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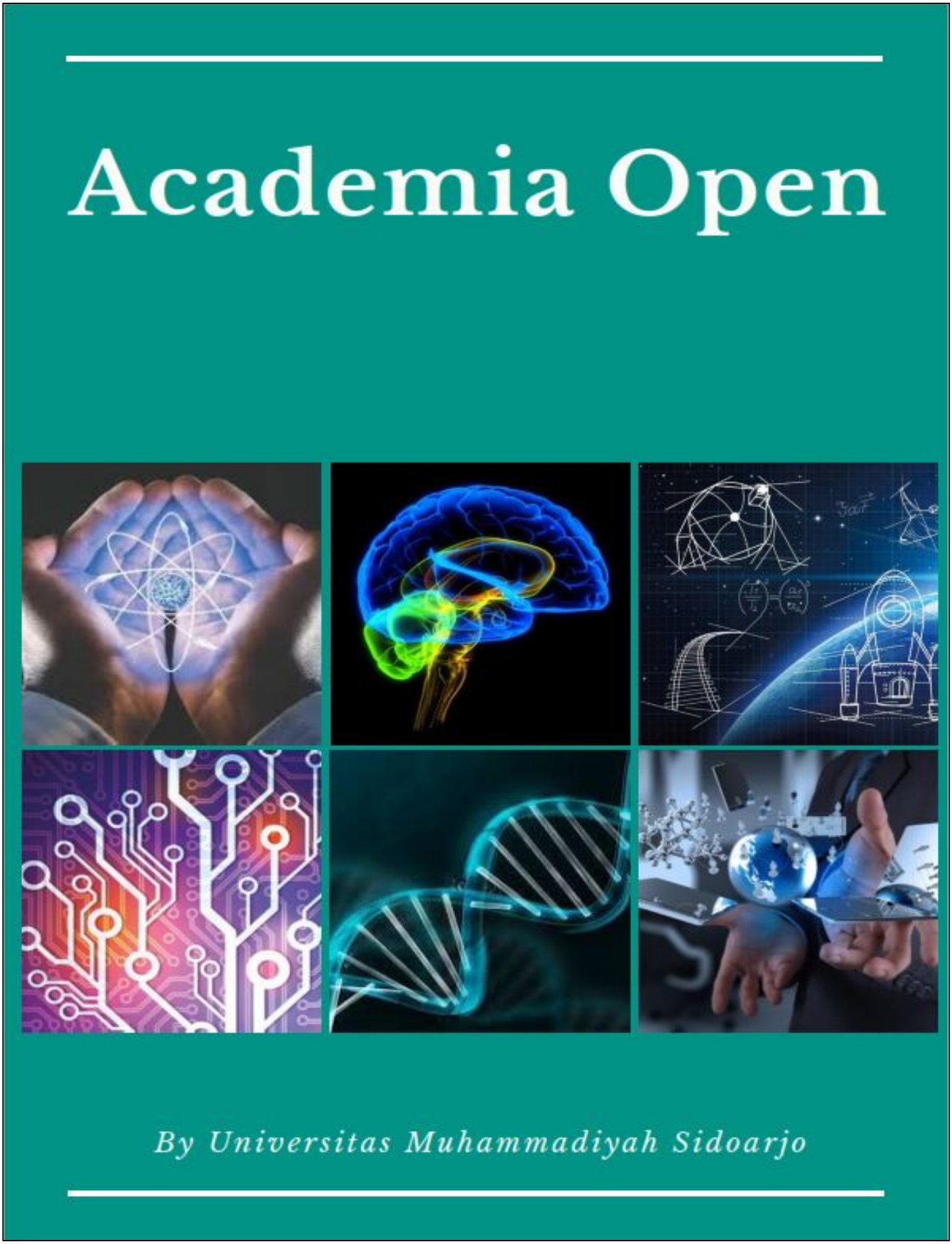

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Veterinary Students' Knowledge of Thyroid Hormones and Educational Needs

