Nutritional status and dietary restrictions of children with asthma in comparison to healthy children

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Abstract

Background: Asthma is a chronic inflammatory disorder of the small airways. It has an impact on childhood nutrition due to the chronic nature of the disease.

Objectives: To describe the nutritional status and dietary practices among children aged 5-14 years with and without asthma.

Method: A comparative cross-sectional study was done among 86 children with asthma attending paediatric clinics, Teaching Hospital Karapitiya and 86 age and sex-matched healthy school children in the Bope-Poddala health unit area. Anthropometric measurements were interpreted using the World Health Organisation growth charts. Thinness, severe thinness, stunting, overweight and obesity were compared between the two groups.

Results: A total of 172 children, aged 5-14 years, was enrolled in the study. Of them 86 (50%) were asthmatics. Eighty (93%) children in the asthma group belonged to the category of mild persistent asthma. Normal body mass index (BMI) was found among 29 (37.3%) asthmatics and 49 (57%) healthy children (p=0.002). Prevalence of stunting, overweight and thinness in the diseased group was 7 (8.1%), 12 (14%) and 45 (52.3%) respectively. In the healthy group prevalence of stunting, overweight and thinness was 4 (4.7%), 4 (4.7%) and 33 (38.4%) respectively. This was not statistically significant. Dietary restrictions were practised by 62 (72%) asthmatics and 9 (9.3%) healthy children (p<0.0001). Among children with asthma, no statistically significant associations were observed between the nutritional abnormalities and the duration of inhaler therapy, inhaler dose or the presence of food restrictions.

Conclusions: There were no statistically significant differences in stunting, overweight, obesity and thinness between children with and without asthma. Duration of inhaled corticosteroid therapy and steroid dose showed no relationship with nutritional abnormalities. Dietary restrictions were significantly commoner in children with asthma but there was no association between dietary restrictions and nutritional abnormalities among them.

(Key words: Asthma, Nutrition, Dietary restrictions, Healthy children, Growth, Steroids)

Introduction

Asthma is a chronic inflammatory disorder of small airways, which results in airflow obstruction, and it is commonly associated with recurrent exacerbations[1]. The prevalence of childhood asthma in Sri Lanka is 15-25%[2]. Childhood nutrition plays a crucial role in adult height and health outcomes[1]. Due to multiple reasons, childhood nutrition is adversely affected by chronic illnesses. Asthma is an illness that can affect childhood nutritional status due to the nature of the disease and its treatment. Firstly, due to cultural beliefs and fear of food allergies, food restriction is common among asthmatic children[3]. Secondly, children with asthma can get impaired linear growth if they are exposed to high doses of systemic steroids for a long duration[4]. Furthermore, poorly controlled asthma can result in frequent exacerbations, frequent hospitalisation and repeated exposure to systemic steroid therapy[4].

On the other hand, obesity is a causative factor for childhood asthma, leading to a complex interrelationship between the nutritional status and the disease status[5,6]. A few studies had been undertaken to assess the growth and nutritional status of children with asthma. Scepanovic A, *et al*[7] conducted a study on the nutritional status (body mass index) of children with asthma from 6 to 15 years, which showed some form of malnutrition (under-nutrition or over-nutrition) in 34.5% of

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children with asthma, though they had not assessed the contributory factors towards the development of malnutrition in these children. According to Ling Ang K, *et al*[3] 60% of children with asthma were on some form of dietary restriction.

A case control study done by Silveria DH, *et al* in Brazil in 2015 revealed that obesity is an association of persistent asthma in children[5]. In contrast, a study done in Sri Lanka in 2003 by Fernando MAM showed no significant association between Body Mass Index (BMI) and asthma and allergic rhinitis among children aged 13-14 years[8]. Lawson JA, *et al*[6] in 2013 conducted a case-control study to assess nutritional status and dietary practices among children with asthma. According to their study, obesity was significantly associated with non-atopic asthma; however, their study had not looked into dietary restrictions of children with asthma. Though several studies had been conducted on malnutrition in otherwise healthy children, hardly any research had been done to assess children's nutritional status in chronic illnesses such as asthma, particularly in relation to dietary restrictions.

Objectives

The main aim of this study was to determine the nutritional status and feeding practices of children with asthma and its contributory factors compared to healthy children of the same age and gender.

