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Original Article

Paediatrics Section

Subclinical Hypothyroidism among Overweight and Obese Children: An Observational Cross-sectional Study

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ABSTRACT

Introduction: Subclinical Hypothyroidism (SH) is often treated by thyroxine hormone by general pediatricians considering deranged thyroid profile, attributing the derangement to be the cause of obesity. However, childhood obesity increases the risk of SH by means of adaptive mechanisms.

Aim: To study the prevalence of SH and their lipid profile derangement in overweight and obese children of Indian population.

Materials and Methods: The present cross-sectional study was conducted in 60 children, between 5 to 15 years of age, presenting in the Department of Paediatrics at ESI PGIMSR Basaidarapur, New Delhi, India from October 2019 to April 2021. The children were grouped into two with 30 in each-overweight (Body Mass Index (BMI) between 23rd to 27th adult equivalent) and obese (BMI more than 27th adult equivalent) children. They were assessed for biochemical derangement including thyroid profile and lipid profile. The data were analysed using the Statistical Package for the Social Sciences (SPSS) Version 21.0 (IBM, Chicago, USA).

Results: The mean age of the study sample was 9.3 years and male/female was 41/19. Mean BMI of the obese children was 24.24 kg/m^2 and that of overweight was 20.4 kg/m^2. Seven (23.33%) children in overweight group and nine (30%) in obese group were diagnosed with SH (normal T4 with high TSH level). Nine out of the total 16 children with SH also had dyslipidaemia.

Conclusion: About 23% in overweight and 30% in obese children were found to have subclinical hypothyroidism. Nine out of these 16 children with subclinical hypothyroidism also had dyslipidaemia.

Keywords: Body mass index, Dyslipidaemia, Thyroid stimulating hormone

INTRODUCTION

Obesity is increasing worldwide with children being no exception. There is an ever-growing focus on the relationship between thyroid homeostasis and weight status. Elevated serum concentrations of Thyroid-Stimulating Hormone (TSH) combined with normal serum concentrations of free thyroxine (fT4) is termed as Subclinical Hypothyroidism (SH) [1-3]. SH is a diagnosis of exclusion that does not cause any clinical symptoms of hypothyroidism. There is always a dilemma whether the raised TSH level found in obese children is a cause or consequence of obesity and whether they require treatment or not [4,5]. Most studies demonstrate a positive correlation between BMI and serum TSH level [6-8]. SH in obesity is caused by a reduced thyroid function or reflects an adaptive mechanism against obesity in order to increase energy expenditure remains to be clarified. Some studies in obese children have reported improvements in thyroid status by reductions in TSH concentrations during weight loss [6,7]. SH has also been suggested as a risk factor for cardiovascular and metabolic disorders such as hypertension and dyslipidaemia [9,10]. According to published studies, overweight and obese children are prone to develop SH, which is a physiological compensatory condition [11-13]. There is a paucity of data in Indian children, therefore, this study was planned to find out the prevalence of SH in overweight and obese children.

MATERIALS AND METHODS

This was a cross-sectional study conducted in the Department of Paediatrics, ESI-PGIMSR and Model Hospital Basaidarapur, New Delhi, India from October 2019 to April 2021. The approval from Institutional Ethics Committee (IEC) was obtained vide IEC number-DM(A)H-19/14/17/IEC/2012-PGIMSR. Informed consent was taken from parents of children age <7 years and assent was taken from children >7 years.

Inclusion criteria: Children aged 5-15 years, with minor illnesses, who were overweight or obese as per the Indian Academy of Pediatrics (IAP) BMI chart 2015 [14]. Initially, 150 children of 5-15 years age group were meant to be included in this study, however, due to COVID-19 pandemic, the number of children attending hospital for routine illness decreased and hence the number of study subjects was reduced to 60 (30 in each group, overweight and obese) due to time constraints.

Overweight group: Thirty children having BMI value between 23rd to 27th adult equivalent.

Obese group: Thirty children having BMI value >27th adult equivalent cut-off.

Exclusion criteria: Children with any major illness or congenital malformations, and those with endogenous cause of obesity were excluded from the study.