Pengetahuan Mahasiswa Kedokteran Hewan tentang Hormon Tiroid dan Kebutuhan Pendidikan

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Abstract

General Background: The thyroid gland, an essential endocrine organ located in the anterior neck, regulates iodine homeostasis and secretes thyroid hormones that influence metabolism and cellular function. **Specific Background:** Understanding thyroid hormone physiology is crucial for veterinary students, as it impacts both human and animal health. **Knowledge Gap:** Limited research exists on veterinary students' awareness of thyroid hormone physiology, particularly its effects on the body. **Aims:** This study assesses veterinary students' knowledge of thyroid hormone function and provides recommendations to enhance their understanding. **Methodology:** A descriptive, cross-sectional, questionnaire-based study was conducted at the College of Veterinary Medicine, University of Basrah, with 150 students (86 females, 64 males). The questionnaire included demographic data and knowledge assessments on thyroid function, hypothyroidism, and hyperthyroidism. **Results:** Female students constituted the majority (57.33%). Most participants (94%) were aged 19–28. The results showed varying levels of knowledge, with 95% of responses being significant and a high mean score, indicating substantial understanding of thyroid hormone effects. **Novelty:** This study highlights veterinary students' competence in endocrinology and suggests targeted educational interventions for knowledge enhancement. **Implications:** Findings emphasize the need for improved curriculum design and interactive learning strategies to reinforce thyroid physiology education in veterinary programs.

Highlights:

1. Knowledge Levels: Students showed varied understanding of thyroid hormone function.
2. Significant Findings: 95% of responses were significant, indicating strong knowledge.
3. Educational Implications: Findings highlight the need for better thyroid education.

Keywords: Thyroid gland, Veterinary students, Endocrinology, Hormone physiology, Knowledge assessment

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Introduction

Once thyroid hormone is activated from the prohormone thyroxine (T4) to the active form triiodothyronine (T3), it controls a large number of variables [1]. The production of several thyroid hormone receptor (TR) isoforms, cell and tissue-specific thyroid hormone transporters, and interactions with corepressors and coactivators make the signaling pathway intricate and tightly controlled [2, 3]. Additionally, thyroid signals frequently interact with a variety of other signaling pathways [4, 5]. Here, we examine how our knowledge of this route has been influenced by clinical findings and animal models, and how this knowledge may be applied to treatment strategies for a variety of ailments.

The gland's two lobes—the left and right lobes—are connected by an intermediary tissue called the isthmus. The pyramidal lobe, a third lobe, occasionally protrudes from the isthmus. It features levator glandulae thyroideae, a fibrous/fibromuscular band that extends from the hyoid body to the isthmus [6].

The external branch of the superior laryngeal nerve and the recurrent laryngeal nerve are two important nerves that are near the thyroid gland. The vagus nerve has both branches. Damage to these nerves during thyroidectomy results in breathing difficulties and/or phonation impairment. Singing becomes extremely difficult when one of the superior laryngeal nerve's branches is injured. Breathing problems and hoarseness of voice can result from unilateral damage to the recurrent laryngeal nerve. Serious bilateral recurrent laryngeal nerve damage frequently requires a tracheostomy [7].

The true and false capsules completely enclose the thyroid gland. Further down to the actual capsule, the thyroid gland is made up of a deep capillary plexus. Because of this physical configuration, removing the plexus with capsule during thyroidectomy is essential [8].

Metabolism

The basal metabolic rate is raised by thyroid hormone. Thyroid hormones promote protein anabolism and carbohydrate metabolism. High levels of thyroid hormones can also cause protein catabolism. Although thyroid hormones don't alter blood sugar levels, they can raise gluconeogenesis, glucose oxidation, glycogen synthesis, and glucose reabsorption [9].

Growth During Childhood

Thyroid hormones and growth hormone work together to promote bone growth in youngsters. It stimulates osteoblasts, osteoclasts, and chondrocytes. Through axonal growth and myelin sheath formation, thyroid hormone also aids in the maturation of the brain [10].

