Original Research Paper

Volume - 10 | Issue - 8 | August - 2020 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Paediatrics Medicine

LIFESTYLE MODIFICATION AND PHYSICAL ACTIVITY SCORE TO ASSIST WEIGHT REDUCTION IN CHILDREN WITH OBESITY AND DETERMINE THE CORRELATION BETWEEN BMI AND THYROID STATUS IN THOSE CHILDREN.

Dr Sarala Kannan* — Senior Consultant, Dept of Pediatrics & Neonatology, Tata Main Hospital, Jamshedpur, Jharkhand, India *Corresponding Author

Dr Souvik Bandyopadhyay — DNB Resident, Dept of Pediatrics & Neonatology, Tata Main Hospital, Jamshedpur, Jharkhand, India

ABSTRACT

Background/Hypothesis: Correlation between hypothyroidism and obesity has been established but their causal relationship is yet to be ascertained. Studies show that weight reduction in obese children is associated with improvement in thyroid profile.

Our study aimed to ascertain the role of lifestyle modifications on weight reduction in obese children through a specially designed Physical Activity score (PAS), and also calculate correlation between Body Mass Index (BMI) and Thyroid profile.

Material & Method: Study group comprised of 60 apparently healthy children between 5-14 years with Body Mass Index > 71st percentile (male) and 75th percentile (female) according to revised Indian Academy of Pediatrics Growth Charts (Khadilkar charts). Their weight, height, Body Mass Index and Thyroid function (TSH,T4) were measured at 1st visit and at 6 monthly intervals for 1 year. Counselling was done to enhance physical activity, decrease sedentary activities along with dietary modifications. A novel scoring system - PAS designed on the basis of caloric expenditures, was applied and weight reduction was monitored 6 monthly. Social media (Whatsapp) was used to encourage the children and their caretakers.

Results & Discussion: Statistically significant increase in PAS ($p<0.0001$) was observed following counselling. S. TSH and BMI were positively correlated ($p<0.0001$) while S. T4 and BMI were negatively correlated ($p<0.0001$).

Conclusion: This paper brings out a simple, regularly monitored scoring system to promote weight reduction in obese children. This incentivized them to reduce weight, having a positive effect on their thyroid profile. No such compliance score has been tabulated for obese children as of date. Being a novel score, it's effectiveness requires further evaluation.

KEYWORDS : Obesity, hypothyroidism, Physical activity score, BMI, Life style, Diet

INTRODUCTION

Obesity is one of the major health issues plaguing the paediatric population today. 8.3% of children in the age group 5-14 years are obese, and the prevalence steadily increases in older age-groups (*2010 WHO Report).*This predisposes children to a much higher risk of developing dyslipidaemia, hypertension, and impaired glucose metabolism.

Obesity and Hypothyroidism are related both ways, it could be a cause and also an effect. Thyroid-stimulating hormone (TSH) may be elevated for several reasons. Increased production of pro-thyrotropin mediated by leptin, thyroid hormone resistance, or have been observed in obesity.[4]

Studies have shown a positive correlation between Body Mass Index (BMI) and TSH levels. Study by R K Marwaha et. Al [5] on healthy Indian school-going children found that Serum TSH and fT3 were positively associated, while Serum fT4 was negatively associated with BMI. However, research in pediatric population is limited. To assist and monitor weight reduction different tools have been used one of them being the physical activity score. Different authors have calculated physical activity score based on time spent in different activities, metabolic equivalent scores based on published data, questionnaires etc.[6,7]

AIM OF THE STUDY

Our study aimed to ascertain the role of lifestyle modifications on weight reduction in obese children through a specially designed Physical Activity score (PAS), and also calculate the correlation between BMI and Thyroid profile.

MATERIAL AND METHODS

This hospital based longitudinal study was conducted in the Department of Pediatrics, Tata Main Hospital, Jamshedpur, Jharkhand from Jan 2017 to June 2018. Sixty apparently healthy children of the age group 5-14 years with BMI > 71st percentile (male) and 75th percentile (female) according to revised IAP Growth Charts (Khadilkar charts) formed the study group. Their weight, height, BMI and Thyroid function were measured at 1st visit and at 6 monthly intervals for 1 year. Children already on Levothyroxine for hypothyroidism and/or taking medications for any chronic illness, high blood pressure, glucose or lipid metabolism were excluded from the study. Children whose parents refused consent for the study were also excluded.

