Original Article

Clinicoepidemiological Profile of Short Stature at a Tertiary Care Centre in North India

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ABSTRACT

Background: Short stature (SS) is a common pediatric problem. The goal of the evaluation of a child with SS is to identify the subset of children with pathologic causes so that appropriate timely intervention can be made. **Aim:** The aim of the study was to study the clinical, epidemiological, and etiological profile of SS at a tertiary hospital of north India. **Materials and Methods:** This was an observational analytical study and was conducted in the department of pediatrics, over a period of 1 year (October 2016–September 2017). A total of 100 children aged 3–14 years, with height <−2SD below the mean height for age and sex, were studied. Clinical history, examination, and laboratory evaluations were done to assess the cause of SS and the data were analyzed using appropriate statistical methods. **Results:** About 55% were female and 45% were male. The causes of SS were found to be familial SS (28%), celiac disease (17%), chronic diseases (15%), constitutional growth delay (12%), hypothyroidism (11%), small for gestational age babies with no catch-up growth (10%), use of corticosteroids (4%), and growth hormone deficiency (3%). **Conclusion:** Chronic systemic illnesses and malnutrition still form a major chunk in the etiological profile of SS in India. Celiac disease should be considered with a high index of suspicion as one of the etiologies of SS.

Key words: Celiac disease, Growth charts, Short stature

Normal growth is a sign of good health. Every individual has a genetic base with a definite growth potential, which may be modulated by various factors both in the prenatal period and in postnatal life. Optimal growth can only be achieved when all these factors operate in harmony [1]. According to the Louisville Twin Study, which examined the height from birth to maturity in twin families, heredity accounted for almost 90% of the factors that determined height from the age of 6 years and after [2]. The rest of the factors included nutrition, socioeconomic status, disease, psychosocial stress, climate, and physical activity [1].

Short stature (SS) is defined as the height below the third centile or less than two standard deviations below the median height for that age and sex according to the population standard [3], or even if the height is within the normal percentiles, but growth velocity is consistently below 25th percentile over 6–12 months of observation [4]. It may be a variant of normal growth or may be a symptom of a disease process (normal variant and pathologic SS). The goal of the evaluation of a child with SS is to identify the subset of children with pathologic causes so that appropriate timely intervention can be made.

Our country has a wide range of factors affecting the height of an individual, namely, genetic, environmental, nutritional factors, and exposure to infectious diseases which vary with geographical variations. It is needed to study these factors and understand their dynamic nature to find the etiology of SS in a region. This study was undertaken at a tertiary care center in north India, to identify the clinico-epidemiological profile of SS in our area.

MATERIALS AND METHODS

This was an observational analytical study and was conducted in the Department of Pediatrics, in a tertiary care teaching hospital in north India over a period of 1 year (October 2016–September 2017). Ethical clearance was taken from the Institutional Ethical Committee. A total of 100 children aged 3–14 years, of either sex, with height two standard deviations below the mean height for age and sex (less than the third percentile) or more than two standard deviations below the mid-parental height, who presented to the general pediatrics outpatient department consecutively, were enrolled. Written consent was obtained from the guardians of the patient. Children with any gross congenital malformations

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(skeletal dysplasia, storage disorders, and chromosomal abnormalities) and children with developmental delay were excluded from the study.

An extensive health history along with nutritional and socioeconomic history (using Kuppuswamy index) was taken and a systemic physical examination, including height and weight measurements, was performed. A stadiometer was used to measure height. The height of all children was measured by keeping their head in Frankfurt plane while occiput, shoulder, buttocks, and heel touching the vertical board. The children were drawn up to their full height by upward pressure on mastoids. The standard deviation score was measured in all subjects and growth charts were used to define SS. For children from 3 to 5 years, WHO growth charts were used and for children 6 to 14 years, Indian Academy of Pediatrics charts were used.