Anatomy and physiology

In human physiology, the thyroid gland and its primary product, thyroid hormone, are crucial. Therefore, any doctor treating patients with thyroid diseases must have a thorough understanding of the anatomy, physiology, and embryology of the thyroid gland. The thyroid gland is a shield-shaped structure in the lower neck that is situated anterior to the trachea. There is extensive research being done on the molecular biology of thyroid function. The sodium iodide symporter and the thyroid-stimulating hormone receptor are examples of clinically significant molecules that have been found and thoroughly described. Our knowledge of thyroid physiology has greatly increased as a result of these studies. Consequently, there are currently or will soon be innovative methods for diagnosing and treating thyroid diseases [11].

Pathophysiology

Hyperthyroidism: Thyroid gland disorders can cause an overabundance of T3 and T4 production in addition to a compensatory drop in TSH. Furthermore, thyrotrophic adenoma can result in elevated T3 and T4 production as well as uncontrolled TSH production. In certain cases, there is an ectopic production of thyroid hormone, which results in a decrease in TSH and an increase in thyroid hormones [12].

Hypothyroidism: TSH rises in primary hypothyroidism as a result of the thyroid gland producing fewer thyroid hormones. Pituitary abnormalities that result in decreased TSH release and low T3/T4 levels are the cause of secondary hypothyroidism. Hypothalamic problems lead to tertiary hypothyroidism, which is characterized by decreasing levels of TRH, TSH, and T3/T4 [13].

Symptoms of Hypothyroidism

Apathy, slower cognition, dry skin, baldness, elevated low-density lipoproteins, and elevated triglycerides are all symptoms of a generalized lowered basal metabolic rate. When psychiatric patients exhibit apathy and impaired cognition, hypothyroidism must be checked out. Bradycardia, constipation, and decreased sweating can result from hypothyroidism's reduction of sympathetic activity. Reduced transcription of sarcolemma genes can cause patients

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to exhibit myopathy and reduced cardiac output [14].

Hypothyroidism can result in hyperprolactinemia. Prolactin and TSH release are stimulated by the hypothalamus's thyrotropin-releasing hormone (TRH). The secretion of GnRH, LH, FSH, and testosterone can all be suppressed by prolactin. Breast tissue expansion is another effect of prolactin [15].

Due to a reduction in the removal of complex glycosaminoglycans and hyaluronic acids from the dermal reticular layer, patients with hypothyroidism may exhibit myxedema. The nonpitting edema is pretibial at first. Patients may experience widespread edema as their hypothyroidism worsens [16].

Symptoms of Hyperthyroidism

Increased Na+/K+-ATPase is a result of generalized hypermetabolism from hyperthyroidism, which encourages thermogenesis. Beta-adrenergic receptors are also upregulated in many organs, and catecholamine secretion is elevated. The hyperadrenergic condition causes a reduction in peripheral vascular resistance. Phospholamban, a protein that typically lowers the affinity of calcium-ATPase for calcium in the sarcoplasmic reticulum, is reduced in the heart as a result of hyperthyroidism. Decreased phospholamban causes more Ca+ to flow between the cytosol and sarcoplasmic reticulum, which increases contractility. Elevated cardiac output is also a result of enhanced beta receptors in the heart [17].

Methods

Design of the study

A descriptive cross-sectional study questionnaire-based study was carried to study the Physiological effect of thyroid hormones as viewed by the students.

Setting of the study

The study conducted in college veterinary of at the university of Basrah

Sample of study

The sample of the study is a total of 150 students (86) Female and male (64).

Data collection

The data was collected through the use of structured Questionnaire prepared by the researchers and through a direct personal interview with each male and Female student who participated in the study. The data collection was carried out from each student spends approximately (5-10) minutes to complete the interview.

The study instruments

A questionnaire of the four parts was prepared by researchers and then displayed to faculty as experts for take their opinions and advices .the questionnaire consist of four parts , the first part was about the demographic information (Age, sex, marital status, stage of study, and other) .Second part of questionnaire consist your knowledge about the thyroid gland .Third part of the questionnaire consist your knowledge about the Hypothyroidism and fourth part your knowledge about the Hyperthyroidism.

