The Impact of Smoking on Thyroid Gland Volume, Echotexture, Nodularity and Function: Initial Experience at INMAS, Mitford

[1]Farida Yasmin, [1]Afroza Naznin, [2]Samira Sharmin, [3]Hosne Ara Rahman

[1]Senior Medical Officer
[2]Principal Medical Officer
[3]Director & Chief Medical Officer, Institute of Nuclear Medicine & Allied Sciences, Mitford, Dhaka.

Correspondence Address : Dr. Farida Yasmin, Senior Medical Officer, Institute of Nuclear Medicine & Allied Sciences, Mitford, Dhaka, E-mail: farida.sb.38@gmail.com

ABSTRACT

Objective: The aim of the study was to investigate the impact of smoking on thyroid gland volume, echotexture, nodularity, and function.

Method: This prospective observational study was conducted in the department of ultrasonography at the Institute of Nuclear Medicine & Allied Sciences, Mitford, from October 2023 to December 2023. A total of 54 subjects of both sexes were randomly selected who had no known thyroid disorders. Among them, 24 were smokers and 30 were nonsmokers. The Esaote My Lab Ultrasound Machine was used to perform a sonographic examination of the thyroid gland, and the hormonal assay was performed using the RIA method. Result: We found a moderately positive correlation between smoking habit and thyroid gland volume ($r_s = 0.494$, $p < 0.01$) and smoking duration and thyroid gland volume ($r_s = 0.478$, $p < 0.01$). No significant correlation was found between smoking habits and thyroid echotexture, nodularity, and function.

Conclusion: Smoking presents a statistically significant goitrogenic effect on thyroid gland volume but has no impact on echotexture, nodularity, or function.

Keywords: Smoking, thyroid gland volume, thyroid echotexture, thyroid nodule, high resolution neck ultrasound.

Bangladesh J. Nucl. Med. Vol. 26 No. 2 July 2023
DOI: https://doi.org/10.3329/bjnm.v26i2.71472

INTRODUCTION

Tobacco is the most commonly used psychoactive substance in the world and has a significant impact on human health. Smoking can harm nearly every organ of the human body. The pulmonary and cardiovascular systems are mostly affected. The influence of smoking on the endocrine system is still under debate. The thyroid gland is a vital endocrine gland that controls important metabolic processes in the body by producing and releasing hormones. Goiter is the most common thyroid disorder in the world. Numerous factors are responsible for diffuse or nodular enlargement of the thyroid gland, like iodine concentration, serum thyroid stimulating hormone level (TSH), thyroid autoantibodies, food and drinking water, etc. Iodine deficiency is the most powerful risk factor for developing goiter. The possible impact of smoking on goiter prevalence has been investigated in a few previous studies. Some studies found a strong association between smoking, increased thyroid volume, and abnormal thyroid function. Some investigators couldn't demonstrate any significant correlation (1–4).

A cigarette contains over 7,000 chemical components. Among them, thiocyanate is thought to be responsible for the goitrogenic effect. Thiocyanate is a hydrogen cyanide derivative that exerts goitrogenic effects through competitive inhibition of iodine transport and organification (2, 4).

The aim of our study was to investigate the impact of smoking on the thyroid gland, echotexture, nodularity, and function in the iodine-sufficient region.

PATIENTS AND METHODS

This prospective observational study was conducted at INMAS, Mitford, from October 2023 to December 2023. A total of 54 subjects of both sexes were randomly selected who had no known thyroid disorders. Among them, 24 were smokers who had been smoking at least 5 cigarettes daily for more than 5 years, and 30 were nonsmokers who had never smoked or had not smoked for the last 10 years. Subjects with anterior neck swelling, clinical evidence of thyroid disease, or subjects with previous surgery were excluded.

Demographic data (age, sex, height and weight), smoking habit, duration of smoking, number of cigarettes per day, and history of thyroid disease were recorded for each subject. These interviews were taken before a sonographic evaluation of the thyroid gland. A sonographic examination of the thyroid gland was performed by the Esaote My Lab Ultrasound Machine using a 7.5 MHz linear transducer. Subjects were examined in the supine position with a hyperextended neck. Images were taken in longitudinal and transverse planes. Width and length were measured from the largest longitudinal section, whereas thickness was measured from the transverse section. The volume of each lobe was calculated by the Brunn method (length x width x thickness x 0.479 in mm). The total thyroid volume was the sum of both lobes. The isthmus was not included to avoid differences due to its anatomic location. Thyroid echotexture was classified as homogeneous or inhomogeneous. Women were examined in the first half of the cycle, as values differed between the two phases of the menstrual cycle. Nodules were defined as nodular goiter (single nodule) or multinodular goiter (2 or more nodules). Blood samples were taken for a thyroid function test (serum concentration of free T4 and TSH) using the radioimmune assay method (RIA). Normal ranges in our laboratory are as follows: free T4: 8.56-25.6 fmol/ml and TSH: 0.3-5.0 µIU/mL.

