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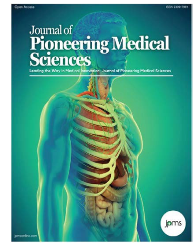


# Nurse-Led Interventions on Selected Physiological Parameters Among Pre-Teen Girls: A Randomized Controlled Trial

**S. Rajeswari[1*], S. Tamilselvi[2] and A. Helen Mary Perdita[3]**
[1]Saveetha College of Nursing, Saveetha Institute of Medical and Technical sciences, Chennai, Tamil Nadu, India
[2]Department of Community Health Nursing, Saveetha College of Nursing, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India
[3]Department of Pediatric Nursing, Apollo College of Nursing, Madurai, Tamil Nadu, India

Author Designation: [1]PhD Scholar, [2]Professor, [3]Principal and Professor

*Corresponding author: S. Rajeswari (e-mail: rajeswari031@yahoo.com).



**Abstract** **Introduction:** Pre-teen girls, aged 9 to 12, undergo crucial developmental changes during puberty, impacting their physiological, psychological and social well-being. Among pre-teen girls, elevated BMI levels are associated with an increased risk of developing comorbidities, like type 2 diabetes and cardiovascular diseases. This study is aimed to evaluate the effectiveness of a nurse-led intervention on Body Mass Index (BMI), total cholesterol, sr.estrodiol and Thyroid Stimulating Hormone (TSH) among pre-teen girls. **Methods:** A randomized controlled trial design was adopted to study 100 pre-pubertal girls from 8 to 12 years, divided into intervention and control groups. Each group consisted of 50 participants. The nurse led a physical activities program consisted of 30-minute daily aerobic exercises combined with parent counselling for twelve weeks. The control group received usual care, the BMI was taken four times, pre-test and post-test at 1 month, 2 month and 3 month. Serum total cholesterol, estradiol and TSH were measured two times, pre-test and post-test at 3month. **Results:** The research outcomes indicate a significant improvement BMI among the experimental group over the three-month study period, while the control group showed no changes, ($p<0.001$). The experimental group demonstrated a significant decline in estradiol level between pre-test and 3 months ($p=0.009$) although there were no significant changes found in Total cholesterol or TSH results. **Conclusion:** The study provides evidence for the effectiveness of the intervention in controlling BMI among the experimental group while maintaining stable biochemical profiles. Overall, the study highlights the need for continued efforts to develop and implement effective weight management strategies between body weight, hormonal balance and socio-demographic factors.

**Key Words** Pre-Teen Girls, Bio Chemical Parameters, Body Mass Index Nurse Led Intervention

## INTRODUCTION

Pre-teen girls, aged 9 to 12, undergo crucial developmental changes during puberty, impacting their physiological, psychological and social well-being. Studies emphasize the importance of addressing their complex emotional needs and the challenges of shifting body image, self-esteem and social relationships. Pre-teen girls often experience heightened depressive moods and a pronounced need for social connections compared to boys [1].

Body Mass Index (BMI) is a widely used measure to categorize individuals based on the weight relative to height, serving as an indication for body fatness. Among pre-teen girls, elevated BMI levels are associated with an increased risk of developing comorbidities, like type 2 diabetes and cardiovascular diseases. Research indicates that interventions aimed at reducing BMI in children and adolescents can lead to significant improvement in health outcomes, including reductions in cholesterol levels and improvements in metabolic health [2].

Among pre-teen girls, the prevalence of nutritional deficiencies, particularly in the context of growing urbanization and lifestyle changes, poses serious health challenges. According to Kumar et al. [3], the rising incidents of pre-diabetes and type 2 diabetes among adolescents aged 10 to 19 years can be attributed to obesity and sedentary lifestyles, influenced significantly by dietary patterns prevalent in various Indian demographics. The study highlights that 12.3% of the studied adolescents were pre-diabetic, demonstrating a concerning trend in metabolic health [3]. Addressing these trends necessitates improved nutritional education and access to healthier food options, particularly for young girls who may be disproportionately affected due to societal factors.

Total cholesterol levels are one of the critical health indicators, as they provide insight into cardiovascular health. Elevated cholesterol levels in children can be a precursor to cardiovascular diseases later in life. Studies have shown that lifestyle interventions, including dietary modifications and increased physical activity, can significantly lower total cholesterol levels in pre-teen girls [4].