Statistical data analysis

For data analysis 1- Percentage. 2- Frequency. 3- Mean of score. used by Manual method

Results and Discussion

Result

Category	Classify	f	%
Male	64	59.49%	
Gander	Female	86	40.51%
Total	150	100%	
19-28	141	94%	
Age	29-38	7	4.66%

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39-48	2	1,33%	
Total	150	100%	
Single	126	84%	
Marital status	Married	24	16%
Total	150	100%	
Stage (2)	66	44%	
Academic Level	Stage (3)	30	20%
Stage (4)	54	36%	
Total	150	100%	

Table 1. *sociodemographic information (N=150)*

This table showed that the percentage of males was 42.66, while the percentage of females was 57.33. Likewise, with regard to age, the first period was (19-28), their percentage was 94%, the second period was (29-38), their percentage was 4.66, and the third period was (39-48), their percentage was 1.33. As for marital status, the percentage of single people was 84%, while the percentage of married people was 16%. Likewise, the percentage of the study stage for stage 2 was 44%, the percentage of third stage 3 was 20%, and the percentage of fourth stage 4 was 36%.

Number of Questionnaire	Agree		Neutral		Disagree		Ms	S
F	%	F	%	F	%			
Q1/The front of the neck is where the thyroid gland is situated.	140	93.33%	6	4%	4	2.66%	2.9	S
Q2/The thyroid gland secretes T3 and T4 hormones	135	90%	10	6.66%	5	3.33%	2.86	S
Q3/The thyroid gland controls the amount of energy that cells consume from the food introduced into them	96	64%	40	26.66%	14	9.33%	2.54	S
Q4/Iodine is stored by the thyroid gland and converted to thyroid hormone.	105	70%	29	19.33%	16	10.66%	2.59	S
Q5/Thyroid hormones have been shown to affect the amount of blood vessel	95	63.33%	47	31.33%	8	5.33%	2.34	S

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dilation. Thus, you can control the amount of heat that leaves the body								
Q6/Iodine deficiency is the most common cause of goiter	97	64.66%	29	19.33%	24	16%	2.48	S
Q7/Swelling of the neck area is one of the most obvious symptoms in patients with goiter	140	93.33%	7	4.66%	3	25%	2.91	S

Table 2. *Your knowledge about the thyroid gland (N=150)*

The table showed the knowledge of the students about thyroid gland ,93.33% know the exact location of the thyroid. 90% know the thyroid hormones, only 64% of the students know the role of the gland in controlling energy expenditure by the body cells.70 % know the role of the gland in Iodine regulation and storage.63.33% of the students know the heat regulation function of the thyroid.64.66% accept that Iodine deficiency causes goiter. 93.33% of the students agree that neck swelling is the most obvious sign in patient with goiter.

When we examine the mean of scores for the items related to thyroid gland as shown in the table above, we found that the students had significant knowledge, where the mean of scores is more than 2.

Number of Questionnaire	Agree		Neutral		Disagree		Ms	S
F	%	F	%	F	%			
Q8/Heart rate decreases as a result of hypothyroidism	109	72.66%	28	18.66%	15	10%	2.65	S
Q9_Blood pressure rises due to decreased thyroid hormones	75	50%	50	33.33%	25	16.66%	2.33	S
Q10_Hypothyroidism causes a person to constantly feel very cold	122	81.33%	20	13.33%	8	5.33%	2.76	S
Q11/Hypothyroidism causes constipation	67	44.66%	56	37.33%	27	18%	2.26	S
Q12/Deficiency of the T3 and T4 hormones	112	74.66%	30	20%	8	5.33%	2.89	S

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causes irregular menstruation in women								
Q13/A deficiency of T3 and T4 hormones makes it difficult to lose weight	103	68.66%	32	21.33%	15	10%	2.58	S
Q14_A deficiency of thyroid hormones causes dry skin	95	63.33%	44	29.33%	11	7.33%	2.56	S

Table 3. *Your knowledge about hypothyroidism (N=150)*

The table showed that 72.66% of the students agree that hypothyroidism (low thyroid function) lead to decrease heart rate, only 50 % of the students know the reactive rises in the blood pressure due to hypothyroidism. 81.33% know the cold feeling, only 44.66 % agree with constipation ,74.66 % know the irregular menses in women, 68.66% know the weight gaining effect of the disease ,63.33% know that the disease causes dry skin.