Statistical analysis was performed using SPSS statistical software version 20.0. Spearman's rho correlation was used to explore the relationship between smoking habit and smoking duration with thyroid gland volume, thyroid echotexture, nodularity, and function. Clinical parameters were presented in terms of mean and SD for quantitative variables and frequency (%) for qualitative variables. A P value of <0.05 was considered statistically significant.

RESULTS

There was a total of 24 (44.44%) smokers and 30 (55.56%) non-smokers in the study sample, with the mean age of smokers being 46.25± 12.80 years and that of non-smokers being 40.67± 14.90 years. Out of 24 smokers, all (100%) were male, as no female smoker was found within the study sample, which is clinically significant (P-). The mean age of the male smokers was 46.25 ± 12.80 years. Out of 30 non-smokers, 46.67% were male, with a mean age of 37.43±15.96 years, and 53.33% were female, with a mean age of 43.5±13.79 years. No statistically significant difference was found between smokers and nonsmokers in terms of age and BMI (P value: 0.660 and P value: 0.850, respectively).

The mean thyroid volume of smokers was 10.08± 7.18 cm3 and that of non-smokers was 5.62± 2.81 cm3. A moderately positive correlation was found between smoking habit and

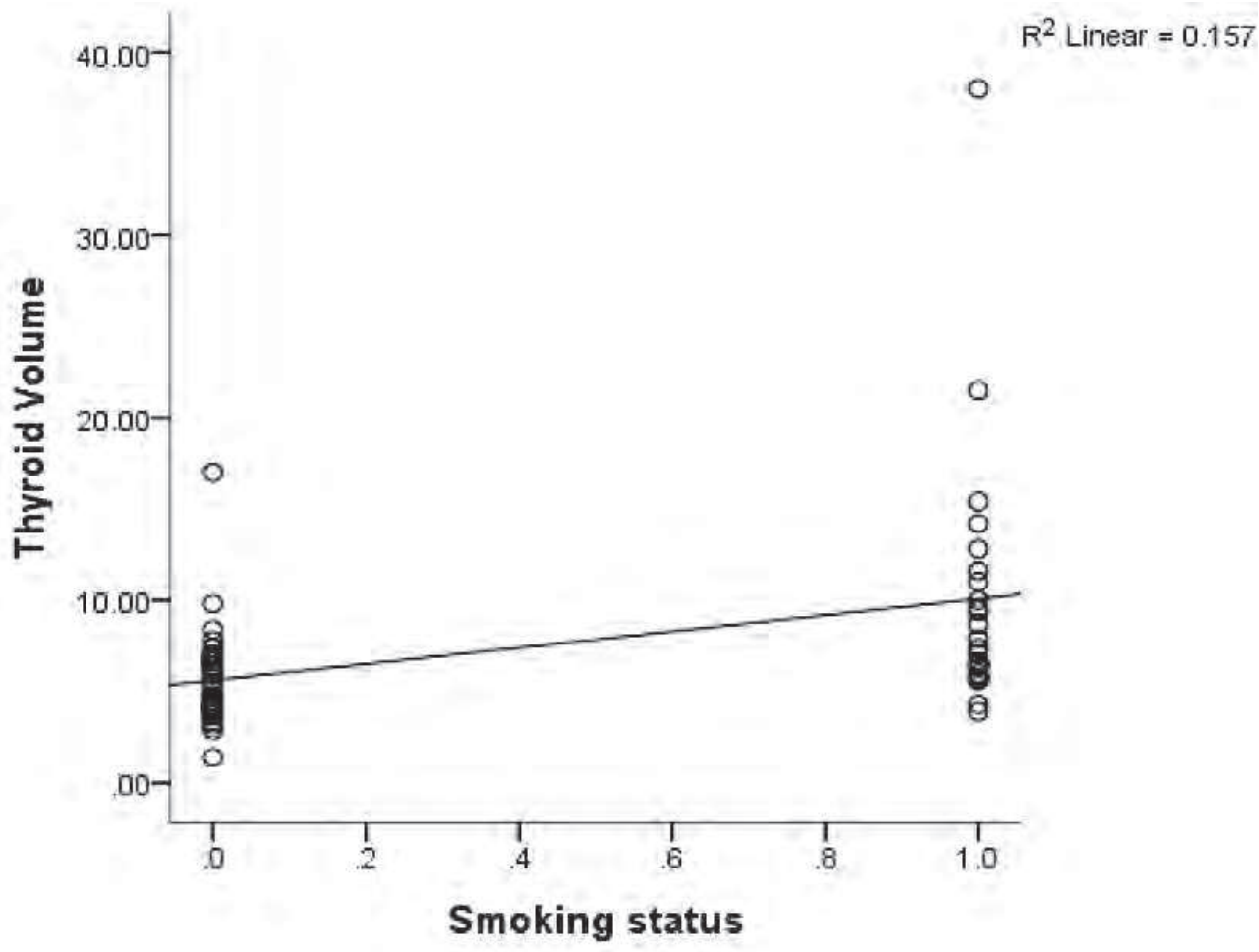
Table 1: Demographic variables, ultrasound findings and thyroid function of the participants according to smoking habit

