrition and anaemia was more common than physiological short stature like present study [9,15]. Also, study by Phirke S et al., showed chronic systemic diseases (24.48%) and malnutrition (12%) [17]. The higher percentage of short stature due to chronic systemic disorders was probably because their study was conducted in a tertiary level hospital where children with chronic illness were referred for further management [Table/Fig-9,10] [9, 10,15,17,27,28].

Name of study	Physiological short stature	Pathological short stature
Our study	40.9%	59.1%
Garg P et al., [9]	24.4%	64%
Colaco P et al., [15]	10.7%	81.3%
Phirke S et al., [17]	26.5%	73.5%
Shrimali K et al., [28]	31%	69%

[Table/Fig-9]: Studies where pathological short stature was found more than physiological short stature [9,15,17,28].

Second most common cause of short stature in present study was familial short stature similar to studies by Hussein A et al., Gutch M et al., Moayeri H et al., where physiological short stature were most common [Table/Fig-11] [19-21]. This emphasises the importance of early diagnosis and proper counselling, which helps in removing parental anxiety and also to avoid unnecessary investigations. In study by Dutta D et al., endocrine cause of short stature was 19% which was more than present study as it was conducted in tertiary endocrine center [27]. Study by Shrimali K et al., showed uncontrolled asthma (6.6%), idiopathic short stature was found in 7.9% in a study by Shu G et al., which is more than present study [Table/Fig-10] [28,29].

Strength of our study was that, it was a community based study which helped in early identification of short stature. Children who were short in first visit were followed-up after one year to calculate their height velocity. Height velocity was normal in physiological cause of short stature.

This difference in the aetiology from different studies may be due to genetic, nutritional, socioeconomic and other related factor [Table/Fig-12] [30-32].

Aetiology	Our study	Colaco P et al., [15]	Phirke S et al., [17]	Dutta D et al., [27]	Shrimali K et al., [28]	Velayutham K et al., [10]	Shu G et al., [29]
Constitutional delay of puberty	13.60%	-	20.4%	12%	21.1%	66.7%	16.5%
Familial short stature	22.70%	-	6.12%	26%	9.85%		37.4%
Hypothyroidism/other endocrine diseases	4.5%	10.7%	12.24%	19%	3.2%	13.79%	7.9%
Chronic malnutrition with IDA	45.50%	43.5%	12.24%	6%	16.5%	10.4%	-
Idiopathic short stature	4.5%	-	-	4%	-	-	7.9%
Chronic systemic diseases like uncontrolled asthma	4.5%	16.4%	24.28%	1%	6.6 %	1. 15%	-

[Table/Fig-10]: Comparison of aetiological profile of short stature with other studies [10,15,17,27,28].

Name of study	Physiological short stature	Pathological short stature
Our study	40.9%	59.1%
Velayutham K et al., [10]	66.67%	33.33%
Hussein A et al., [19]	63.6%	40.9%
Gutch M et al., [20]	57.2%	42.8%
Moayeri H et al., [21]	53%	47%

[Table/Fig-11]: Studies where physiological cause of short stature is more common than pathological cause of short stature [10,19-21].

Aetiology	Our study	Sadiq A et al., [30]	Singh A et al., [31]	Essaddam L et al., [32]
Constitutional delay of growth and puberty	13.60%	10%	7.5%	2.8%
Familial short stature	27.30%	36%	22.5%	2.2%
Hypothyroidism/other endocrine diseases	4.5%	4%	4.75%	4%
Chronic malnutrition with IDA	45.50%	4%	29.25%	4.4%
Idiopathic short stature	4.5%	-	8%	-
Chronic systemic diseases like uncontrolled asthma	4.5%	4%	9.25%	-

[Table/Fig-12]: Comparison of aetiology with recent studies [30-32].
IDA: Iron deficiency anaemia

Limitation(s)

Limitation of this study includes this study was done in few schools of Bangalore. A larger study catering many schools across India will be beneficial to analyse overall prevalence of short stature in India.