When we examine the mean of scores for the items related to hypothyroidism as shown in the table above, we found that the students had significant knowledge, where the mean of scores is more than 2.

Number of Questionnaire	Agree		Neutral		Disagree		Ms	S
F	%	F	%	F	%			
Q15/Hyperthyroidism causes a person to constantly feel very hot	112	74.66%	20	13.33%	18	12%	2.62	S
Q16_Increased levels of T3 and T4 cause a person to sweat more than usual	115	76.66%	29	19.33%	6	4%	2.72	S
Q17/Hyperthyroidism leads to insomnia and stress	123	82%	24	16%	3	52%	2.8	S
Q18_Hyperthyroidism leads to loss of body weight	105	70%	32	21%	13	8.66%	2.61	S
Q19/Hyperthyroidism speeds up the body's metabolism	100	66.66%	28	18.66%	22	14.66%	2.52	S
Q20_Increased thyroid hormones	88	58.66%	42	28%	20	13.33%	2.45	S

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cause hand tremor								

Table 4. *Your knowledge about hyperthyroidism (N=150)*

The table showed that 74.66% know that the disease cause hot feeling, 76.66% agree that the disease causes sweating, 82% accept that the disease causes insomnia and stress, 66.66% know that the disease speed up the body metabolism, and 58.66% know that the disease causes hand tremor

When we examine the mean of scores for the items related to hyperthyroidism as shown in the table above, we found that the students had significant knowledge, where the mean of scores is more than 2.

Discussion

This part divided into two parts according to the objectives of the study.

Part One: Socio- D emographic Data of the Students

According to these results showed that the percentage of the percentage of females was 57.33.

These results agreed with numerous studies [18-22] that mention the most of the study sample were females.

Regarding the age of the study sample, the highest period was between 19 and 28, their percentage was 94%.

These results agreed with numerous studies [23-26] that mention the most of the study sample were females.

Regarding the marital status, the highest percentage of single people was 84%.

These results agreed with numerous studies [27-30] that mention the most of the study sample were females.

Regarding the stage of the students, the percentage of the study stage for stage 2 was 44%.

These results agreed with numerous studies [31-34] that mention the most of the study sample were females.

Part Two: Students Knowledge Regarding t he Physiological Effects of Thyroid Hormones

According to these results the most of the students have good knowledge regarding the physiological effects of thyroid hormones.

These results agreed with numerous studies [35, 36] which mention the most of the students have good knowledge regarding the physiological effects of thyroid hormones.

From the researcher point of view, this good knowledge due to the curriculum contains the thyroid gland disorders (hypothyroidism, hyperthyroidism, goiter, physiology of the thyroid gland).

Conclusion

1-Female students made up the largest percentage in answering the evaluation questionnaire.

2-Study results show different levels in students' knowledge about thyroid hormone.

3-95%of the answers were significant.

4-The total mean of score was significant.