Research has indicated that higher body fat percentages are associated with increased estradiol levels, which can further complicate the health profiles of pre-teen girls. Understanding the interplay between BMI and estradiol levels is crucial, as elevated estradiol can contribute to the early onset of puberty and associated health risks, including obesity and metabolic syndrome [5].

Thyroid-Stimulating Hormone (TSH) is another important biomarker that reflects thyroid function, which is essential for regulating metabolism. Abnormal TSH levels can indicate thyroid dysfunction, which may contribute to weight gain or difficulty in losing weight. In pre-teen girls, monitoring TSH levels can provide valuable insights into metabolic health and the potential for developing obesity-related conditions. Studies have shown that interventions targeting lifestyle changes can positively influence TSH levels, thereby improving metabolic outcomes [5].

A nurse-led intervention focusing on dietary education and physical activity demonstrates a marked reduction in cholesterol levels among participants, underscoring the role of healthcare professionals in promoting heart health [6]. A nurse-led intervention that included regular monitoring of TSH levels alongside lifestyle modifications resulted in improved metabolic health among participants [6,7].

The interplay between BMI, total cholesterol, serum estradiol and TSH levels among pre-teen girls is complex and multifaceted. Addressing these health indicators through targeted interventions is essential for promoting long-term health and preventing obesity-related comorbidities. Nurse-led interventions, in particular, have shown promise in effectively managing these health metrics, highlighting the critical role of healthcare professionals in fostering healthier lifestyles among young girls. Hence this study was aimed to evaluate the effectiveness of a nurse-led intervention on body mass index (BMI), total cholesterol, serum. estrodiol and TSH among pre-teen girls.

## MATERIAL AND METHODS

The Institutional Ethics Committee gave approval for the study proposal (ECR/1365/Inst/TN/2020 & EC/NEW/INST/2022/TN/0059, dated 01.09.2023). This research followed a randomized controlled trial design to study the effect on 100 pre-teen girls (8 to 12 years) and were equally divided into intervention and control groups. The sample size was estimated at 100 participants, with 50 assigned to the control group and 50 to the experimental group.

The nurses led physical activity program consisting of 30-minute daily aerobic exercises combined with parent counseling for twelve weeks was carried out (monthly follow up was done). The control group received usual care after the completion of the final data collection; the control group was demonstrated the aerobic exercise for 30 minutes in one session. Serum total cholesterol, estradiol and TSH were measured two times, pre-test and post-test at 3month.

The research used two-way RM ANOVA to study sequential health changes in BMI and hormone levels among different test and control groups. The experiment used the Bonferroni 't' post-hoc test to check for significant differences between and within every pair of groups. The research assessed potential BMI differences between groups through separate t-tests from various measurement points. The chi-square test showed that the groups have similar socio-demographic traits before testing proceeded.

### Ethical Consideration

The study obtained informed consent from guardians and assent from participants. All data were kept confidential and participants' privacy was ensured. Ethical approval was obtained from an Institutional Review Board (IRB). Participants could withdraw at any time without consequence and the intervention was designed to minimize harm and maximize benefits.

### Statistical Analysis

The statistical analysis involved a two-way RM ANOVA to compare BMI changes between the groups, Bonferroni-adjusted t-tests for post-hoc comparisons, frequency and percentage distributions for demographic data and chi-square tests for categorical variables. SigmaPlot software was used for these analyses.

## RESULTS

Table 1 shows the comparison of body mass index (BMI) between control and experimental groups at all-time points (pretest, posttest at 1, 2 and 3 months) and Bonferroni 't' post hoc tests were performed. Results showed that there was no significant difference of BMI pretest ($p = 0.231$) between the control and experimental groups. However, at 1 month ($p = 0.015$), 2 months ($p = 0.002$) and 3 months ($p<0.001$) the obtained findings were significantly different ($p<0.05$) that favored the experimental group. However, the changes in the control group between the pre-test and month one ($t = 2.363$; $p = 0.113$) is not significant whereas, month two ($t = 5.259$; $p<0.001$) and month three ($t = 9.184$; $p<0.001$) were significant. At each of the 1, 2 and 3 months' time points, BMI was significantly reduced in the experimental group with t's of 11.699 ($p<0.001$), 17.187 ($p<0.001$) and 32.812 ($p<0.001$) than pretest (Figure 1).