Variable	Smoker (N=24)	Nonsmoker (N=30)	*p* value
Mean Age (Year)	46.25± 12.80	40.67±14.90	0.660
Sex (%)			<0.01
Male	24 (100%)	14 (46.67%)	
Female	0	16 (53.33%)	
BMI	25.51±4.32	25.51±4.29	0.850
Mean smoking duration (yr)	25.0±12.25		<0.01
Mean thyroid volume (cc)	10.08± 7.18	5.62± 2.81	< 0.01
Echotexture			0.128
Homogenous	20 (37.04%)	28 (51.85%)	
Inhomogeneous	4 (7.41%)	2 (3.70%)	
Presence of Nodule	6 (11.11%)	8 (14.81%)	0.929
Abnormal thyroid function	2 (3.70%)	2 (3.70%)	

Table 2: Correlation of smoking habit with thyroid gland volume, echotexture, nodularity & function

	Smoking status	Smoking duration	Thyroid volume	Echotexture	Nodule location	Nodule	Thyroid function
Smoking status	1						
Smoking duration	.947**	1					
Thyroid volume	.494**	.478**	1				
Echotexture	.210	.138	.433**	1			
Nodule location	-.012	.062	-.109	.046	1		
Nodule number	-.012	.064	-.119	.037	.994**	1	
Thyroid function	.021	.020	.300*	.514**	-.012	-.026	1

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).



o=Nonsmoker and 1= smoker.

Figure 1: Plot showing positive linear correlation between smoking habit and thyroid gland enlargement

thyroid gland volume, which was statistically significant (rs = 0.494, p< 0.01) (Table 1). In smokers, the mean duration of smoking was 25.0±12.25 years. A statistically significant correlation was found between smoking duration and thyroid gland volume (rs = 0.478, p value < 0.01).

Among the 24 smokers, 20 (37.04%) had a homogenous thyroid texture and 4 (7.41%) had an inhomogeneous thyroid texture. 28 (51.85%) nonsmokers had homogenous thyroid texture, and 2 (3.70%) had inhomogeneous thyroid texture from 30 nonsmokers. Thyroid nodules were present in 6 (11.11%) smokers and 8 (14.81%) nonsmokers. No statistically significant difference was found between smokers and non-smokers with respect to echotexture or the presence or absence of nodules (P values of 0.128 and 0.929, respectively).

Laboratory analysis revealed no significant differences between smokers and non-smokers regarding FT4 and TSH (P value: 0.920 and P value: 0.880, respectively).

DISCUSSION

Goiter prevalence in the iodine-deficient region indicates an association between smoking and goiter formation. The hypothesis is that thiocyanate, an important component in cigarettes, is a competitive inhibitor of iodine transport and organification. So, heavy exposure to thiocyanate exaggerates the effect of iodine deficiency that results in thyroid enlargement (2,4,5).

Goiter and nodule prevalence is higher in certain groups and populations. Women are more prone to goiter and nodule formation compared to men. The role of smoking regarding goiters and nodules is still debatable. There are contradictory results about smoking habits and goiters in the literature. Our study found a significant correlation between smoking and thyroid gland enlargement, which is similar to the findings of Salaam et al., Knudsem et al., Aydin et al., and Karatoprak et al., whereas Jastaniah et al. and Podsadna et al. failed to demonstrate a significant correlation. Geographical differences are thought to influence the interaction between smoking and goiter. Most of the studies suggested an association between smoking and thyroid gland enlargement, which was found to be strong in the iodine-deficient region (6, 7, 8, 9, 10).