CONCLUSION(S)

The study results indicate that the overall prevalence of short stature in school-going children was 5.50%, representing a significant percentage of our society that needs proper attention.

This study also indicates that pathological short stature, which is correctable, was more common than physiological short stature. Chronic malnutrition with IDA was the most common pathological cause of short stature in the present study. Hence, growth monitoring with standard growth charts should be mandatory in all schools as a part of school health programmes. Early diagnosis and intervention will be effective only before epiphyseal fusion and also help in preventing psychosocial affects associated with short stature.

Acknowledgement

We thank our nursing staff and medical social workers for their help and support.

REFERENCES

[1] Kamboj M. Short stature and growth hormone. IJP. 2005;72(2):149-57.
[2] Haymond M, Kappelgaard AM, Czernichow P, Biller BM, Takano K, Kiess W. Early recognition of growth abnormalities permitting early intervention. Acta Paediatrica. 2013;102(8):787-96.
[3] Ullah F, Ghaffar T, Afridi AK, Ali A, ulhasanAamir A. Short stature: What is the cause in our population. J Ayub Med Coll Abbottabad. 2016;28(1):135-40.
[4] Nath P, Kumar J, Rahaman SK, Rai M. Short stature: Evaluation and management of short stature [Internet]. 2008 [cited 15 June 2017]. Available from: http://www.apiindia.org/medicine_update_2013/chap137.pdf.
[5] Sultan M, Afzal M, Qureshi SM, Aziz S, Lutfullah M, Khan SA, et al. Etiology of short stature in children. J Coll Physicians Surg Pak. 2008;18(8):493-97.
[6] Ray J. Childhood short stature. Al Ameen Journal of Medical Sciences. 2012;1(5):212-15.
[7] Wit JM, Reiter EO, Ross JL, Saenger PH, Savage MO, Rogol AD, et al. Idiopathic short stature: Management and growth hormone treatment. Growth Horm. 2008;18(2):111-35.
[8] Mohammadian S, Khoddam H. An etiologic evaluation of children with short stature in Gorgan (Northeast Iran), 2005. J Med Sci. 2007;7(7):1206-09.
[9] Garg P. Short stature in Indian children: Experience from a community level hospital. Srilanka J Child Health. 2004;34:84-88.
[10] Velayutham K, Selvan SS, Jeyabalaji RV, Balaji S. Prevalence and etiological profile of short stature among school children in a South Indian population. Indian J Endocrinol Metab. 2017;21(6):820.
[11] Dabadghao P, Bhatia V. Growth Retardation. In: Desai MP. Pediatric endocrine disorders. Third edition. Hyderabad: Universities press (India) Private Limited; 2014.53-61.
[12] Khadgawat R, Dabadghao P, Mehrotra RN, Bhatia V. Growth charts suitable for evaluation of Indian children. Indian Pediatr.1998;35:859-65.
[13] Lwanga SK, Lemeshow S. Sample size determination in health studies: A Practical Manual. Geneva: World Health Organization; 1991.
[14] Frindik JP, Kemp SF, Hunold JJ. Near adult heights after growth hormone treatment in patients with idiopathic short stature or idiopathic growth hormone deficiency. Journal of Pediatric Endocrinology & Metabolism: JPEM. 2003;16:607-12.
[15] Colaco P, Desai M, Choksi CS. Short stature in Indian children: The extent of the problem. IJP. 1991;58(5):57-58.
[16] De Mel T. A study of short stature in a community of Sri Lankan children, University of Colombo UC(MED). [Internet]. 1987 [cited on 4 June 2017]. Available from: https://sjdem.sljol.info/article/10.4038/sjdem.v4i1.7255/galley/5605.
[17] Phirke DS, Phirke SO, Khot S. An aetiological evaluation of short stature. International Journal of Research in Medical Sciences. 2017;5(9):3887-90.
[18] Lashari SK, Korejo HB, Memon YM. To determine frequency of etiological factors in short statured patients presenting at an endocrine clinic of a tertiary care hospital. Pak J Med Res. 2014;30(4):858.
[19] Hussein A, Farghaly H, Askar E, Metwalley K, Saad K, Zahran A, et al. Etiological factors of short stature in children and adolescents: Experience at a tertiary care hospital in Egypt. Ther Adv Endocrinol Metab. 2017:2042018817707464.
[20] Gutch M, Sukriti K, Keshav GK, Syed MR, Abhinav G, Annesh B, et al. Etiology of short stature in Northern India. J ASEAN Fed Endocr Soc. 2016;31(1):23.
[21] Moayeri H, Aghighi Y. A prospective study of etiology of short stature in 426 short children and adolescents. Arch Iran Med. 2004;7:23-27.
[22] Sengupta N, Sahana PK, Baidya A, Goswami S, Chatterjee K, Siddanta S. A study on assessment of prevalence and etiology of short stature in a tertiary care centre in India. Indian J Endocrinol Metab. 2017;21(6):820-22.
[23] Karim MR, Shamaly KJ, Tithi BB, Akter R, Jahan I, Begum S. Etiology of short stature in children attending pediatric endocrinology clinic of a tertiary care hospital in Bangladesh. Int J Contemp Pediatr. 2020;7:363-68.
[24] Rabbani MW, Khan WI, Afzal AB, Rabbani W. Causes of short stature identified in children presenting at a tertiary care hospital in Multan Pakistan. Pak J Med Res. 2013;29(1):53.
[25] Shiasi-Arani K. Etiology of short stature in first five years of life. Zahedan J Res Med Sci. 2016;18(3):e6272.
[26] Rajput R, Rani M, Rajput M, Garg R. Etiological profile of short stature in children and adolescents. Indian J Endocrinol Metab. 2021;25(3):247-51.
[27] Dutta D, Biswas K, Arora R, Barman N, Bhushan D, Bhakhri BK. Profile and height outcomes of children with short stature in north India: An experience from a tertiary care centre. IJP. 2014;81:205-06.
[28] Shrimali K, Patel P, Shah C, Das S. Study of short stature in children. International Journal of Novel Research in Healthcare and Nursing. 2016;3(2):115-24.
[29] Shu SG, Chen YD, Chi CS. Clinical evaluation of short children referred by school screening: an analysis of 655 children. Acta paediatrica Taiwanica = Taiwan er ke yi xue hui za zhi. 2002;43(6):340-44.