Table 2 presents the comparison of serum total cholesterol (TC), estradiol (E) and thyroid stimulating hormone (TSH) levels between control and experimental groups. At the pre-test ($t = 0.603$, $p = 0.552$) and at the 3 month posttest ($t = 0.383$, $p = 0.706$), there were no significant differences between the control and experimental groups for TC. Similarly, there

Table 1: Socio-demographic variables of control and experimental groups of children for homogeneity.

| S. No. | Variable | Category | Control group n = 50 | Experimental group N = 50 | Statistics |
|---|---|---|---|---|---|
| 1 | Father's education | Schooling | 26 | 27 | $\chi^2 = 0$ |
| | | Graduate | 24 | 23 | p = 1.0 |
| 2 | Mother's education | Schooling | 33 | 35 | $\chi^2 = 0.046$ |
| | | Graduate | 17 | 15 | p = 0.830 |
| 3 | Father's employment | Private/Govt employee | 29 | 32 | $\chi^2 = 0.168$ |
| | | Miscellaneous work | 21 | 18 | p = 0.682 |
| 4 | Mother's employment | Private/Govt employee | 17 | 13 | $\chi^2 = 0.429$ |
| | | Miscellaneous work | 33 | 37 | p = 0.513 |
| 5 | Type of family | Nuclear | 40 | 40 | $\chi^2 = 0.0625$ |
| | | Joint | 10 | 10 | p = 0.803 |
| 6 | Residence | Urban | 44 | 47 | $\chi^2 = 0.488$ |
| | | Rural | 6 | 3 | p = 0.485 |
| 7 | Number of children | 1 | 19 | 21 | $\chi^2 = 0.0417$ |
| | | More than 1 | 31 | 29 | p = 0.838 |
| 8 | Habit of eating high fat foods | Never/rarely | 17 | 9 | $\chi^2 = 2.547$ |
| | | Frequently/regularly | 33 | 41 | p = 0.111 |
| 9 | Use of electronic Gadgets per day | <4 hours | 18 | 13 | $\chi^2 = 0.748$ |
| | | >4 hours | 32 | 37 | p = 0.387 |
| 10 | History of parental obesity | No | 24 | 19 | $\chi^2 = 0.653$ |
| | | Yes | 26 | 31 | p = 0.419 |
| 11 | History of breastfeeding | <6 months | 33 | 38 | $\chi^2 = 0.777$ |
| | | Exclusive for 6 months | 17 | 12 | p = 0.378 |

Table 2: Comparison of control and experimental groups on body mass index (BMI) by two-way RM ANOVA with Bonferroni 't' test.

| S. No | Groups comparisons | Test comparisons | BMI |
|---|---|---|---|
| 1 | Control | Pre-test | 26.14+0.41 |
| | Control | Post-test 1 month | 26.26+0.41 |
| | Control | Post-test 2 month | 26.41+0.42 |
| | Control | Post-test 3 month | 26.62+0.42 |
| | Experimental | Pre-test | 25.43+0.41 |
| | Experimental | Post-test 1 month | 24.82+0.42 |
| | Experimental | Post-test 2 month | 24.53+0.41 |
| | Experimental | Post-test 3 month | 23.71+0.41 |
| 2 | Significance among groups (Control and Experimental) | | F = 8.862 p = 0.004 |
| | Significance among tests (Pre-test/1 month/2 month/3 month) | | F = 94.627 p<0.001 |
| | Significance in the interaction (groups X test) | | F = 308.166 p<0.001 |
| 3 | Significance between Pre-test (Control and Experimental) | | t = 1.205 p = 0.231 |
| | Significance between 1 month (Control and Experimental) | | t = 2.468 p = 0.015 |
| | Significance between 2 month (Control and Experimental) | | t = 3.221 p = 0.002 |
| | Significance between 3 month (Control and Experimental) | | t = 4.977 p<0.001 |
| 4 | Significance within Control (Pre-test and 1 month) | | t = 2.363 p = 0.113 |
| | Significance within Control (Pre-test and 2 month) | | t = 5.259 p<0.001 |
| | Significance within Control (Pre-test and 3 month) | | t = 9.184 p<0.001 |
| 5 | Significance within Experimental (Pre-test and 1 month) | | t = 11.699 p<0.001 |
| | Significance within Experimental (Pre-test and 2 month) | | t = 17.187 p<0.001 |
| | Significance within Experimental (Pre-test and 3 month) | | t = 32.812 p<0.001 |
| Values are Mean+SE; n = 50 each | | | |

was no difference in the level of estradiol in the groups before (t = 0.330, p = 0.745) or at 3 months (t = 0.125, p = 0.901). For TSH, there were no significant differences between the pretest (t = 0.296, p = 0.770) and 3 month posttest (t = 0.512, p = 0.614) for the control and experimental group. Within control group TC (t = 0.586, p = 0.565), E (t = 0.907, p = 0.376) and TSH (t = 1.390, p = 0.181) did not change significantly between pretest and 3 months after test. However, estradiol levels decreased