Data were collected on age, sex, birth height, birth weight, parental heights, and the age of puberty for each parent. Primary screening tests including routine and complete blood count, erythrocyte sedimentation rate (ESR), renal function test, calcium (Ca), phosphorus (P), alkaline phosphatase (ALP), T4, thyroid-stimulating hormone (TSH), stool exam, urinalysis, urine culture, celiac serology, and bone age radiographs were performed for all of the subjects. The bone age was calculated by Tanner Whitehouse System.

Approach to Diagnosis

Non-endocrinal causes were diagnosed based on history and relevant investigations. Hypothyroidism was confirmed by measuring serum concentrations of TSH and total or free T4 and matching them with age-appropriate reference ranges [5]. Growth hormone deficiency (GHD) was considered when other etiologies were excluded and a child had a height more than 3 SD below the mean, a subnormal growth rate (a 1-year height velocity more than 1 SD below the mean) or height more than 1.5 SD below the mid-parental height (average of mother's and father's height), delayed bone maturation, and was confirmed by the peak growth hormone concentration <10 ng/mL with two provocative tests done 1 week apart (clonidine and insulin) [6].

Normal variants included a constitutional delay in growth (CDG) and familial SS (FSS). These children had height <3 SD with normal investigations. CDG was defined as a proportionate