The children included in the study were assessed for clinical history, including any concurrent illness, past illness, drug intake, birth history, immunisation history, developmental history, family history, personal history, dietary assessment and socio-economic profile. Height was measured using sliding stadiometer with an accuracy of 0.1 mm. Weight was recorded using electronic weighing machine calibrated to 0.1 kg accuracy. Five mL of blood sample from peripheral vein was collected after overnight fasting and assessed for biochemical derangement of fT4, fT3, TSH, lipid profile after processing in laboratory by using chemiluminescence assay [Table/Fig-1].

STATISTICAL ANALYSIS

The presentation of the categorical variables was done in the form of number and percentage (%). The comparison of the variables which were qualitative in nature was done using Chi-square test. If any cell had an expected value of less than five then Fisher's-exact test was used. The data entry was done In the Microsoft Excel

Biochemical parameters	Normal reference range
Thyroid profile	
T3 (Triiodothyronine)	2.0-4.4 pg/mL
T4 (Tetraiodothyronine)	0.8-4.8 ng/dL
TSH (Thyroid Stimulating Hormone)	0.5-4.8 IU/L
Lipid profile	
Total cholesterol	130-200 mg/dL (Normal)
	170-199 mg/dL (Borderline high)
	>200 mg/dL (High)
Triglyceride	45-130 mg/dL (Normal)
	75-99 mg/dL (Borderline high)
	>100 mg/dL(High) for 0-9 years of age
	90-129 mg/dL (Borderline high)
	>130 mg/dL (High) for 10-19 years of age
HDL (High Density Lipoprotein)	<40 mg/dL (Low)
	40-45 mg/dL (Borderline low)
	>45 mg/dL (Acceptable)

[Table/Fig-1]: Reference values of biochemical parameters (of the lab where tests were conducted).

spreadsheet and the final analysis was done with the use of the Statistical Package for the Social Sciences (SPSS) software, (IBM, Chicago, USA), version 21.0. For statistical significance, p-value of <0.05 was considered statistically significant.

RESULTS

Total of 60 children were included, who were categorised into two groups (overweight and obese) of 30 subjects each based on their BMIs. Male: female ratio was 2.2:1 (41M:19F), with mean age at presentation being 9.3 years. Mean BMI of obese children was 24.24 kg/m^2 and of overweight children was 20.4 kg/m^2.

Overweight group had high TSH level in 7 (23.33%) children and the obese group had high TSH level in 9 (30%) children [Table/Fig-2].

Thyroid profile	Overweight (n=30)	Obese (n=30)	Total	p-value
T3 (pg/mL)				
<2 (Low)	2 (6.67%)	4 (13.33%)	6 (10%)	0.798*
2 to 4.4 (Normal)	19 (63.33%)	17 (56.67%)	36 (60%)	
>4.4 (High)	9 (30%)	9 (30%)	18 (30%)	
Mean±SD	3.66±1.15	3.67±1.17	3.67±1.15	0.959‡
T4 (ng/dL)				
<0.8 (Low)	1 (3.33%)	0	1 (1.67%)	1*
0.8 to 4.8 (Normal)	28 (93.33%)	29 (96.67%)	57 (95%)	
>4.8 (High)	1 (3.33%)	1 (3.33%)	2 (3.33%)	
Mean±SD	1.77±1.49	1.67±1.5	1.72±1.48	0.8‡
TSH (IU/L)				
0.5 to 4.8 (Normal)	23 (76.67%)	21 (70%)	44 (73.33%)	0.559†
>4.8 (High)	7 (23.33%)	9 (30%)	16 (26.67%)	
Mean±SD	4.16±1.16	4.54±1.39	4.35±1.28	0.254‡

[Table/Fig-2]: Comparison of thyroid profile with overweight and obese.
‡Independent t-test, *Fisher's-exact test, †Chi-square test

Dyslipidaemia was present in total 27 (45%) out of 60 children in overweight and obese groups; in which 9 (33.3%) had SH with mean TSH value of 4.59±1.35. Therefore, nine children had SH with dyslipidaemia [Table/Fig-3].

In SH with dyslipidaemia, two children had raised cholesterol, 16 had raised triglyceride and one had low HDL [Table/Fig-4].