Children and their caregivers were instructed to adopt healthy Lifestyle Modifications. Serial measurement of Serum TSH, T_3, T_4 and Fasting/Random Blood Sugar (FBS/RBS) and Lipid Profile (Total Cholesterol, Triglycerides, HDL, LDL and VLDL cholesterol) were carried out at 1st visit and after 6 months and 1 year after start of study.

A physical activity score was assigned to all the children of the study population on their enrolment, at 6 months, and 1 year, post enrolment. The basis of scoring system was the calorie expenditure of different physical activities along with the duration of activity. The activities were selected so as to suit the male and female adolescent children in the Indian context with attention to the socioeconomic status, safety of the child, and their study timings. The score for the activity and the score for the duration of each activity were then multiplied to give the final score for that activity.

Table 1: Calculation Of Physical Activity Score

CALCULATION OF PHYSICAL ACTIVITY SCORE FOR CHILDREN					
TYPE OF ACTIVITY	Caloric expenditure (40Kg child) Cals/min	Assigned score *	Duration of activity Score	Final score for that activity**	Cumulative physical activity score ***
Brisk Walking (around 3 miles/hr or 5 km/hr)	1.6	1	NO ACTIVITY = 0 1-15 MINS = 1 16-30 MINS = 2 >30 MINS =3	0	14
Skipping	5.3	3.25		0	
Running (around 5 miles/hr or 8 km/hr)	5.1	3.25		6.5	
Cycling (light to moderate effort)	3.6	2		0	
Swimming (light to moderate effort)	4.4	2		7.5	
Cricket	2.7	1.75		0	
Football 4 calories/min	4	2.5		0	
Tennis	4	2.5		0	
Basket-ball (non-game):	3.3	2		0	

* Brisk walking was given a score of 1and the other physical activities were then given a rounded-off score based on the ratio of Calories expended compared to brisk walking.

** The score for the activity and the score for the duration of each activity were then multiplied to give the final score for the activity

*** A child who does 20 mins of running and 45 mins of swimming was scored as (3.25 x 2) + (2.5 x 3) = 6.5 + 7.5 = 14 (Final PAS)

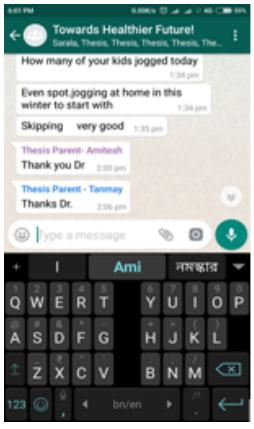
Based on the above values each child in the study group was given a chart to fill out for the next 18 months.

Table 2: Individual Pas Records

PHYSICAL ACTIVITY CHART OF ..... ENROLLED ON .....

DATE OF EVALUATION	SKIPPING (MINS) 3.25			BRISK WALKING (MINS) 1			RUNNING (MINS) 3.25			OUTDOOR SPORTS (MINS) CRICKET 1.75 FOOTBALL 2.5 TENNIS 2.5 BASKETBALL 2			CYCLING (MINS) 2			SWIMMING (MINS) 2.5			FINAL SCORE	% COMPLIANCE	REMARKS	BMI
	0 MINS	1 TO 15	16 TO 30	0	1 TO 15	16 TO 30	0	1 TO 15	16 TO 30	0	1 TO 15	16 TO 30	0	1 TO 15	16 TO 30	0	1 TO 15	16 TO 30				

Fig 1: Social Media Group



A voluntary WhatsApp group was created consisting of parents/caregivers of the children who were on WhatsApp (30 participants) along with the investigators as administrators. Messages related to healthy lifestyle, healthy diet, along with answers to queries from the caregivers were posted for the benefit of all.

Dietary modifications including but not limited to:

- Increase the no. of meals to 5 or 6 per day and reduce the quantity of each meal
- Add more amounts of green leafy vegetables and fruits in the diet
- Reduce the intake of fried foods, junk foods, cold drinks etc.
-

Serial measurement of Serum TSH, T_3, T_4 and Fasting/Random Blood Sugar (FBS/RBS) and Lipid Profile (Total Cholesterol, Triglycerides, HDL, LDL and VLDL cholesterol) were carried out at 1st visit and after 6 months and 1 year after start of study

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analysed by SPSS 24.0. and GraphPad Prism version 5.