References

1. B. Gereben, A. M. Zavacki, S. Ribich, B. W. Kim, S. A. Huang, W. S. Simonides, et al., "Cellular and molecular basis of deiodinase-regulated thyroid hormone signaling," Endocrine reviews, vol. 29, pp. 898-938, 2008.
2. S.-Y. Cheng, J. L. Leonard, and P. J. Davis, "Molecular aspects of thyroid hormone actions," Endocrine reviews, vol. 31, pp. 139-170, 2010.
3. G. R. Williams, "Neurodevelopmental and neurophysiological actions of thyroid hormone," Journal of neuroendocrinology, vol. 20, pp. 784-794, 2008.
4. J. Bernal, "Thyroid hormone receptors in brain development and function," Nature clinical practice

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Endocrinology & metabolism, vol. 3, pp. 249-259, 2007.
5. Y.-Y. Liu and G. A. Brent, "Thyroid hormone crosstalk with nuclear receptor signaling in metabolic regulation," Trends in Endocrinology & Metabolism, vol. 21, pp. 166-173, 2010.
6. P. Chaudhary, Z. Singh, M. Khullar, and K. Arora, "Levator glandulae thyroideae, a fibromusculoglandular band with absence of pyramidal lobe and its innervation: a case report," Journal of Clinical and Diagnostic Research: JCDR, vol. 7, p. 1421, 2013.
7. C. Giulea, O. Enciu, E. A. Toma, V. Calu, and A. Miron, "The Tubercle of Zuckerkandl is associated with increased rates of transient postoperative hypocalcemia and recurrent laryngeal nerve palsy after total thyroidectomy," Chirurgia (Bucur), vol. 114, pp. 579-585, 2019.
8. E. Kaplan, P. Angelos, M. Applewhite, F. Mercier, and R. Grogan, "Chapter 21 surgery of the thyroid," Endotext [Internet]. South Dartmouth (MA): MDText. com, Inc, 2000.
9. B. B. Mughal, J.-B. Fini, and B. A. Demeneix, "Thyroid-disrupting chemicals and brain development: an update," Endocrine connections, vol. 7, pp. R160-R186, 2018.
10. D. Springer, J. Jiskra, Z. Limanova, T. Zima, and E. Potlukova, "Thyroid in pregnancy: From physiology to screening," Critical reviews in clinical laboratory sciences, vol. 54, pp. 102-116, 2017.
11. N. Stathatos, "Anatomy and physiology of the thyroid gland," in The thyroid and its diseases: A comprehensive guide for the clinician, ed: Springer, 2019, pp. 3-12.
12. A. Tiryag, M. Atiyah, and A. Khudhair, "Nurses' knowledge and attitudes toward thyroidectomy: A cross-sectional study," Health Education and Health Promotion, vol. 10, pp. 459-465, 2022.
13. Y. Shafagoj, F. Mohammed, and K. Hadidi, "Hubble-bubble (water pipe) smoking: levels of nicotine and cotinine in plasma, saliva and urine," International journal of clinical pharmacology and therapeutics, vol. 40, pp. 249-255, 2002.
14. H. Mohajan, "Knowledge is an essential element at present world," 2016.
15. E. H. Rahi, Z. M. H. Al-Hejaj, and A. M. Tiryag, "Nurses' knowledge of nonalcoholic fatty liver disease: A cross-sectional study," Academia Open, vol. 9, pp. 10.21070/acopen. 9.2024. 10306-10.21070/acopen. 9.2024. 10306, 2024.
16. A. Berhaupt, "Exploring the Science on Measures of Body Composition, Body Fat Distribution, and Obesity," 2024.
17. M. J. Allen, Assessing academic programs in higher education: John Wiley & Sons, 2003.
18. F. Z. Hamza and M. H. Al-Saeed, "Ameliorative Effect of Ghrelin on Thyroxin Hormones and Body Weight in Hyperthyroidism Male rats," Basrah Journal of Veterinary Research, vol. 20, pp. 44-58, 2021.
19. F. Z. Hamza and M. H. Al-Saeed, "Effect of ghrelin on some sexual hormones and molecular characterization of luteinizing hormone and follicular stimulating hormone genes in hyperthyroidic male rats," REDVET-Revista electrónica de Veterinaria, vol. 23, 2022.