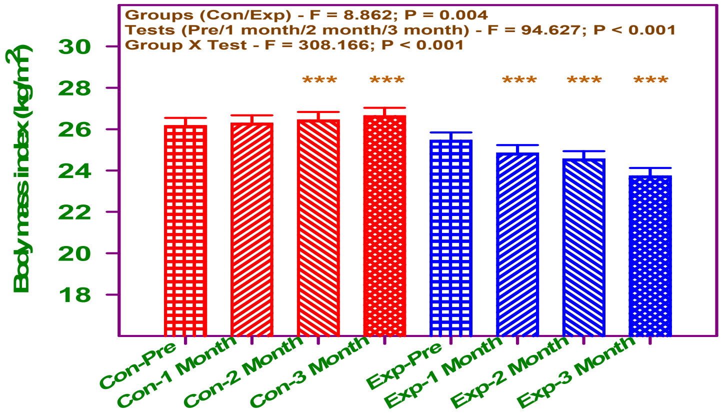


Figure 1: Comparison of control and experimental groups on body mass index in pre-test (Pre) and post-tests

Table 3: Comparison of control and experimental groups on serum total cholesterol (TC), estradiol (E) and thyroid stimulating hormone (TSH) by two-way RM ANOVA with Bonferroni 't' test

| S. No | Groups comparisons | Test comparisons | TC (mg/dL) Mean+SE | E (pg/mL) Mean+SE | TSH (mIU/L) Mean+SE |
|---|---|---|---|---|---|
| 1 | Control | Pre-test | 185.0+6.3 | 33.33+5.05 | 3.64+0.23 |
| | Control | Post-test 3 month | 186.8+5.0 | 34.08+5.19 | 3.77+0.18 |
| | Experimental | Pre-test | 190.4+7.2 | 35.89+6.26 | 3.74+0.29 |
| | Experimental | Post-test 3 month | 183.4+7.0 | 33.11+5.25 | 3.59+0.29 |
| 2 | Significance among groups (Control and Experimental) | | F = 0.0132 p = 0.910 | F = 0.0105 p = 0.919 | F = 0.0121 p = 0.913 |
| | Significance among tests (Pre-test/3 month) | | F = 1.098 p =0.308 | F = 2.579 p =0.125 | F = 0.0495 p =0.826 |
| | Significance in the interaction (groups X test) | | F = 3.292 p =0.085 | F = 7.805 p =0.012 | F = 4.169 p =0.055 |
| 3 | Significance between Pre-test (Control and Experimental) | | t = 0.603 p = 0.552 | t = 0.330 p =0.745 | t = 0.296 p = 0.770 |
| | Significance between 3 months (Control and Experimental) | | t = 0.383 p =0.706 | t = 0.125 p =0.901 | t = 0.512 P =0.614 |
| 4 | Significance within Control (Pre-test and 3 month) | | t = 0.586 p =0.565 | t = 0.907 p =0.376 | t = 1.390 p =0.181 |
| 5 | Significance within Experimental (Pre-test and 3 month) | | t = 1.893 p =0.074 | t = 2.910 p =0.009 | t = 1.498 p =0.15 |

in the experimental group at pretest to 3 months (t = 2.910, p = 0.009) and TC (t = 1.893, p = 0.074) and TSH (t = 1.498, p = 0.150), were not significantly different in the experimental group between pretest and 3 months.

Table 3 showed that all the socio-demographic variables provided no statistically significant difference between the control and experimental groups as tested by the chi-square test (p>0.05). Parental education, employment, family type, residence, number of children, dietary habits, gadget use, parental obesity history, breast feeding duration were included. Furthermore, there were no statistically significant differences between the groups regarding the habit to eat high fat foods, using electronic gadgets or history of breastfeeding. These findings support that the control and experimental group are similar on various socio demographic variables.

## DISCUSSION

The research outcomes indicate a significant decrease in Body Mass Index (BMI) among the experimental group over the three-month study period, while the control group showed no significant changes. The p-values for the experimental group remained below 0.05, indicating statistical significance in the observed changes. Specifically, the control group did not exhibit significant BMI modifications during the first month but showed significant changes at the two-month and three-month evaluation. This pattern suggests that the intervention applied to the experimental group was effective in promoting weight management, while the control group remained stable BMI over the same period [8-10].