OBSERVATION & RESULTS

Among the 60 children enrolled in the present study, 46 (76.6%) were male and 14 (24.4%) were female. At enrolment, the mean age of the study group was 9.9433 ± 2.0293 years. Ten (16.7%) children belonged to age-group of 5-8 years, 43 (71.6%) belonged to age-group of 8-12 years, while rest 7 (11.7%) belonged to age-group of 12-14 years.

Fig 2: Age Distribution

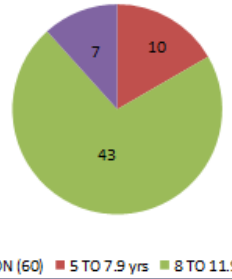


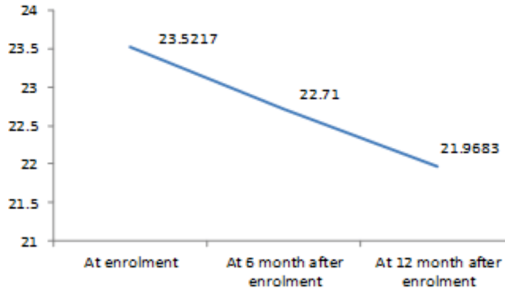
Table 3: Mean BMI With Follow-up

BMI OF STUDY GROUP (n=60) WITH FOLLOW UP

	Mean	SD	Mininum	Maximum	Median	p-value
At enrolment	23.5217	3.6901	18.1	40.1	22.8	0.0518
6 month after enrolment	22.71	3.4155	17.8	38	22	
12 month after enrolment	21.9683	3.2873	15.9722	36.8481	21.4142	

Mean BMI of participants was 23.5217 ± 3.6901 which decreased to 22.7100 ± 3.4155 at 6 months after enrolment and to 21.9683 ± 3.2873 at 12 months after enrolment. The difference of mean BMI vs. follow-up was statistically significant (p=0.0518).

Fig 3: BMI Trend Of Study Group (N=60)



There was a steady decrease in the BMI during the study period

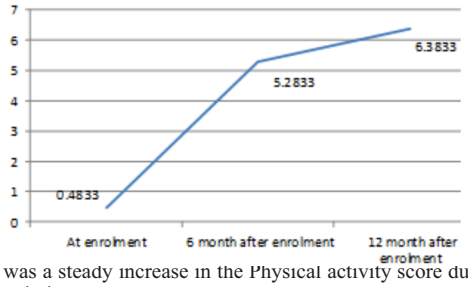
Table 4: Mean Physical Activity Score With Follow-up

PHYSICAL ACTIVITY SCORE THROUGH THE STUDY PERIOD (n=60)

	Mean	SD	Minimum	Maximum	Median	p-value
At enrolment	0.4833	0.6507	0	2	0	<0.0001
6 month after enrolment	5.2833	2.0959	2	9.5	5	
12 month after enrolment	6.3833	2.1636	2	11	6.5	

We found that at enrolment, the mean PAS (mean ± S.D.) of participants was 0.4833 ± 0.6507. At 6 months after enrolment, it increased to 5.2833 ± 2.0959 which further increased to 6.3833 ± 2.1636, at 12 months after enrolment. The increase was statistically significant (p<0.0001)

Fig 4: Trend Of Physical Activity Score During Study Period



There was a steady increase in the Physical activity score during the study period

Table 5: Mean Serum Tsh, T3 &t4 Levels Through The Study Period

TSH,T3 & T4 LEVELS DURING THE STUDY PERIOD

	Period of study*	Mean	SD	Minimum	Maximum	Median	p-value
Serum TSH (µIU/ml)	0	4.40	1.52	1.56	9.92	4.32	0.5231
	6	4.27	1.25	1.9	8.47	4.17	
	12	4.13	1.11	2.01	6.45	4.11	
Serum T_3 (ng/ml)	0	1.22	0.28	0.82	1.84	1.13	0.4312
	6	1.25	0.27	0.82	1.86	1.2	
	12	1.28	0.26	0.89	1.93	1.265	
Serum T_4 (µgm/dl)	0	9.18	1.33	6.02	12.5	9.2	0.9412
	6	9.13	1.05	6.72	11.53	9.13	
	12	9.20	0.86	7.14	11.06	9.205	