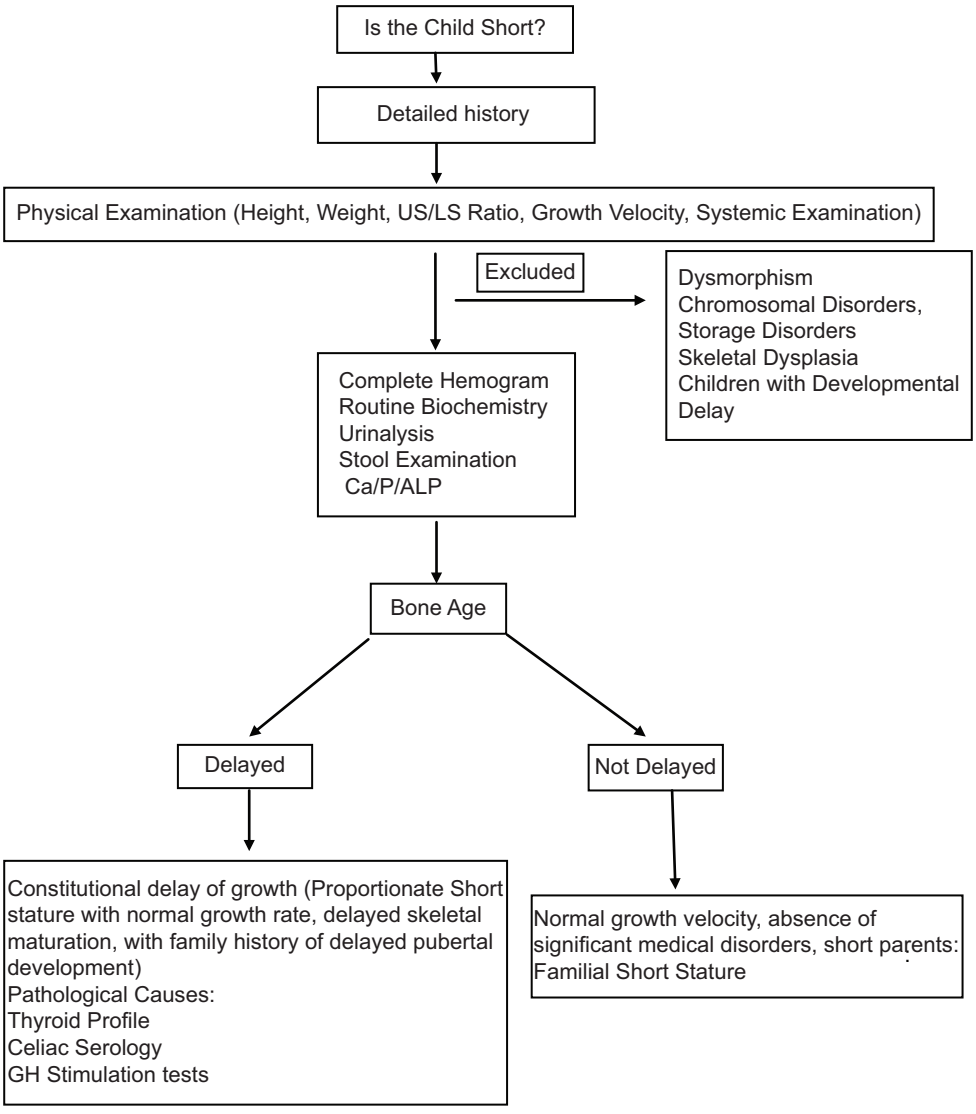

Figure 1: The flow chart for approach toward diagnosis

SS with a normal growth rate, delayed skeletal maturation often with a family history of delayed pubertal development, or late adolescent growth spurt. FSS was defined as a proportionate SS with a normal growth rate, skeletal age similar to chronologic age, absence of significant medical disorders, and short parents [7,8]. Fig. 1 shows the flow chart for the approach toward diagnosis.

The data collected were then compiled into Microsoft excel sheet. Categorical variables were presented as proportions (%) and continuous variables as mean (SD).

RESULTS

Among the 100 reviewed patients, 45 were male and 55 were female. The mean age of presentation was 8.7 years (SD 3.1) years. Of 100 cases, 4 (4%) cases belonged to the age group of <5 years; 31 (31%) cases belonged to the age group of 11–14 years and maximum cases belonged to the age group of 5–10 years (65%), as shown in Table 1.

Table 1: Baseline characteristics

Baseline characteristics	
Mean (SD)	
Age at presentation (years)	8.7 (3.1)
Height (cm)	108.9 (15.3)
Weight (kg)	20.7 (7.4)
Number (%)	
Age distribution	
<5 years	4 (4%)
5–10 years	65 (65%)
11–14 years	31 (31%)
Gender	
Male	45 (45%)
Female	55 (55%)
Gestation	
Preterm	15 (15%)
Term	85 (85%)
Birth weight	
<2 kg	14 (14%)
2–2.5 kg	22 (22%)
>2.5 kg	64 (64%)

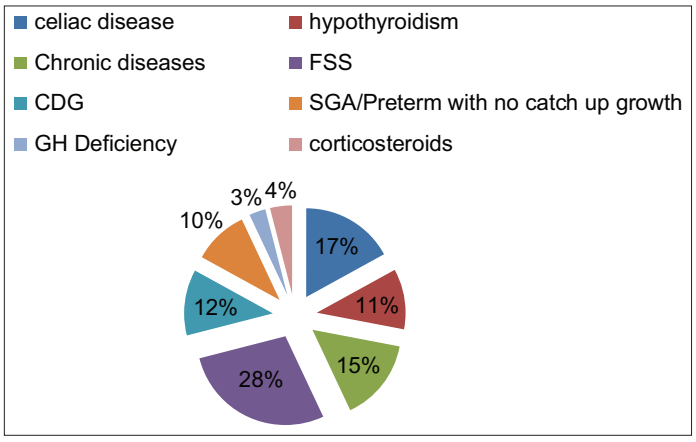

Figure 2: Etiological profile of short stature

The etiology varied widely. Pathological SS was found to be more prevalent than the normal variant. However, FSS (28%) was found to be the most common single cause of SS in our population followed by celiac disease (17%), chronic diseases (15%), CDG (12%), hypothyroidism (11%), small for gestational age/preterm babies with no catch-up growth (10%), use of corticosteroids (4%), and GHD (3%), as shown in Fig. 2. Various systemic diseases implicated included anemia, chronic pyelonephritis causing CKD, nephritic syndrome, congenital heart diseases, and pulmonary tuberculosis.

DISCUSSION

SS is a common cause of worry in the parents, especially those of school-going children. Therefore, the early diagnosis is of paramount importance and treatment for the SS would be effective only before epiphyseal fusion [9]. To obtain a clear insight about the prevalence and etiological significance of SS in the present study population, we compared our data with earlier reports from India. In our study, consisting of 100 patients, FSS was found to be the most common cause followed by celiac disease.