Method

A comparative cross-sectional study was conducted in Teaching Hospital, Karapitiya (THK). The *sample size* was calculated using the formula for estimating the difference between two population proportions[9]. {Power = 80%, significance level = 5%, estimated proportion with malnutrition in study disease group (p1) = 34.5%[7], estimated proportion with malnutrition in the comparison group (p2) = 10.7%}

N= (u+v) 2 [p1(1-p1) +p2(1-p2)]/ (p1- p2)2 = 44.85

Therefore, the minimum sample size needed to compare the proportion with malnutrition was 45 children with asthma and 45 healthy children matched for age and sex. However, to increase the study's power, it was decided to increase the sample size to up to 86 children in each group.

The study group included 86 children with asthma for a minimum duration of three months followed up at the paediatric pulmonology clinic and general paediatric clinics at THK. An age-and-sex-matched sample of 86 children selected from the adjacent health unit area Bope-Poddala was used as the comparison group. Study was conducted from June 2018 to December 2020. A consecutive sample of asthmatic children who met the eligibility criteria was recruited. Consecutive sampling was also used to obtain the age-and-sex-matched control sample from the community.

A pre-tested interviewer-administered questionnaire was used to obtain demographic details and dietary practices of children. Disease-related data were extracted from clinic records of individual participants. A stadiometer was used to measure height, and measurements were taken to closest 0.1cm. Weight was measured using an electronic weighing scale (Seca R France) to closest 100g. Body mass index (BMI) was calculated by using the standard formula (weight in kg/height in metres^2). All anthropometric measurements were interpreted using World Health Organization (WHO) growth charts[10]. Height for age was also assessed but weight for age was not assessed since the WHO growth chart contains reference values for only up to 10 years of age. Children with nutritional abnormalities were referred to the nutrition clinic, THK.

Stunting was defined as height for age <-2SD[10]. Based on BMI, 5 categories of nutritional status (severe thinness, thinness, normal BMI, overweight and obesity) were considered. Normal BMI was defined as -2SD to +1SD. Thinness and severe thinness were defined as BMI between -2SD to -3SD and less than -3SD, respectively[10]. Overweight and obesity were defined as BMI between +1SD to +2SD and greater than +2SD respectively[10].

Ethical issues: Approval for study was obtained from the Institutional Ethics Committee of THK (Ref. No. 17.05.2018/3.1). All participants enrolled voluntarily. Administrative approval was sought before study implementation. Nature of study, its importance, procedures, potential risks and benefits were clearly explained to all participants. Informed written consent was obtained from the parents, and assent was obtained from children. All records were kept anonymous and confidential by coding.

Statistical analysis: Data were analysed using SPSS version 21. Z test was used to compare the characteristics of the two groups. During analysis of BMI values, overweight and obesity categories were amalgamated. Similarly, thinness and severe thinness were considered as one group. Chi-square test was used for all analyses within the asthma group. $p< 0.05$ was considered significant in all analyses except in assessing the association between BMI and asthma, where the Bonferroni-adjusted p-value of 0.008 (0.05/6) was used to determine statistical significance in order to reduce the type I error as the comparisons between these two variables were performed at multiple levels.

Results

The response rate was 100%. Out of 172 children 106 (61.6%) were males. The mean age was 8.8 ± 2.6 years. The birth weight ranged from 1300g to 4500g. The mean birth weight was 2841.5 ± 490.3g. There were no significant differences in basic characteristics between the asthma group and the comparison group except in birth weight. Proportions with low birth weight (LBW) in study group and comparison group were 34.9% and 16.3%, respectively (p=0.018).

Disease-related data of asthmatic children are given in Table 1. Mean age at diagnosis of asthma was 4.4 ± 3.4 years. Mean age at starting treatment was 5.4 ± 3.2 years.

Comparison of the nutritional status of children with asthma and healthy children is shown in Table 2.

Table 1: ***Disease-related data of children with asthma (n=86)***

Variable	n (%)
Asthma category	
Mild persistent	80 (93.0)
Moderate persistent	05 (05.8)
Severe persistent	01 (01.2)
Inhaler device	
Meter dose inhaler	75 (86.0)
Dry powder inhaler	11 (14.0)
Duration of therapy	
3 months -2 years	20 (23.2)
2-5 years	46 (53.4)
>5 years	20 (23.2)
Montelukast therapy	
Yes	10 (11.6)
No	76 (89.4)
Number of exacerbations during the previous month	
No exacerbations	61 (70.9)
1	18 (20.9)
≥ 2	07 (08.1)
Number of hospitalisations during the previous year	
No admissions	52 (60.5)
1	19 (22.1)
2	09 (10.5)
≥ 3	06 (07.0)
Inhaled corticosteroid dose (µg/day)	
100	04 (04.7)
200-400	63 (73.2)
>400	18 (21.0)