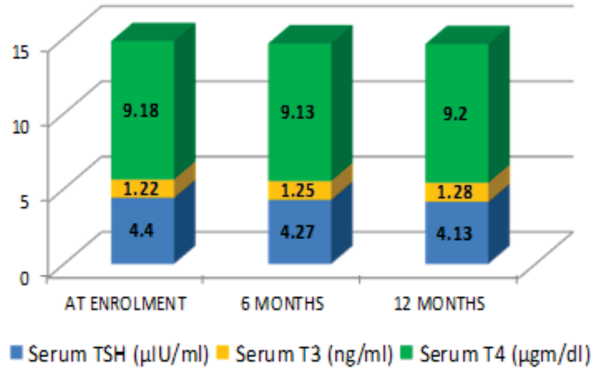
*Period of Study : 0= At enrolment, 6= 6 months after enrolment, 12= 12 months after enrolment

At enrolment, the mean serum TSH (mean ± S.D.) of participants was 4.4047 ± 1.5177 µIU/ml which decreased to 4.2742 ± 1.2484 µIU/ml at 6 months after enrolment and to 4.1335 ± 1.1082 µIU/ml 12 months after enrolment. However, this difference was not statistically significant (p=0.5231). The mean serum T_3 (mean ± S.D.) of participants was 1.2203 ± 0.2829 ng/ml. At 6 months after enrolment, it increased to1.2478 ± 0.2676 ng/ml, which further increased to 1.2842 ± 0.2583 ng/ml at 12 months after enrolment. The difference of

mean serum T_3 vs. follow-up was not statistically significant (p=0.4312)

Our study found that at enrolment, the mean serum T_4(mean ± S.D.) of participants was 9.1805 ± 1.3334 µgm/dl. At 6 months after enrolment, it decreased to 9.1295 ± 1.0478 µgm/dl, and again increased to 9.1963 ± .8648 µgm/dl at 12 months after enrolment. Difference of mean serum T_4vs. follow-up was not statistically significant (p=0.9412).

Fig 5: Thyroid Profile Trends During Study Period



In the present study, at enrolment, 15(25.0%) participants were overweight and 45(75.0%) participants had obesity. At 6 months after enrolment, 20(33.3%) participants were overweight and 40(66.7%) participants had obesity. At 12 months after enrolment, 6(10.0%) participants weight decreased to normal range, 27 (45.0%) participants were overweight and 27(45.0%) participants still had obesity. The association of obesity vs. follow-up was statistically significant (p=0.0005)

Fig 6: Normal, Overweight & Obese Children

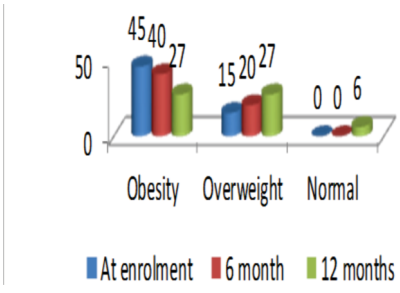
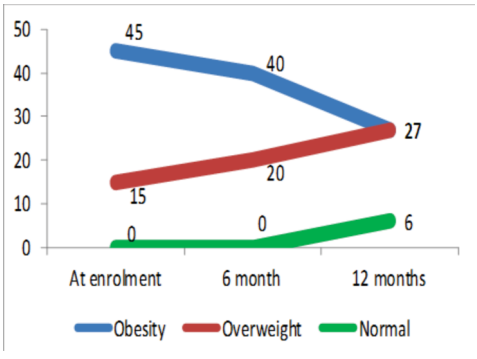


Fig 7: BMI Trend From Enrolment To Follow Up At 12 MTHS



Positive correlation was found between S. TSH vs. BMI at enrolment, 6 months and 12 months after enrolment and it was statistically significant (p<0.0001)

Negative correlation was found between S. T_3 at enrolment vs. BMI at enrolment and it was statistically significant (p=0.043). However, though Negative correlation was found at 6 months and at 12 months after enrolment between S. T_3vs. BMI, it was not statistically significant (p=0.284 and p=0.603 respectively).

Negative correlation was found between S. T_4vs. BMI at enrolment, at 6 months and 12 months after enrolment and it was statistically significant (p<0.0001).