In terms of hormonal measurements, both groups displayed comparable results regarding serum total cholesterol, estradiol and Thyroid-Stimulating Hormone (TSH) levels during the pre-test and three-month post-test assessments. Notably, the experimental group showed a significant decline in estradiol levels from pre-test to the three-month follow-up, while no significant changes were noted in total cholesterol or TSH levels. This finding aligns with existing literature that suggests thyroid hormones can influence lipid metabolism and that estradiol levels can be affected by various interventions, including dietary changes and exercise [8,11]. The lack of significant changes in TSH levels across both groups may indicate that the intervention did not adversely affect thyroid function, which is crucial for maintaining metabolic homeostasis [12].

The socio-demographic factors, including parental education and family type, as well as dietary habits, were comparable between the experimental and control groups, suggesting that the observed differences in BMI and hormonal levels were likely due to the intervention rather than external confounding variables. This is consistent with studies that emphasize the importance of controlling for socio-demographic factors in clinical research to ensure that the results are attributable to the intervention itself [13]. The findings reinforce the notion that effective interventions can lead to significant health improvements, particularly in populations at risk for obesity and related metabolic disorders [14].

The study's results demonstrate a clear decrease in BMI within the experimental group, implying that the intervention method employed has promising effectiveness. This is particularly relevant in the context of rising obesity rates and associated health complications, where effective management strategies are urgently needed [15-17]. The significant decline in estradiol levels in the experimental group may also suggest potential implications for reproductive health, as hormonal balance is critical for various physiological processes. Furthermore, the absence of significant changes in total cholesterol and TSH levels indicates that the intervention did not negatively impact lipid metabolism or thyroid function, which is a crucial consideration in the design of weight management programs [18]. It is also implied that compared to general physical activities at school level, a nurse-led intervention will be more adoptable particularly for the girls children.

## CONCLUSIONS

The study provides compelling evidence for the effectiveness of the intervention in improving BMI among the experimental group while maintaining stable hormonal profiles. The significant decline in estradiol levels in the experimental group suggests potential implications for reproductive health, while the absence of significant changes in total cholesterol and TSH levels indicates that the intervention did not negatively impact lipid metabolism or thyroid function. These findings contribute to the growing body of literature advocating for targeted interventions in managing obesity and its related health issues. Future research should explore the long-term effects of such interventions on metabolic health and hormonal balance, as well as the mechanisms underlying these changes. Overall, the study highlights the need for continued efforts to develop and implement effective weight management strategies that consider the complex interactions between body weight, hormonal balance and socio-demographic factors. A nurse-led intervention will be more acceptable for school-going children rather than general physical exercises and sports activities. The study was limited by its reliance on self-reported data and a small, geographically confined sample size. Future research should extend the intervention duration and include more diverse demographic groups to enhance generalizability.

## REFERENCES


[1] Kaur, Jaspreet *et al.* "Study of Performance Characteristics of TSH on Finecare™ Poct Device." *Journal of Pharmaceutical and Clinical Research,* vol. 16, no. 3, March 2023, pp. 48-51. https://journals.innovareacademics.in/index.php/ajpcr/article/view/46724.

[2] Salam, Rehana A., *et al.* "Effects of lifestyle modification interventions to prevent and manage child and adolescent obesity: A systematic review and meta-analysis." *Nutrients,* vol. 12, no. 8, July 2020. https://www.mdpi.com/2072-6643/12/8/2208.

[3] Kumar, Pradeep, *et al.* "Prevalence of pre-diabetes/type 2 diabetes among adolescents (10–19 years) and its association with different measures of overweight/obesity in India: a gendered perspective." *BMC Endocrine Disorders,* vol. 21, July 2021. https://link.springer.com/article/10.1186/s12902-021-00 802-w.

[4] Videira-Silva, António, *et al.* "Combined high-intensity interval training as an obesity-management strategy for adolescents." *European Journal of Sport Science,* vol. 23, no. 1, November 2021, pp. 109-120. https://onlinelibrary.wiley.com/doi/abs/10.1080/17461391.2021.1995508.

[5] Tang, Hong K., *et al.* "Improving the lifestyle of adolescents through peer education and support in vietnam: protocol for a pilot cluster randomized controlled trial." *JMIR Research Protocols,* vol. 9, no. 6, August 2019. https://www.researchprotocols.org/2020/6/e15930/.