Bhadada *et al.* in 2003 found out that normal variant SS (36.1%) (CDG [21.02%] and FSS [15.09%]) were the most common causes of SS followed by endocrine causes (30.09%), intrauterine growth restriction and birth anoxia (8.52%), chronic systemic diseases (7.38%), metabolic bone diseases (5.68%), and malnutrition (5.1%). Miscellaneous causes contributed to 6.25% in their study [10]. In another study in 2010 by Bhadada *et al*., pituitary disorders (19.2%) were found to be the most common, followed by hypothyroidism (13.7%), celiac disease (13.7%), and normal variants (9.8%) [11].

Ramagopal *et al*. studied only the pathological causes of SS and found the common causes to be endocrinal causes such as hypothyroidism (20%) and genetic causes such as Downs, Seckel, and Turners (24% each) followed by nutritional causes and musculoskeletal causes such as skeletal dysplasia, vertebral defect, and myofascial pain syndrome were about 20% each and the remaining were chronic diseases such as chronic renal failure, cyanotic congenital heart disease, and caries spine [12]. Gutch *et al*. in 2016 found common causes of SS to be CDG and puberty (41.2%), FSS (15.9%), type 1 diabetes mellitus (9.9%), primary hypothyroidism (8.6%), and systemic disorders (including chronic liver disease, chronic renal disease, cardiac disorder, tuberculosis, and nephritic syndrome) (10.6%), and GHD (2.4%) [7].

The etiological profile found by Zargar *et al*. in 1998 consisted of GHD (22.8%) to be the most common cause of SS followed by normal variants (18.7%) and hypothyroidism (7.8%). Other causes included distal renal tubular acidosis, growth hormone insensitivity syndrome, and malnutrition. Rare causes included craniopharyngioma and eosinophilic granuloma [8]. Phirke *et al*. in 2017 did a study on 49 children and found out chronic systemic disorders (24.48%), CDG (20.4%), endocrine causes (12.24%),

malnutrition (12.24%), and skeletal dysplasias (10.20%) to be the common causes of SS. A few number of cases were diagnosed with chromosomal and dysmorphic disorders (4.08% each) [13].

The results strongly indicate that the methodological approach has implications in the relative contribution of various causes to the profile of SS. Similar to our finding of FSS being the most common etiology, a number of studies worldwide have also found normal variants to be the most common cause of SS [3,14-16]. Several Indian studies have also published more prevalence of either FSS or CDG as causes of SS [7,10,17]. However, we found that GHD was present only in 3% cases, as opposed to a few studies [8,11,12]. Another important observation made in our study along with some Indian studies was that the prevalence of SS due to chronic systemic illnesses and malnutrition was higher as opposed to endocrinological causes. This is probably because of India being a developing country and a prevalence of prenatal as well as postnatal malnutrition for our young population, thus reflecting poorly on the nutritional status of our population.

Our study finds celiac disease to be an emerging cause of SS in north India. This is in accordance with the study by Bhadada *et al*. in which the authors suggested an increasing trend of celiac disease as a causative factor of SS [11]. In previous studies [8,10], celiac disease has not been reported as a cause. Even in the newer literature from India [7,13,18], it has not even been studied as one of the causes. This might be because these studies come from western and southern India, where the population is predominantly consuming rice and therefore, the overall prevalence of celiac disease itself is not as much as in our population. Now that the serological tests are widely and easily available, a high index of suspicion is needed in the areas with a high prevalence of the disease, making serological testing for celiac disease an important part of work up while evaluating a case of SS.

The study had a few limitations. It was limited to its small sample size. Larger scale, community-based studies would better describe SS in a population.

CONCLUSION

The study stresses upon the fact that the etiology of SS varies with the demographic, nutritional, and socioeconomic profile of a geographical area. However, it is found that apart from the normal variants, chronic systemic illnesses, and malnutrition still form a major chunk in the etiological profile of SS in our country. Celiac disease is a common cause of SS, especially in endemic areas.

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