Some authors reported significantly increased nodule formation among smokers. But in our study, smoking has no significant impact on thyroid nodularity. Knudsen et al. and Aydin et al. detected a higher occurrence of multinodularity among the smoker group, which is opposite to ours. Karatoprak et al. found no association between smoking and thyroid nodules, which is similar to ours. As for us, most of the studies revealed no effect of smoking on thyroid echotexture (7, 8, 10).

Zhang et al. identified that smoking is associated with a reduced serum concentration of TSH. One possible hypothesis for the reduced TSH level is to suppress the effect of thiocyanate-induced increased thyroid hormone synthesis to maintain normal metabolic function in the body. Jastaniah et al. found smokers had normal thyroid function compared to nonsmokers, but we did not find any significance between them. Our study is similar to the findings of Aydin et al. (5, 7, 10).

There are a few limitations to this study. Firstly, a single-center-based study may affect the generalizability of the findings. Secondly, a small sample size might be inadequate to draw a conclusion. Large-scale studies with bigger sample size may be planned near future to clarify the effect of smoking on the thyroid gland in Bangladesh.

CONCLUSION

smoking enhances diffuse enlargement of thyroid gland. Moderate positive correlation found with thyroid gland volume to smoking habit and smoking duration but no significant correlation found with smoking habit to thyroid echotexture, nodularity and function.

REFERENCES

1. Aksoy FG, Kesim O. Influence of Cigerette Smoking on Thyrid Gland Volume: An Ultrasonographic Approach. Turk J Med Sci. 2002; 32:335-338
2. Gruppen EG, Kootstra-Ros J, Kobold AM, Connelly MA, Touw D, Bos JHJ, et al. Cigarette smoking is associated with higher thyroid hormone and lower TSH levels: the PREVEND study. Endocrine [Internet].
   2019;67(3) https://doi.org/10.1007/s12020-019-02125-2
3. Sawicka-Gutaj N, Gutaj P, Sowiński J, Wender-Ożegowska E, Czarnywojtek A, Brązert J, et al. Influence of cigarette smoking on thyroid gland — an update. Endokrynol Pol. 2014;65(1):54–62 https://doi.org/10.5603/ep.2014.0008
4. Podsadna EL, Andrzejewska A, Czarnywojtek AC. Impact of tobacco smoking on thyroid ultrasound image assessed among random population of spa patients in Kolobrzeg, Poland. WSN. 2018; 108:229-236

5. Zhang Y, Shi L, Zhang Q, Peng N, Chen L, Lian X, et al. The association between cigarette smoking and serum thyroid stimulating hormone, thyroid peroxidase antibodies and thyroglobulin antibodies levels in Chinese residents: A cross-sectional study in 10 cities. PLoS One. 2019;14(11). https://doi.org/10.1371/journal.pone.0225435

6. Salaam A, Danjem S, Ibinaiye P, Salaam A, Angba H, Igoh E, et al. DETERMINATION OF RELATIONSHIP BETWEEN THYROID GLAND VOLUME AND PARITY, SMOKING HABITS AND ALCOHOL CONSUMPTION. Jos J Med. 2019;13(2).

7. Knudsen N, Bülow I, Laurberg P, Ovesen L, Perrild H, Jørgensen T. Association of tobacco smoking with goiter in a low-iodine-intake area. Arch Intern Med. 2002;162(4):439–43. https://doi.org/10.1001/archinte.162.4.439

8. Karatoprak C, Kartal I, Kayatas K, Ozdemir A, Yolbas S, Meric K, et al. Does smoking affect thyroid gland enlargement and nodule formation in iodine-sufficient regions? Ann Endocrinol (Paris). 2012;73(6):542–45.

https://doi.org/10.1016/j.ando.2012.09.008

9. Jastaniah S, Abed Alhazmi A, Alabdullah H, Fawzi Selamee F, Khalid Barahim W, Wazzan M, et al. Investigating the Association of Smoking with Thyroid Volume and Function. Health (Irvine Calif). 2017;09(13):1843–51.

https://doi.org/10.4236/health.2017.913133

10. Aydin Y, Fahri BH, Demirin H, Yildirim H, Önder E, et al. Effect of smoking intensity on thyroid volume, thyroid nodularity and thyroid function: the Melen study. MINERVA Endocrinol. 2011;36(4):273–80. https://doi.org/10.13140/RG.2.1.5129.4169