Table 2: ***Comparison of nutritional status of children with asthma and healthy children***

Nutritional status		Asthma group *(n=86)* n (%)	Comparison group *(n=86)* n (%)	p-value
Height	Stunting (<-2SD)	07 (08.1)	04 (04.6)	p=0.352
	No stunting	79 (91.9)	82 (95.3)	
BMI	Severe thinness (<-3SD)	20 (23.3)	13 (15.1)	
	Thinness (<-2SD)	25 (29.1)	20 (23.2)	p=0.093*
	Normal BMI (-2SD to +1SD)	29 (33.7)	49 (57.0)	p=0.002
	Overweight (>+1SD)	05 (05.8)	02 (02.3)	
	Obesity (>+2SD)	07 (08.1)	02 (02.3)	p=0.036**

**For the analysis, thinness and severe thinness are amalgamated together*

*** For the analysis, overweight and obesity are amalgamated together*

In assessing the association between BMI and asthma the Bonferroni-adjusted p-value of 0.008 (0.05/6) was used to determine statistical significance. Therefore, the difference in proportion of obesity and overweight between the asthmatic group and the control group (p=0.036) was not statistically significant. However, the proportion with a normal BMI value for age and sex was significantly higher among the healthy children compared to the children with asthma in this sample (p=0.002) indicating that nutritional abnormalities

were more common among asthmatic children compared to healthy children.

Among children with asthma, no statistically significant associations were observed between stunting and the sex of the child, the duration of inhaler therapy, the inhaler dose or presence of food restrictions (Table 3). The duration of inhaler treatment and the dose of inhaled steroids did not show any significant association with the occurrence of overweight and obesity. Similarly, there was no sex predominance on the proportion of overweight (Table 3). Thinness or severe thinness was not statistically significant (p=0.84) among those on dietary restrictions.

Table 3: ***Relationship of stunting and overweight with sex of child, food restrictions, inhaled corticosteroid (ICS) dose and duration among children with asthma (n=86)***

Characteristic	Height			Body mass index		
	Stunting n (%)	No stunting n (%)	p- value	Overweight/ obesity n (%)	No overweight/ obesity n (%)	p- value
Sex						
Male	02 (03.8)	51 (96.2)	0.06	07 (13.2)	46 (86.8)	0.80
Female	05 (15.2)	28 (84.8)		05 (15.2)	28 (84.4)	
ICS dose (µg/day)						
200-400	04 (06.1)	61 (93.9)	0.23	07 (10.8)	58 (89.2)	0.13
>400	03 (14.2)	18 (85.7)		05 (23.8)	16 (76.2)	
Duration of ICS						
<3 years	02 (05.1)	37 (94.9)	0.35	03 (07.7)	36 (92.3)	0.12
≥3 years	05 (10.2)	42 (89.8)		09 (19.1)	38 (80.9)	
Food restrictions						
Yes	05 (08.1)	57 (91.9)	0.67	08 (12.9)	54 (87.1)	0.65
No	02 (08.3)	22 (91.7)		04 (16.7)	20 (83.3)	

Sixty-two (72%) children with asthma were on some form of dietary restriction due to their underlying disease. In the comparison group, only 9 (9.3%) were on dietary restrictions. This was statistically significant (p<0.001).

Of the children with asthma, 59% of parents restricted food mainly during acute asthma exacerbations, whereas 29% of parents practised food restrictions every day. The most common reason behind dietary restriction was the belief in asthma exacerbations due to certain food items. The most commonly restricted food items were refrigerated food and beverages, eggs, fresh milk and king coconut water (Table 4). However, stunting and thinness or severe thinness were not common among those who were on dietary restrictions.

Table 4: ***Commonly restricted food and beverages among asthmatic children (n=86)***

Type of restricted food and beverages	Number (%)*
Refrigerated food and beverages	61 (70.9)
Eggs	33 (38.4)
Fresh milk	29 (33.7)
King coconut water (‘Thambili’)	24 (27.9)
Mung beans	23 (26.7)
Milk rice	23 (26.7)
Cucumber	21 (24.4)
Curd	09 (10.5)
Banana	09 (10.5)
Watermelons	09 (10.5)
Papaw	07 (08.1)

**Percentages do not add up to 100% due to multiple responses*

Discussion

The main aim of this study was to describe the nutritional status and dietary habits of children with asthma in comparison to healthy children. In addition, investigators attempted to identify any association between dietary restrictions and nutritional abnormalities. The findings showed that normal BMI is less common among children with asthma compared to healthy children. Furthermore, dietary restrictions were common among children with asthma group. However, no association was found between dietary restrictions and overweight or thinness.