[30] Sadiq AM, Hassan QF, Mutlag YA. The prevalence and etiological profile of short stature in children. Eurasian J Med Oncol. 2022;6:17-23.
[31] Singh A, Masand R, Verma CR, Khinchi Y. Etiological profile of short stature in rural Rajasthan. IJCH. 2021:297-301.
[32] Essaddam L, Kallali W, Cherifi E, Guedri R, Mattoussi N, Fitouri Z, et al. Characteristics and etiologies of short stature in children: Experience of an endocrine clinic in a Tunisian tertiary care hospital. Int J Pediatr Adolesc Med. 2020;7(2):74-77.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Paediatrics, SDM College of Medical Sciences and Hospital, Dharwad, Karnataka, India.
2. Consultant Paediatrician, Paediatric Endocrinologist, Department of Paediatrics Bangalore Baptist hospital, Bangalore, Karnataka, India.
3. Consultant Paediatrician, Paediatric Geneticist, Head, Department of Paediatrics, Bangalore Baptist Hospital, Bangalore, Karnataka, India.
4. Consultant and Head, Department of Community Medicine, Bangalore Baptist Hospital, Bangalore, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Jasmine Kandagal,
4th Main, Shivagiri, Dharwad, Karnataka, India.
E-mail: jasminesmile18@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Dec 19, 2022
- Manual Googling: Mar 14, 2023
- iThenticate Software: Apr 04, 2023 (10%)

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: **Dec 17, 2022**
Date of Peer Review: **Jan 28, 2023**
Date of Acceptance: **Apr 07, 2023**
Date of Publishing: **May 01, 2023**