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SUBCLINICAL THYROID DYSFUNCTION AMONG HEALTHCARE WORKERS IN A UNIVERSITYHOSPITAL

By

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Abstract

Introduction: Subclinical thyroid dysfunction (STD) is rapidly rising worldwide and reported among medical staff to about 30% due to high work stress and night shifts affecting the circadian system leads to hormonal irregularities. **Aim of Work:** To assess the prevalence of subclinical thyroid dysfunction and its associated factors among healthcare workers. **Materials and Methods:** A cross-sectional study was carried out during the period from September 2023 to February 2024 among a random sample including: Group I: 118 participants of healthcare workers at Menoufia University Hospitals, Shebin Al-Kom City, Egypt and Group II: control group (118) who were attending outpatient clinic of Family Medicine at the same hospitals and were matched in age and sex with group I. A pre-designed questionnaire was answered by each participant and blood samples were taken for assessment of free tri-iodothyronine (FT3), free thyroxine (FT4) and serum thyroid-stimulating hormone (TSH) level. **Results:** The prevalence of STD was 33.1% among healthcare workers (HCWs) versus 11.9% among controls with overall prevalence of 22.5%. Female gender, smoking, comorbidities, working >8 hours daily and obesity were more frequent among those with STD 79.5%, 15.4%, 38.5%, 87.2% and 46.2% versus only 58.2%, 3.8%, 13.9%, 69.6% and 11.4% of those without STD ($p=0.037$, 0.025, 0.005, 0.038 and 0.002; respectively). Logistic regression was performed to show the effects of the studied risk factors on the likelihood of STD occurrence and it was statistically significant $p<0.05$. **Conclusion and Recommendations:** STD was more prevalent among HCWs. Screening of all HCWs for STD by TSH testing and analyses of the work environment to assess all risk factors associated with this disorder are suggested. Repeating the screening of TSH should be done after 3 months in cases of subclinical hypothyroidism for diagnosis of overt hypothyroidism.

Keywords: Subclinical hypothyroidism, Thyroid Dysfunction, Thyroid-stimulating hormone and Healthcare workers.

Introduction

Subclinical thyroid dysfunction (STD) is a state of abnormal serum TSH concentration either increased in a condition termed by subclinical hypothyroidism or decreased in case of subclinical hyperthyroidism and characterized by thyroid hormones free T3 and free T4 levels within the normal reference range in both conditions (Ku et al., 2023). STD is mainly a laboratory diagnosis (Ren et al., 2023).

Thyroid hormones (T3 and T4) have a great role in neurocognitive development, adaptive thermogenesis of skeletal muscles and regulation of metabolic pathways of carbohydrate, protein, and lipid (Mullur et al., 2014). T3and T4 secretions are regulated by TSH that released from the pituitary gland through hypothalamic-pituitary-thyroid (HPT) axis (Sinha and Yen, 2024). Thyroid disease may be primary from the thyroid gland itself or secondary due to other factors outside this gland mostly central affection including hypothalamic or pituitary disease (Alyahya et al., 2021). Hypothyroidism differentiated from subclinical hypothyroidism by depressed level of FT3 and FT4 together with elevated TSH (Khandelwal and Tandon, 2012). In the same way, hyperthyroidism and thyrotoxicosis is diagnosed by elevated level of FT3 and FT4 together with low TSH in contrast to subclinical hyperthyroidism with normal thyroid hormones (Karat et al., 2021).

Prevalence of thyroid dysfunction is rapidly rising worldwide estimated by about 49.76% of adult population , and subclinical hypothyroidism (SCH) is the most common form reported between 4 and 20%, while hypothyroidism primary type was reported at 5.3% (Ragusa et al., 2019). SCH was reported 39.2% at primary care settings (Alqahtani, 2021). Thyroid function abnormalities were reported among medical staff and vary between 4 to 30% (Ren et al., 2023).

Several conditions preceded subclinical hypothyroidism as Hashimoto thyroiditis that involves autoantibodies against thyroid gland, past thyroid surgery with subsequent radiation and some drugs as lithium and antiarrhythmics as amiodarone (Biondi, 2012, Kim and Park, 2014).

STD is applied to patients with minimal thyroid-related symptoms with abnormal TSH value. TSH screening is described as the best laboratory parameter for defining cases with this dysfunction (Jones et al., 2010; Alhazmi et al., 2022).

Patients with SCH tend to report symptoms of a hypoactive thyroid gland

that may be non-specific and variable as fatigue, lack of concentration, cognitive impairment, myalgia, menstrual irregularities, cold intolerance, weight gain…. (Zhang et al., 2019, Huang et al., 2020). Metabolic risk factors such as hyperlipidemia usually were associated with SCH (Han et al., 2015; Tsou and Chen, 2021).

Disruption of the circadian rhythm leads to hormonal irregularities as increased TSH levels (Leso et al., 2020; Luo et al., 2023). Exposure to radiation in some specialties as radiology, oncology and orthopedics, may lead to increase the risk of thyroid diseases as hyper or hypothyroidism (Chen et al., 2017).

There are few studies on the prevalence of STD among HCWs in Egypt; so the current study was proposed to investigate this prevalence and its determinates in Menoufia University Hospitals.

Aim of Work

To assess the prevalence of subclinical thyroid dysfunction and its associated factors among healthcare workers.