Table 6: Correlation Between Bmi And Thyroid Profile

CORRELATION OF BMI & THYROID PROFILE DURING THE STUDY (N=60)							
THYROID PROFILE	STATISTICAL PARAMETER	AT ENROLMENT		6 MONTHS AFTER		12 MONTHS AFTER	
		BMI	CORRELATION	BMI	CORRELATION	BMI	CORRELATION
S. TSH (µIU/ml)	Pearson Correlation Coefficient (r)	0.601**	Positive correlation	0.588**	Positive correlation	0.602**	Positive correlation
	p-Value	0	Significant	0	Significant	0	Significant
S. T_3 (ng/ml)	Pearson Correlation Coefficient (r)	-0.262*	Negative correlation	-0.141	Negative correlation	-0.068	Negative correlation
	p-Value	0.043	Significant	0.284	Not significant	0.603	Not significant
S. T_4 (µgm/dl)	Pearson Correlation Coefficient (r)	-0.629**	Negative correlation	-0.582**	Negative correlation	-0.581**	Negative correlation
	p-Value	0	Significant	0	Significant	0	Significant

DISCUSSION

The present study was done with the aim to determine a correlation between body weight as defined by BMI and the Thyroid hormone status of the child, with an objective to investigate the role of appropriate lifestyle modifications to achieve weight reduction for improvement in
thyroid profile.

The sex ratio of study participants (76.6% male gender and 24.4% female gender) and the mean age of 9.9433 ± 2.0293 years (Fig 2) matched the study of Basma Abdel Moel Ali et al.[8] Stichel et al.[9] had also studied a similar age group. It was seen that majority of children belonged to pre-pubertal age group of 8-12 years

The mean BMI of participants (Table 3, Fig3) of this study gradually decreased over the study period which was statistically significant, probably due to lifestyle interventions in the form of physical activity and dietary modifications. The Physical Activity Score (PAS) increased significantly (Table 4, Fig 4) throughout the study period. PAS, being the first of its kind, we have not been able to compare it with any other study to establish it as a validated research tool. Physical activities e.g. skipping, running, cycling etc. were used to enable the average Indian child to comply effectively with the program. Education burden, road safety, and financial constraints were kept in mind. Counselling sessions with the children and their care-givers helped this novel idea of PAS to have a dual effect, to reinforce the concept of adoption of healthier activities, and secondly to objectively assess and provide a quantified 'report card' about the daily physical activities.

The mean serum TSH (Table 5, Fig 5) did not significantly decrease in our study similar to the study in 2002 by **Reinehr and Andler**[1]. However, **Radetti et al.**[10] found that Lifestyle intervention was associated with a significant decrease in TSH. The change in mean serum T_3 was also not statistically significant again in contrast to the study done by **Reinehr and Andler**[1] **and Radetti et al.**[10]Difference of mean serum T_4 in the period of study was also not statistically significant which was not analysed by any study which we reviewed.

The decreasing trend of obese children over the study period (Fig 6 & 7) was statistically significant which clearly indicates that lifestyle interventions are of utmost importance.

Positive correlation was found between S. TSH and BMI at enrolment, 6 months and 12 months later (Table 6) and was statistically significant (p<0.0001). Stichel et al.[9] conducted a study in 290 obese children in the year 2000 and found TSH to be correlated with the BMI z-score. Grandone et al.[11] (2010) in a case series with longitudinal data involving 1010 children found that BMI z-score correlated positively with TSH. Similar result was also obtained by Basma Abdel-Moez Ali et al.[8] in 2016 and Jin HY et al.[12] in 2018. Thus our study findings are consistent with the results of previous studies. Negative correlation was found between S. T_3 and BMI at enrolment with statistical significance. However Negative correlation for the same at 6 and 12 months after enrolment was not statistically significant in contrast to the study by Stichel et al.[9] However, Basma Abdel-Moez Ali et al.[8] in 2016 found no correlation between T_3 and BMI which is consistent with our study result at 6 months and 12 months following enrolment. Negative correlation was found between S. T_4 and BMI at enrolment, 6 and 12 months after was statistically significant (p<0.0001) similar to the study of Jin HY et al.[12] (2018) wherein serum concentrations of fT_4 after adjusting for age were used.

CONCLUSION

Childhood Obesity is a major cause of morbidity worldwide with rapidly increasing prevalence. Overweight and Obesity can lead to raised TSH and decreased T_4. Lifestyle modifications in the form of regular physical activity and dietary modifications are the most important measure to achieve reduction in BMI levels. Physical Activity Score (PAS) can be used as a tool for encouraging regular Physical Activity and for ascertaining compliance to follow-up, however, further studies are needed to evaluate its effectiveness. The authors accept that the limitations of the study include insufficient sample size, single centre study, hospital bias, and sample represented children hailing from higher socio-economic strata. Inadequate monitoring and less aggressive approach to lifestyle modification may have been the cause for a decreased positive outcome.

ABBREVIATIONS:

PAS: Physical Activity Score
BMI: Body mass Index
IAP: Indian Academy of Pediatrics
TSH: Thyroid Stimulating Hormone
T4: Free Thyroxine
HDL: High Density Lipoprotein
LDL: Low Density Lipoprotein
VLDL: Very low density Lipoprotein

DECLARATION

1.Ethical approval and consent to participate

The study was approved by the institutional ethics committee before the start of the study, and the second authors conducted the research as part of his thesis study.Consent for participation for the study was obtained from the parent of the child participating in the study.

2.Permission for publication in a journal

Permission for publication in a journal has been obtained from the Head of Tata Main Hospital, Jamshedpur, Jharkhand, India.

3.Availability of Data and Materials

Data and material are available as an excel file used for statistical analysis.

4.Competing interest There were no competing interests in the study.

5.Funding No funding of any kind was used for this research.

6.Author's Contributions Dr Souvik Bandyopadhyay (second author) was a DNB resident during the conduct of the study and was responsible for data collection under the guidance of the first author Dr. Sarala Kannan , Senior consultant, Dept. of Pediatrics. Tabulation of the physical activity score , analysis and manuscript preparation for publication has been done by the first author.

ACKNOWLEDGEMENTS

The authors acknowledge all the children and their parents for active participation in the study. We thank Dr Subrata Dey, Senior consultant Pediatrician & Endocrinologist, Apollo Institute of post graduate Pediatrics for his kind consent to give some inputs when needed.

REFERENCES

1. Reinehr T, Andler W. Thyroid hormones before and after weight loss in obesity. Arch Dis Child. 2002 Oct;87(4):320–3.
2. Ladenson PW, Kristensen JD, Ridgway EC, Olsson AG, Carlsson B, Klein I, et al. Use of the thyroid hormone analogue eprotirome in statin-treated dyslipidemia. N Engl J Med 2010;362:906-16.
3. Marras V, Casini MR, Pilia S, Carta D, Civolani P, Porcu M, et al. Thyroid function in obese children and adolescents. Horm Res Paediatr. 2010;73(3):193–7.
4. Pacifico L, Anania C, Ferraro F, Andreoli GM, Chiesa C. Thyroid function in childhood obesity and metabolic comorbidity. ClinChimActa. 2012;413:396–405.
5. Marwaha RK, Tandon N, Garg MK, Ganie MA, Narang A, Mehan N, et al. Impact of body mass index on thyroid functions in Indian children. ClinEndocrinol (Oxf). 2013 Sep;79(3):424–8.
6. Jennifer Mindell and Bridget Holmes LIDNS |VOL: 3 | CHAPTER15: PHYSICAL ACTIVITY using a questionnaire scores were calculated based on time spent in different activities and metabolic equivalent scores based on published data
7. Kowalski, K., Crocker, P., & Donen, R. The Physical Activity Questionnaire for Older Children (PAQ-C) and Adolescents (PAQ-A) Manual. College of Kinesiology, University of Saskatchewan.
8. BA-M, Mahrous DM, Ahmed DM. Thyroid Function Status in Obese Children. J Diabetes Metab. 2016 Apr 30;7(4):2–5.
9. Stichel H, l'Allemand D, Grüters A. Thyroid function and obesity in children and adolescents. Horm Res. 2000;54(1):14–9.
10. Radetti G, Longhi S, Baiocchi M, Cassar W, Buzi F. Changes in lifestyle improve body composition, thyroid function, and structure in obese children. J Endocrinol Invest 2012;35:281-5.
11. Grandone A, Santoro N, Coppola F, Calabrò P, Perrone L, Del Giudice EM. Thyroid function derangement and childhood obesity: an Italian experience. BMC EndocrDisord. 2010 May 4;10:8.
12. Jin HY. Prevalence of subclinical hypothyroidism in obese children or adolescents and association between thyroid hormone and the components of metabolic syndrome. Journal of paediatrics and child health. 2018 May 16.