There was male predominance among asthmatic children which is compatible with many other studies[11,12]. Since comparison group was age-and-sex-matched, the sex distribution was identical to the asthma group. The 2 groups were similar in maternal educational level. Low birth weight (LBW)

was more prevalent among asthmatic children compared to healthy children. A similar finding was observed by Mebrahtu TF, *et al*[13] who concluded that wheezing in later life was positively correlated with LBW. A study in Europe by Sonnenschein-Van Der Voort, AMM, *et al*[14] showed that prematurity was associated with occurrence of asthma in later life, but a weaker relationship was found when birth weight was adjusted to gestational age. In current study, we did not obtain the gestational period at the time of birth. Therefore, it is not possible to comment on whether the observed difference of LBW in the two groups was due to prematurity, and we believe this is a limitation of our study.

In the current study 66.3% children with asthma had some form of nutritional abnormality. Conversely, in a study in Serbia in 2013, Scepanovic A, *et al*[7] revealed that under-nutrition or over-nutrition exists in 34.5% of children with asthma. In the present study, irrespective of the disease status the most prevalent (overall proportion 45.3%) nutritional abnormality was thinness or severe thinness. Furthermore, 38.4% of healthy children also had either thinness or severe thinness and this showed no statistically significant difference between children with and without asthma. Similarly, a study in 2016 by the Medical Research Institute, Sri Lanka, in collaboration with United Nations International Children's Emergency Fund (UNICEF) and World Food Programme, revealed a 30.2% prevalence of thinness. In the same study, prevalence of thinness in the southern province was 34.8%[15], indicating that the nutritional status of the comparison group was fairly representative of the general paediatric population.

Studies conducted in Poland and United States revealed that children with asthma were likely to have overweight or obesity compared to healthy children. This is compatible with most research conducted in Poland and the United States[16-18]. In the present study, 14% children with asthma were either overweight or obese. In a study in Poland by Umławska W, in 2014, 18.7% of children with asthma had BMI above the cut-off level for overweight[16]. Among healthy children, 4.6% were either overweight or obese. Similarly, prevalence of overweight or obesity was 6.0% in a large-scale study in the Southern province of Sri Lanka in 2016[15].

Obesity is a recognised complication of long-term systemic steroid therapy[5]. However, in our study, the duration and the dose of inhaled steroids did not show a significant association with the presence of obesity in children with asthma. Some studies reveal that long-term inhaled steroid usage could affect the children's linear growth[5,19,20]. In contrast, a recent study in Sri Lanka by Anuradha KW, *et al*[21] showed that inhaled corticosteroids (ICS) do not affect linear growth and bone profile; however, long-term ICS usage can result in adrenal suppression. There was no significant difference in prevalence of stunting among children with asthma compared to healthy children in our study. Further, duration and dose of ICS showed no relationship with stunting within the asthma group.

Some form of dietary restrictions was seen among 72% children with asthma in our study. Similarly, a study by Ling Ang K, *et al*[3] in Singapore revealed that 60% of children with asthma were on some form of dietary restrictions. Parents tend to restrict refrigerated food, eggs and dairy products. However, there was no statistically significant association between nutritional abnormalities and dietary restrictions in the asthma group. There could be a high prevalence of micronutrients deficiencies, especially vitamin D levels among children with asthma[22].

This study is a maiden attempt to identify the relationship between nutritional abnormalities among children with asthma in relation to healthy children of the same age and sex, particularly in reference to their restrictive dietary practices. However, in the present study, we have not considered other confounding factors for overweight and obesity, such as physical activity, screen time and monthly income of the two groups, which can be considered as a limitation. Also, we did not address micronutrient abnormalities, which could be a potential nutritional risk considering the restriction of food such as eggs and dairy products. The small sample size could be another limitation leading to the failure in detecting associations with nutritional abnormalities within the asthma group. Furthermore, the disease group consisted of children attending one tertiary care centre in Sri Lanka. Therefore, there will be limitations when it is extrapolated into the population.

The authors recommend conducting further studies in different setups to assess the nutritional status among children with chronic asthma in larger samples to elicit significant associations. Furthermore, it is essential to look into micronutrient deficiencies among children with asthma.

Conclusions

There were no statistically significant differences in stunting, overweight, obesity and thinness between children with and without asthma. Duration of ICS therapy and steroid dose showed no relationship with nutritional abnormalities. Dietary restrictions were significantly more common in children with asthma. However, there was no association between

dietary restrictions and nutritional abnormalities among them.

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