20. A. Tiryag, "Revitalizing hearts: The transformative impact of pacemaker therapy on cardiac conduction disorders," Academia Open, vol. 9, pp. 10-21070, 2024.
21. F. K. I. Al-Mahdawi, A. S. Hassan, and W. A. W. Alsiadi, "Parathyroid gland, anatomy, histology, and physiology (a short review)," Basrah Journal of Veterinary Research, vol. 19, 2020.
22. Y. Akalu, M. D. Molla, G. Dessie, and B. Ayelign, "Physiological effect of ghrelin on body systems," International journal of endocrinology, vol. 2020, p. 1385138, 2020.
23. A. M. Tiryag, "Nurses' Knowledge and Attitudes Toward Pacemaker: A Cross-Sectional Study," Academia Open, vol. 9, pp. 10.21070/acopen. 9.2024. 8845-10.21070/acopen. 9.2024. 8845, 2024.
24. N. K. Almaliky, U. Al-Sari, S. J. AL-Shaeli, and H. A. Gharban, "Insights for possible association and impact of thyroidectomy to osteoarthritis," Beni-Suef University Journal of Basic and Applied Sciences, vol. 13, p. 99, 2024.
25. S. A. Majeed, A. M. Jewad, and M. Y. N. Al Atbee, "Assessment of Thyroid and Parathyroid Dysfunction in Hemodialysis Patients," University of Thi-Qar Journal Of Medicine, vol. 26, pp. 408-425, 2023.
26. A. Hamed, F. El Dabbah, A. Hassan, A. Elshoura, and N. Omar, "Histopathological And Biochemical Study of Toxic Effects of The Chronic Administration of Bisphenol A On The pituitary and Thyroid Glands Of Adult Albino Rats," Al-Azhar International Medical Journal, vol. 3, pp. 112-116, 2022.
27. A. Aljaberi, R. Alamoudi, T. M. Elsherbiny, K. Hafidh, S. A. Raza, and S. A. Beshyah, "Thyroxine Replacement Therapy during Ramadan Fasting: A Narrative Review," Journal of Diabetes and Endocrine Practice, 2024.
28. M. Mohammad, F. Jassim, and A. Tiryag, "Retrograde Intrarenal Lithotripsy Using Disposable Flexible Ureteroscope," Georgian Medical News, vol. 348, pp. 44-46, 2024.
29. R. F. Ghadhban and A.-D. H. Ala, "LEPTIN EFFECTS ON, THYROID HORMONES AND SOME BIOCHEMICAL PARAMETERS OF FEMALE RABBITS (LEPUS CUNICULUS) SERUM."
30. A. Yassin, "Histomorphometric Study of the Thyroid Gland of the Adult Male Squirrel (Sciurus Anomalus)," Kufa Journal for Veterinary Medical Sciences, vol. 15, pp. 1-9, 2024.
31. T. T. Nguyen, T. K. Nguyen, N. Q. Ho, T. N. Le, T. C. Pham, and C. K. Nguyen, "International Journal of Veterinary Science," Int J Vet Sci, vol. 13, pp. 617-622, 2024.
32. M. F. Hasan, W. F. Hussein, A. M. Tiryag, I. J. Ali, and Z. M. Shaker, "Nurses' knowledge toward lower back pain: A cross-sectional study," Academia Open, vol. 9, pp. 10.21070/acopen. 9.2024. 10363-10.21070/acopen. 9.2024. 10363, 2024.
33. F. H. Ramadan, "Crucial Role of Mitochondrial Mechanisms in the Antineoplastic Effects of Desethylamiodarone," University of Pécs (Hungary), 2023.
34. F. A. Jassim, A. M. Tiryag, and S. S. Issa, "Effect of bad habits on the growth of school students: A cross-sectional study," Indonesian Journal on Health Science and Medicine, vol. 1, pp. 10-21070, 2024.

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

35. G. A. Brent, "Mechanisms of thyroid hormone action," The Journal of clinical investigation, vol. 122, pp. 3035-3043, 2012.
36. J. R. Klein, "The immune system as a regulator of thyroid hormone activity," Experimental Biology and Medicine, vol. 231, pp. 229-236, 2006.

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo