PAKISTAN JOURNAL OF HEALTH SCIENCES
https://thejas.com.pk/index.php/pjhs
ISSN (P): 2790-9352, (E): 2790-9344
Volume 5, Issue 3 (March 2024)

Original Article

Thyroid and Lipid Profile Dysfunction among Obese versus Non-Obese Individuals Study Design

Rizwan Hafeez[1], Adeel Zafar[1*], Sibgha Bashir[1], Zen-Ul-Abideen[2], Maryam Ejaz[3], Natasha Zahid[3] and Mazhar Ul Haque[1]

[1]Shahida Islam Medical and Dental College, Lodhran, Pakistan
[2]CMH Institute of Medical Sciences, Bahawalpur, Pakistan
[3]Al-Aleem Medical College, Lahore, Pakistan

ARTICLE INFO

Keywords:
Obesity, Lipid Profile, Thyroid Profile, Thyroid Dysfunction

How to Cite:
Rizwan, R., Zafar, A., Bashir, S., Abideen, Z.-U., Ejaz, M., Zahid, N., & Haque, M. U. (2024). Thyroid and Lipid Profile Dysfunction among Obese versus Non-Obese Individuals Study Design : Obesity and Thyroid Lipid Profile Dysfunction . Pakistan Journal of Health Sciences, 5(03). https://doi.org/10.54393/pjhs.v5i03.1412

***Corresponding Author:**
Adeel Zafar
Department of Pathology, Shahida Islam Medical and Dental College, Lodhran, Pakistan
aznagra@hotmail.com

Received Date: 9th March, 2024
Acceptance Date: 29th March, 2024
Published Date: 31st March, 2024

ABSTRACT

Obesity, a complex disorder influenced by both genetic and environmental factors, manifests through intricate interactions. **Objective:** To assess thyroid function tests and serum lipid profiles in obese and non-obese individuals. **Methods:** This cross sectional observational study was conducted over six months from July to December 2023 at the medical outpatient department of Shahida Islam Medical College, after obtaining ethical approval (IRB Ref no. SIMC/H.R./7314/23, dated May 1, 2023). A sample size of 200 was calculated, divided equally into obese (BMI > 30 kg/m^2) and non-obese (BMI < 25 kg/m^2) groups. Data were analyzed using SPSS version 23.0, employing chi-square tests for significance ($p < 0.05$). **Results:** Each group comprised 100 participants, with mean ages of 42.49 ± 9.0 years for the obese and 43.83 ± 6.2 years for the non-obese group. Females constituted 62% of the obese and 51% of the non-obese group. Mean BMI was 35.8 kg/m^2 and 26.6 kg/m^2 in the obese and non-obese groups, respectively. Obese individuals exhibited higher mean total cholesterol (173 ± 40.77 mg/dl vs. 134 ± 29.62 mg/dl, p = 0.05) and significant differences in HDL, LDL, triglycerides, TSH, T3, and T4 levels ($p < 0.05$). **Conclusions:** Obesity is associated with adverse thyroid and lipid profiles, with a higher prevalence among females. These findings underscore the importance of addressing these metabolic factors in obesity management.

INTRODUCTION

It is a well-known fact that obesity is considered a multi-factorial disease which is influenced on both aspects of being an environmental or a genetic disorder. Therefore the term multi-factorial is appropriate to use for obesity [1]. However the primary reason attributed to being overweight or obese is the sedentary lifestyle such as unhealthy diet habits, decreased physical activity and a genetic predisposition increases the ever-so likelihood of becoming obese. As regards to the most prevalent type of malnutrition, obesity is said to be on top of the list [2]. Due to its chronicity, and incidence all over the world, be it in developing or the developed countries which affects both the young and the old, it is slowly but surely becoming so commonly observed that it has started to replace more traditional concerns of public health that are included under the heading of nutrition [3]. Obesity is the most substantial cause of ill health. Worldwide, more than 600 million have been categorized under the term obese where slightly higher percentage was of women as regards to males [4]. Among the adults, 39 % were above 18 years of age that were obese or overweight. It is estimated that the prevalence of obesity has shown doubling between 1980s and 2010s and this figure is expected to rise ever-so more if necessary measures are not put into place [5]. Obesity if

DOI: https://doi.org/10.54393/pjhs.v5i03.1412

described as an excess of bodily fat which is because of higher intake of energy in comparison to the expenditure of energy. Even though the mechanism of feedback is pre-determined in the body, however the pathway through which take of energy becomes disproportionate as it becomes chronic is a process which is not yet descriptively known [6]. Studying obesity has its difficulty since this abnormality does not comprise of a single disease and also a reason being the need for long-termed follow ups on a larger scale which is not possible nor available in the present literature [7]. Obesity is a vital threat to the health and well-being of an individual in addition to economic burden and welfare of the population in almost every part of the world. Above 300 million individuals are predicted to be under obesity. Resultantly, approximately 1.7 billion people around the globe are at risk of obesity induced life-threatening disorders such as cardiac diseases and cerebrovascular accidents [8]. Even though the exact biochemical pathway which are accountable for obesity leading to the above mentioned diseases have yet not being fully understood, it is reported that higher bodily stores of triglycerides have been linked to a linear increases in cholesterol formation that in return is linked to higher secretion of cholesterol in the bile leading to higher risks for formation of gall stones and a variety of other diseases of the gall bladder [9]. Likewise, higher circulating levels of triacylglycerol seen in obesity are also related to a reduction in levels of the 'Good Cholesterol' known as high density lipoprotein that might be accountable for cause higher risks for cardiac disorders among the obese patients [10]. As similar to the relationship between obesity and BMI has been established, the association between thyroid dysfunction and obesity is also well known, however their influences on each other and mechanisms of association remain unclear [11]. Most obese patients do definitely undergo thyroid function assessment at some point in their life, nonetheless on a few of them, around 10-19 % finally get laboratory and clinically proven hypothyroidism [12]. Recent researches focusing on relating abnormal thyroid function to changes in bodily weight have found that even euthyroid individuals have the tendency to go obese. Thyroid dysfunctions related to BMI have recently gained attention but with no definite conclusion [13]. Furthermore, obesity of central type has been highly associated with multiple endocrinal abnormalities one of which is hypothyroidism. This isn't surprising form the fact that energy metabolism's regulation and thermogenesis is controlled by T3 which play critical role in the metabolism of lipids as well as glucose along with intake of food and fatty acid oxidation [14]. De-regulation of thyroid is linked to body weight changes along with temperature, expenditure of energy independent of physical activities. Additionally, weight gain mostly occurs after treating thyroid disorder. Both overt hypothyroidism and sub-clinical hypothyroidism are linked frequently to weight gain, decreased metabolism and reduced thermogenesis [15].

The aim of this study was to determine and evaluate the levels of thyroid functions test and different serum lipid profiles amongst obese versus non-obese individuals.

METHODS

This cross-sectional study with the help of non-probability convenient sampling technique was done at the medicine out-patient department of Shahida Islam Medical College, Lodhran for a period of six months from July 2023 to December 2023. After ethical approval from the Ethical Review Board (ERB) of the hospital IRB Ref no. SIMC/H.R./7314/23 dated 1st May 2023, the study was carried out. Informed consent was obtained from participants. The sample size was determined using the open EPI software available online, based on an obesity prevalence of 39%, with a confidence interval of 95% and a precision of 7% [5]. A total of 200 participants were included in the study which were divided into two groups of 100 each, one group being the obese group and the other non-obese group. Individuals above 18 years of age and below 70 years, presenting to the medical outpatient department were first checked for obesity via the anthropometric measurement of height in m and weight in kg following calculation of Body Mass Index (BMI). Individuals having BMI of above 30 kg/m2 were categorized intro obese group and individuals having BMI below 25 kg/m2 were classified as the non-obese group. After this, the individuals without prior history of hyperlipidemia were included in the study while the individuals that were on lipid lowering agents, i.e. known cases of hyperlipidemia, or a known case of diabetes mellitus, females on oral contraceptive pills, pregnant or lactating mothers and individuals having any documented metabolic disorder that could affect lipid profile were excluded from the study. All individuals were surveyed and their name, age (in years), gender, weight (in kilograms), height (in meters), and any history of co-morbidity were collected and documented. Enrolled participants were asked for their blood sample for lipid profile after fasting for 10-12 hours without eating or drinking, after which around five ml of whole blood was taken from the participants through vena puncture via disposable syringe of five cc. in the morning. Different fractions of lipids were determined which included total cholesterol, triglycerides, High Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL) all as mg/dl while thyroid function profile including serum Thyroid-Stimulating Hormone (TSH), Free T3 and T4 were determined. Data analysis was done with the help of SPSS version 23.0.

DOI: https://doi.org/10.54393/pjhs.v5i03.1412

Demographics such as age and gender were recorded along with different serum lipid fractions. The quantitative variables were reported as mean and standard deviation while qualitative variables as frequency in percentages. Chi-square test was applied between the lipid profiles and thyroid function tests of obese group participants with non-obese group keeping p-value of <0.05 as statistically significant.

RESULTS

The mean age of participants in the obese group was 42.49 ± 9.0 years while in the non-obese group the mean age was 43.83 ± 6.2 years. 38 (38%) males were in the obese group while 62 (62%) were Females. In the non-obese group, 49 (49%) were males while 51 (51%) were females. Mean height of obese patients was 1.52 ± 0.07 m while the mean height in non-obese group was 1.65 ± 0.09 m. The mean weight of the participants in the obese group was 82.75 ± 15.4 kg while in the non-obese group mean weight was 72.43 ± 13.98 kg as shown in table 1.

Table 1: Mean of Baseline Demographics of Study Participants in Obese Versus Non-Obese Group

Variables		Obese Group n= 100	Non-Obese Group n= 100
Age (Years)		42.49 ± 9.0	43.83 ± 6.2
Gender	Males	38 (38)	49 (49)
	Females	62 (62)	51 (51)
Height (m)		1.52 ± 0.7	1.65 ± 0.9
Weight (kg)		82.75 ± 15.40	72.43 ± 13.98
BMI kg/m^2		35.8	26.6

The mean total cholesterol among the obese group was 173 ± 40.77 mg/dl while in the non-obese group; mean total cholesterol was 134 ± 29.62 mg/dl. A statistically significant difference with p value 0.01 was observed between the two groups. The mean HDL among the obese group was found to be 29 ± 7.9 mg/dl while in the non-obese group mean HDL was 38 ± 10.3 mg/dl. A substantial difference of 0.05 was found between both groups. Mean LDL among the obese group was 108 ± 15.54 mg/dl whereas in the non-obese group mean LDL was reported to be 93 ± 22.97 mg/dl. The mean levels of triglyceride among the obese group were 142 ± 32.4 mg/dl whereas in the non-obese group, mean triglycerides were reported to be 113 ± 24.36 mg/dl. A significant difference of 0.05 was found between the groups. The mean level of thyroid stimulating hormone in obese group was 4.4 ± 1.2 µIU/L while 2.7 ± 0.8 µIU/L in the non-obese group. Mean free T3 in the obese group was 1.67 ± 0.44 nmol/L while 2.75 ± 0.77 nmol/L in the non-obese group. Mean free T4 in the obese group was 6.86 ± 2.10 µg/dl while in the non-obese group it was 9.13 ± 2.58 µg/dl. A statistically significant difference with p value < 0.05 was observed between the groups as shown in table 2.

Table 2: Comparison of Different Lipid and Thyroid Function Values Among Obese Versus Non-Obese Group

Lipid Profile (mg/dl) / Thyroid Profile	Obese group (mean ± SD)	Non-Obese group (mean ± SD)	p-value
Total Cholesterol (mg/dl)	173 ± 40.77	134 ± 29.62	*< 0.05
High Density Lipoprotein (HDL)	29 ± 7.9	38 ± 10.3	*< 0.05
Low Density Lipoprotein (LDL)	108 ± 15.54	93 ± 22.97	*< 0.05
Triglycerides	142 ± 32.4	113 ± 24.36	*< 0.05
Thyroid Stimulating Hormone (TSH) µIU/L	4.4 ± 1.2	2.7 ± 0.8	*< 0.05
Free T_3 (nmol/L)	1.67 ± 0.4	2.75 ± 0.77	*< 0.05
Free T_4 (µg/dl)	46.86 ± 2.10	9.13 ± 2.58	*< 0.05

Chi square test applied *(significant difference)

The graphical representation of Lipid Profile is shown in figure 1 and Thyroid Profile in figure 2.

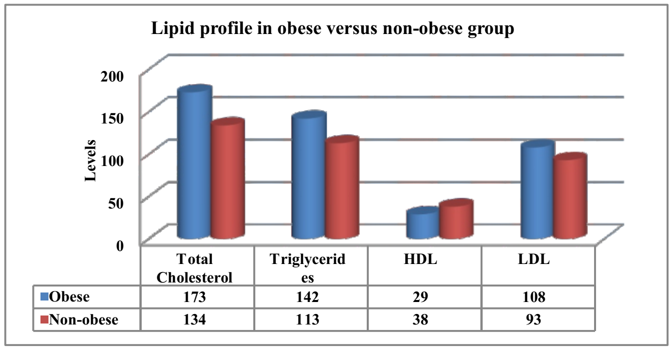

Figure 1: Graphical Representation of Different Lipid Values (mg/dl) Among Obese Versus Non Obese Group

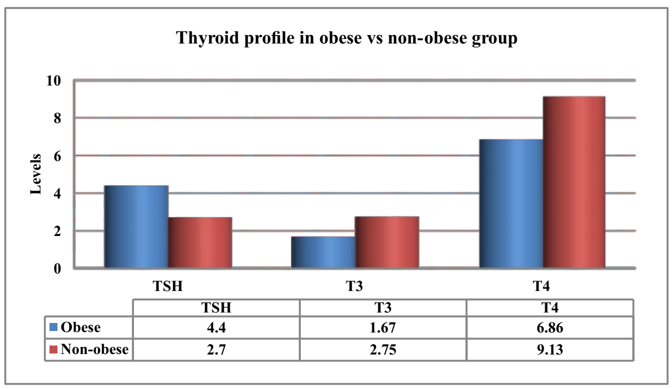

Figure 2: Graphical Representation of TSH (µIU/L), T3 (nmol/L) and T4 (µg/dl) Among Obese Versus Non Obese Group

DOI: https://doi.org/10.54393/pjhs.v5i03.1412

DISCUSSION

According to the results of our study and what has been mentioned in the literature, lipid levels were found in general, to be higher among obese participants in comparison to non-obese participants. The results reported total serum cholesterol to be significantly (p-0.01) higher among obese as compared with non-obese. Similarly, LDL and triglycerides were also found to be substantially higher amongst the obese group when compared with the levels of non-obese group (p-0.04, p-0.05), respectively. HDL among the obese group was substantially lower in comparison to the levels of LDL in the non-obese group (p-0.05). Likewise, thyroid levels were found in the lower normal limit among the obese group while in the upper normal limits in the non-obese group. However an inverse relation of thyroid levels with degree of obesity was reported. (p-0.05). Similar results have been observed in other researches as well where cholesterol levels were found higher among obese patients as compared to the non-obese participants [16]. It is worth mentioning that differences in lipid levels which are observed and reported in different individuals are based on multiple factors such as age, gender, race, ethnicity, body mass index, diet, history of smoking, exercise, even alcohol [17]. A variety of diseases like hypertension, diabetes, liver or kidney disease, metabolic syndrome all have been linked with obesity as a detrimental risk factor for the disease [18]. In a study by Kanwar *et al.*, reported that post-menopausal women were reported to have significant difference in the lipid levels as compared with that of pre-menopausal women, however a significant decrease of HDL was reported among the post-menopausal women in comparison to pre-menopausal women [19]. Similarly, another study by Maghsoudi *et al.*, reported findings that are consistent with the findings of our study in which levels of total cholesterol, LDL and triglycerides were found to be substantially lower in obese patients as compared to non-obese patients [20]. In another study, levels of total cholesterol, triglycerides and HDL were reported to have a significant difference among obese and non-obese participants; however LDL levels were not significantly different in both the groups [21]. Studies from developed countries have reported higher values of total serum cholesterol as well as other serum lipids in patients that were obese [22]. An interesting fact is that in most studies where serum cholesterol, LDL and triglycerides were reported to be higher among obese individuals as compared to non-obese individuals, a significant lowered levels of HDL were also found in the obese individuals when compared with that of non-obese individuals [23]. With regards to the association of obesity with derangements in thyroid function, a cross-sectional study reported that in individuals with a BMI of above 30 kg/m2, sub-clinical and overt hypothyroidism correlated to a high BMI and higher obesity prevalence among smokers and non-smokers as well [24]. Similar findings were reported in our study as well; however we did not assess obesity prevalence among smokers and non-smokers. Several studies have reported among adult obese individuals that thyroid hormones are more often at the lower normal limit or are reduced in comparison to normal healthy non-obese individuals. Multiple mechanisms have been proposed as to the above changes. Underlying the altered levels is thoroughly not known [25]. Some of them include high rate of conversion from T_4, the active form to T_3, the inactive form in obese individuals due to fat accumulation via decreased expenditure of energy, basal metabolic rate and total energy expenditure, being negatively related to total T_3 [26]. Another pathway with regards to explaining low values of thyroid hormone are the fact that increased adiposity in obese individuals leads to less expression of TSH as compared to non-obese normal weighing individuals. This in turn might explain the decrease in tissue's responsiveness towards circulating thyroid hormones and also explain the resultant increase in TSH secretion for up regulating the state of peripheral resistance [27]. Similar findings were reported in our study as well. Although the study encircled both thyroid and lipid levels among obese and non-obese individuals, it was not free from limitations. The study was not free from selection or observer bias and the fact that the study was a single center study having limited sample size, therefore further multi-centered studies having larger sample size would enlighten the results of this study with betterments. It is vital to keep in mind the ever-rising rates of obesity world over and confound the definition of normal thyroid and lipid levels among such population.

CONCLUSIONS

According to the results of the study, a significant difference between both thyroid hormone profile and lipid profile were observed amongst obese individuals in comparison with non-obese healthy individuals. In addition, higher frequencies of women were observed in the obese group as compared to males or women in non-obese group.

Authors Contribution

Conceptualization: RH
Methodology: ZUA
Formal analysis: AZ
Writing, review and editing: SB, ME, NZ, MUH

All authors have read and agreed to the published version of the manuscript.

DOI: https://doi.org/10.54393/pjhs.v5i03.1412

Conflicts of Interest

The authors declare no conflict of interest.

Source of Funding

The authors received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Van Dijk SJ, Molloy PL, Varinli H, Morrison JL, Muhlhausler BS. Epigenetics and human obesity. International Journal of Obesity. 2015 Jan; 39(1): 85-97. doi: 10.1038/ijo.2014.34.

[2] Hruby A and Hu FB. The epidemiology of obesity: a big picture. Pharmacoeconomics. 2015 Jul; 33(7): 673-89. doi: 10.1007/s40273-014-0243-x.

[3] Topór-Mądry R. Health Effects of Overweight and Obesity in 195 Countries over 25 Years. New England Journal of Medicine. 2017 July; 377(1): 13-27. doi: 10.1056/NEJMoa1614362.

[4] Smith KB and Smith MS. Obesity statistics. Primary Care: Clinics in Office Practice. 2016 Mar; 43(1): 121-35. doi: 10.1016/j.pop.2015.10.001.

[5] Oliveros E, Somers VK, Sochor O, Goel K, Lopez-Jimenez F. The concept of normal weight obesity. Progress in Cardiovascular Diseases. 2014 Jan; 56(4): 426-33. doi: 10.1016/j.pcad.2013.10.003.

[6] Heymsfield SB and Wadden TA. Mechanisms, pathophysiology, and management of obesity. New England Journal of Medicine. 2017 Jan; 376(3): 254-66. doi: 10.1056/NEJMra1514009.

[7] Simmonds M, Llewellyn A, Owen CG, Woolacott N. Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. Obesity Reviews. 2016 Feb; 17(2): 95-107. doi: 10.1111/obr.12334.

[8] Hruby A, Manson JE, Qi L, Malik VS, Rimm EB, Sun Q *et al.* Determinants and consequences of obesity. American Journal of Public Health. 2016 Sep; 106(9): 1656-62. doi: 10.2105/AJPH.2016.303326.

[9] Björnson E, Adiels M, Taskinen MR, Borén J. Kinetics of plasma triglycerides in abdominal obesity. Current Opinion in Lipidology. 2017 Feb; 28(1): 11-8. doi: 10.1097/MOL.0000000000000375.

[10] Fan J, Liu Y, Yin S, Chen N, Bai X, Ke Q *et al.* Small dense LDL cholesterol is associated with metabolic syndrome traits independently of obesity and inflammation. Nutrition & Metabolism. 2019 Dec; 16(1): 7-16. doi: 10.1186/s12986-019-0334-y.

[11] Sanyal D and Raychaudhuri M. Hypothyroidism and obesity: An intriguing link. Indian Journal of Endocrinology and Metabolism. 2016 Jul; 20(4): 554-7. doi: 10.4103/2230-8210.183454.

[12] Fontenelle LC, Feitosa MM, Severo JS, Freitas TE, Morais JB, Torres-Leal FL *et al.* Thyroid function in human obesity: underlying mechanisms. Hormone and Metabolic Research. 2016 Dec; 48(12): 787-94. doi: 10.1055/s-0042-121421.

[13] Witkowska-Sędek E, Kucharska A, Rumińska M, Pyrżak B. Thyroid dysfunction in obese and overweight children. Endokrynologia Polska. 2017; 68(1): 54-60. doi: 10.5603/EP.2017.0007.