[6] Krishnasamy, Vembu, *et al.* "Effectiveness of nurse-led intervention on weight reduction among adults in urban Puducherry–A randomized controlled pilot trial." *Journal of Education and Health Promotion,* vol. 13, no. 1, June 2024. https://journals.lww.com/jehp/fulltext/2024/07110/effectiveness_of_nurse_led_intervention_on_weight.210.aspx?context=latestarticles.

[7] Whitehead, Lisa, *et al.* "The effectiveness of nurse-led interventions to prevent childhood and adolescent Overweight and obesity: A systematic review of randomised trials." *Journal of Advanced Nursing,* vol. 77, no. 12, June 2021, pp. 4612-4631. https://onlinelibrary.wiley.com/doi/full/10.1111/jan.14928.

[8] Brady, Kristen, *et al.* "Transcriptome analysis during follicle development in Turkey hens with low and high egg production." *Frontiers in Genetics,* vol. 12, March 2021. https://www.frontiersin.org/articles/10.3389/fgene.2021.619196/full.

[9] Kjaergaard, Alisa D., *et al.* "Thyroid function, sex hormones and sexual function: a Mendelian randomization study." *European Journal of Epidemiology,* vol. 36, 2021, pp. 335-344. https://link.springer.com/article/10.1007/s10654-021-00721-z.

[10] Akane, Hirotoshi, *et al.* "Histopathological and immunohistochemical evaluation for detecting changes in blood hormone levels caused by endocrine disruptors in a 28-day repeated-dose study in rats." *Journal of Applied Toxicology,* vol. 42, no. 10, April 2022, pp. 1603-1617. https://analyticalsciencejournals.onlinelibrary.wiley.com/doi/abs/10.1002/jat.4327.

[11] Huang, Han-Bin, *et al.* "Mediation effects of thyroid function in the associations between phthalate exposure and lipid metabolism in adults." *Environmental Health,* vol. 21, no. 1, July 2022. https://link.springer.com/article/10.1186/s12940-022-00873-9.

[12] Ajayi, O.O., *et al.* "Effect of phases of the menstrual cycle on biophysical and biochemical parameters of African black women with breast cancer." *Rwanda Medical Journal,* vol. 79, no. 2, 2022, pp. 16-26. https://www.ajol.info/index.php/rmj/article/view/228169/215404.

[13] Bhagyalakshmi, Audi, *et al.* "Serum lipids in sub clinical hypothyroidism: A retrospective study." *International Journal of Clinical Biochemistry and Research,* vol. 7, no. 2, June 2020, pp. 260-263.

[14] Gong, Lei, *et al.* "Circulating free triiodothyronine concentration is positively associated with β-cell function in euthyroid patients with obesity and type 2 diabetes." *Journal of International Medical Research,* vol. 50, no. 8, August 2022. https://journals.sagepub.com/doi/full/10.1177/03000605221118511.

[15] Kaminski, Juliana, *et al.* "Effects of oral versus transdermal estradiol plus micronized progesterone on thyroid hormones, hepatic proteins, lipids, and quality of life in menopausal women with hypothyroidism: a clinical trial." *Menopause,* vol. 28, no. 9, September 2021, pp. 1044-1052. https://journals.lww.com/menopausejournal/fulltext/2021/09000/Effects_of_oral_versus_transdermal_estradiol_plus.9.aspx.

[16] Al-Saaidi, Jabber A., and Jaafar K. Al-Bedary. "Gonadotropin profile in experimentally induced hypothyroid and hyperthyroid cyclic female rats." *Iraqi Journal of Veterinary Sciences,* vol. 36, no. 3, June 2022, pp. 745-751. https://www.semanticscholar.org/paper/Gonadotropin-profile-in-experimentally-induced-and-Al-Saaidi-Al-Bedary/020a9cdd049bdca9d295627ad25629256ea0adf5.

[17] Li, Ying, *et al.* "Altered circulating GDF-15 level predicts sex hormone imbalance in males with major depressive disorder." *BMC psychiatry,* vol. 23, no. 1, January 2023. https://link.springer.com/article/10.1186/s12888-023-04527-z.

[18] Kabakçı, Ruhi, and Taha Burak Elifoglu. "Serum triiodothyronine, Thyroxine, and thyroid stimulating hormone concentrations of domestic female cats at different reproductive stages." *Harran Üniversitesi Veteriner Fakültesi Dergisi,* vol. 9, no. 2, December 2020, pp. 200-205. https://dergipark.org.tr/en/doi/10.31196/ huvfd.819930.