DISCUSSION

Obesity is an evolving epidemic affecting the paediatric population with significant numbers seen in developing nation like India. These

Thyroid profile	Normal lipid profile (n=33)	Dyslipidaemia (n=27)	Total	p-value
T3 (pg/mL)				
<2 (Low)	0	6 (22.22%)	6 (10%)	0.015*
2 to 4.4 (Normal)	21 (63.64%)	15 (55.56%)	36 (60%)	
>4.4 (High)	12 (36.36%)	6 (22.22%)	18 (30%)	
Mean±SD	4.02±0.87	3.23±1.3	3.67±1.15	0.009‡
T4 (ng/dL)				
<0.8 (Low)	0	1 (3.70%)	1 (1.67%)	0.085*
0.8 to 4.8 (Normal)	33 (100%)	24 (88.89%)	57 (95%)	
>4.8 (High)	0	2 (7.41%)	2 (3.33%)	
Mean±SD	1.37±0.23	2.16±2.13	1.72±1.48	0.066‡
TSH (IU/L)				
0.5 to 4.8 (Normal)	26 (78.79%)	18 (66.67%)	44 (73.33%)	0.291†
>4.8 (High)	7 (21.21%)	9 (33.33%)	16 (26.67%)	
Mean±SD	4.15±1.21	4.59±1.35	4.35±1.28	0.197‡

[Table/Fig-3]: Association of thyroid profile with dyslipidaemia.
‡Independent t-test, *Fisher's-exact test, †Chi-square test

Parameters	Raised total cholesterol	Raised triglyceride	Low HDL
Subclinical hypothyroidism (SH) (n=16)	2/16	9/16	1/16
Normal thyroid function (n=44)	3/44	13/44	7/44

[Table/Fig-4]: Association of thyroid profile with lipid profile.

obese children are prone to developing diabetes mellitus, SH, hypertension, and osteoarthritis. SH is a common biochemical parameter in these children and when these results are interpreted by general practitioners, they commonly treat the children with thyroxin attributing to cause of obesity, therefore, the present study was conducted and it was found that prevalence of SH is 7 (23.33%) in overweight group and 9 (30%) in obese children. Shalitin S et al., found a prevalence of SH in 22.2% of 207 obese 5 to 18-year-old, Marras V et al., found deranged thyroid profile (84 had elevated fT3 levels, 15 elevated TSH, six elevated fT4, three elevated fT3 and TSH, and one elevated fT3, fT4 and TSH levels) in 23% of 468 obese children aged 3.7 to 17.9 years [11,12]. Dahl M et al., demonstrated a prevalence of SH in 10.4% of Danish obese children [13]. Thus, the present study also showed findings in accordance with the above-mentioned studies and concluded the same prevalence of SH among overweight and obese children. Dyslipidaemia was present in total 27 (45%) out of 60 children of overweight and obese in which 9 (33.3%) had SH also.

In this study, one child had high TSH and high T4 level in overweight group. Obese group had two children with high TSH and high T4 level and another child had normal TSH and high T4 level. Reinehr T suggested that elevated TSH with high T4 level is a hyperthyrotropinaemia condition, and hypothesised a link between chronic inflammation of thyroid gland in obese children. It was suggested that there was no need of any treatment for SH, raised T4 and T3 levels since these conditions seem to be consequences rather than a cause of obesity [15]. However, it is advocated to keep these children under follow-up and monitor them for biochemical derangements.

Among the various hypotheses for increase in TSH levels in obesity, it may be due to an increase in leptin-mediated production of prothyrotropin-releasing hormone. Also, decrease in T3 receptors in the hypothalamus may impair the feedback and decrease in peripheral deiodinase activity. There are also studies showing decreased TSH levels following weight loss which may be indicative of obesity being the cause rather than a consequence of raised TSH [15]. Thus, it can be concluded that overweight and obese children were more prone for SH and dyslipidaemia.

Limitation(s)

The number of study subjects was low due to the COVID-19 pandemic. Due to the lockdown, hospital visit of patients with minor illnesses was also low.

CONCLUSION(S)

Prevalence of SH was 23.33% in overweight children and 30% in obese children of age group 5-15 years; nine children out of total 16 children of SH also had dyslipidaemia. Therefore, overweight and obese children often develop SH, however, in the absence of clinical and laboratory evidence, therapy with thyroid hormone seems unnecessary. Also, one should evaluate for changes in thyroid function tests with weight loss in these children during follow-up.

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