[14] García-Solís P, García OP, Hernández-Puga G, Sánchez-Tusie AA, Sáenz-Luna CE, Hernández-Montiel HL *et al.* Thyroid hormones and obesity: a known but poorly understood relationship. Endokrynologia Polska. 2018; 69(3): 292-303. doi: 10.5603/EP.2018.0032.

[15] Montoya-Morales DS, de los Ángeles Tapia-González M, Alamilla-Lugo L, Sosa-Caballero A, Muñoz-Solís A, Jiménez-Sánchez M et al. Alterations of the thyroid function in patients with morbid obesity. Revista Médica Del Instituto Mexicano Del Seguro Social. 2015 Feb; 53(1): 18-23.

[16] Hussain A, Ali I, Kaleem WA, Yasmeen F. Correlation between Body Mass Index and Lipid Profile in patients with Type 2 Diabetes attending a tertiary care hospital in Peshawar. Pakistan Journal of Medical Sciences. 2019 May; 35(3): 591-7. doi: 10.12669/pjms.35.3.7.

[17] Bora K, Pathak MS, Borah P, Das D. Association of Decreased High-Density Lipoprotein Cholesterol (HDL-C) With Obesity and Risk Estimates for Decreased HDL-C Attributable to Obesity: Preliminary Findings From a Hospital-Based Study in a City From Northeast India. Journal of Primary Care & Community Health. 2017 Jan; 8(1): 26-30. doi: 10.1177/2150131916664706.

[18] Bastien M, Poirier P, Lemieux I, Després JP. Overview of epidemiology and contribution of obesity to cardiovascular disease. Progress in Cardiovascular Diseases. 2014 Jan; 56(4): 369-81. doi: 10.1016/j.pcad.2013.10.016.

[19] Kanwar GU, Kirad SU, Chawla L. A comparative study of serum lipid profile between premenopausal and post-menopausal women in Kota, Rajasthan, India. International Journal of Research in Applied, Natural and Social Sciences. 2014; 2(8): 61-6. doi: 10.21276/ijcmr.2018.5.8.21

[20] Maghsoudi Z, Kelishadi R, Hosseinzadeh-Attar MJ. The comparison of chemerin, adiponectin and lipid profile indices in obese and non-obese adolescents. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2016 Apr; 10(2): 43-6. doi: 10.1016/j.dsx.2016.01.020.

DOI: https://doi.org/10.54393/pjhs.v5i03.1412

[21] Suneetha K. Study of Lipid Profile in Obese and Non-obese Students in Acharya Nagarjuna University. International Journal of Pharmaceutical and Clinical Research. 2018; 10(2): 40-2.
[22] Oliosa PR, Zaniqueli D, de Oliveira Alvim R, Barbosa MC, Mill JG. Body fat percentage is better than indicators of weight status to identify children and adolescents with unfavorable lipid profile. Jornal de Pediatria. 2019 Jan; 95(1): 112-8. doi: 10.1016/j.jped.2017.11.003.
[23] Kanwar GU and Kabra RA. A study of association between obesity and lipid profile. Impact Journals. 2016; 4(4): 69-74.
[24] Rotondi M, Leporati P, Rizza MI, Clerici A, Groppelli G, Pallavicini C *et al.* Raised serum TSH in morbid-obese and non-obese patients: effect on the circulating lipid profile. Endocrine. 2014 Feb; 45(1): 92-7. doi: 10.1007/s12020-013-9928-8.
[25] Wang X, Liu H, Chen J, Huang Y, Li L, Rampersad S *et al.* Metabolic characteristics in obese patients complicated by mild thyroid hormone deficiency. Hormone and Metabolic Research. 2016 May; 48(05): 331-7. doi: 10.1055/s-0042-105150.
[26] Martínez-Sánchez N, Alvarez CV, Fernø J, Nogueiras R, Diéguez C, López M *et al.* Hypothalamic effects of thyroid hormones on metabolism. Best Practice & Research Clinical Endocrinology & Metabolism. 2014 Oct; 28(5): 703-12. doi: 10.1016/j.beem.2014.04.004.
[27] Gutch M, Rungta S, Kumar S, Agarwal A, Bhattacharya A, Razi SM *et al.* Thyroid functions and serum lipid profile in metabolic syndrome. Biomedical Journal. 2017 Jun; 40(3): 147-53. doi: 10.1016/j.bj.2016.12.006.