Materials and Methods:

Study design: It is a comparative cross-sectional study

Place and duration of the study: The study was conducted during the period from September 2023 to February 2024 at Menoufia University Hospitals, Shebin Al-Kom City, Egypt.

Study sample: Assuming that the hypothesized percentage of thyroid dysfunction in the general population was 23.8% according to a previous study (Alhazmi et al., 2022); sample size was estimated at 80% power and 0.05 level of significance using Open-epi software for epidemiological statistics to be 118 HCWS selected and was increased to 150 participants for compensation of drop out with response rate was 78.7%. Two groups were enrolled in this study; Group I included healthcare staffs working at the fore mentioned university hospitals selected by a simple random method, and group II included controls who were attending outpatient clinic of Family Medicine and were selected by cluster random sampling technique to be matched in age and sex with group I.

Inclusion criteria: Healthcare staffs who agreed to participate in the study. **Exclusion criteria** : Workers who had any history of current or past thyroid disease before work admission, systemic diseases affecting thyroid gland or taking any medicine that alter normal thyroid function, type II diabetes mellitus, pregnancy and patients with

autoimmune diseases.

Study methods: All participants were subjected to:

1) **A self-administrated questionnaire** was independently validated by 3 experts of Occupational Medicine then was disseminated to the HCWs and controls; which consists of three subsections: a) Socio-demographic characteristics including age, sex, residence, marital status, smoking, comorbidities (as diabetes, cardiovascular ,autoimmune diseases) and any medication used. b) Occupational history including the years of experience, working hours and specialty. c) Present specific history of thyroid disease including a hypo or hyperactive thyroid gland. d) Family history of thyroid dysfunction.

2) **Investigations**: About 3 milliliters of venous blood were taken under strictly sterile conditions from all study participants. The blood sample was placed in a simple, sterile tube and allowed to coagulate at 37°C before separation of serum by using centrifugation then used for thyroid function tests including free T3, free T4 and TSH, using Architect I 1000 SR immunoassay analyzer (California, USA).

Ethical Approval

The current study was approved by Institutional Review Boards (IRB) of the Menoufia Faculty of Medicine, Menoufia University, Egypt with approval code 8/2023COM9.

Consent

An informed consent was taken from each participant after explaining the aim of the study. Data were handled anonymously to maintain the confidentiality of the participants.

Data Management

Statistical Package for Social Sciences (SPSS) version 28 (SPSS Inc., Chicago, IL, USA) was used to analyze the research data. Data analysis involved descriptive statistics and inferential statistical techniques. Descriptive statistics was expressed in: Number (No), percentage (%) mean ($\bar{x}$) and standard deviation (SD). Analytic statistics included t-test that was used for quantitative data. Chi-square test ($\chi 2$) was used to study association between qualitative variables. Assessment of exposure's risk was done by using the Odds ratio (OR). Regression analysis was used to detect the predictors or risk factors of the likelihood of developing STD. P value of < 0.05 was considered statistically significant.

Results

The current study was carried out enrolling 236 participants. Group 1 included 118 HCWs while Group II included 118 controls.

Table (1): Socio-demographic and clinical data of the studied participants:

	Studied groups				χ^2 test	p value
	Group I (No=118)		Group II (No =118)			
	No.	%	No.	%		
Age (years): Mean ±SD Range	37.74±8.36 27– 49		39.35±8.43 29– 51		t-test = 1.47	0.142
Sex: Male Female	41 77	34.7 65.3	46 72	39.0 61.0	0.45	0.511
Residence: Urban Rural	65 53	55.1 44.9	57 61	48.3 51.7	1.09	0.294
Marital status: Unmarried Married	27 91	22.9 77.1	19 99	16.1 83.9	1.32	0.251
Smoking: Yes NO	9 109	7.6 92.4	11 107	9.3 90.7	0.22	0.641
Comorbidities ##: Yes NO	26 92	22.1 77.9	18 100	15.3 84.7	1.37	0.242

Family history of TD: Yes NO	 19 99	 16.1 83.9	 12 106	 10..2 89.8	1.34	0.247
Occupation: Physicians Nurses	 55 63	 46.6 53.4	 49 69	 41.5 58.5	0.43	0.512
Working unit at hospital : Medical Surgical	 52 66	 44.1 55.9	 48 70	 40.7 59.3	0.16	0.692
Years of experience: ≤ 10 years 10– 20 years > 20 years	 53 36 29	 44.9 30.5 24.6	 44 51 23	 37.3 43.2 19.5	4.11	0.127
Working hours: ≤ 8 hours > 8 hours	 29 89	 24.6 75.4	 36 82	 30.5 69.5	1.04	0.307
BMI (kg/m²):** Normal Overweight Obese	 37 54 27	 31.3 45.8 22.9	 51 49 18	 43.2 41.5 15.3	4.27	0.118
MAP (mmHg)#: Mean±SD Range	 89.63±19.81 80.0–130.0		 84.85±15.29 70.0–110.0		**t-test** = 2.07	0.061

TD: thyroid disorder ** BMI: Body Mass Index # MAP: Mean arterial blood pressure

##: like diabetes mellitus, cardiovascular and autoimmune diseases

Table (1) showed that there was no statistically significant difference as regards most of basic clinical characteristics (P>0.05) with higher female participants than male ones among both studied groups. However, comorbidities, family history of TD, working more than 8 hours and obesity were higher among group I but didn't reach the significance level

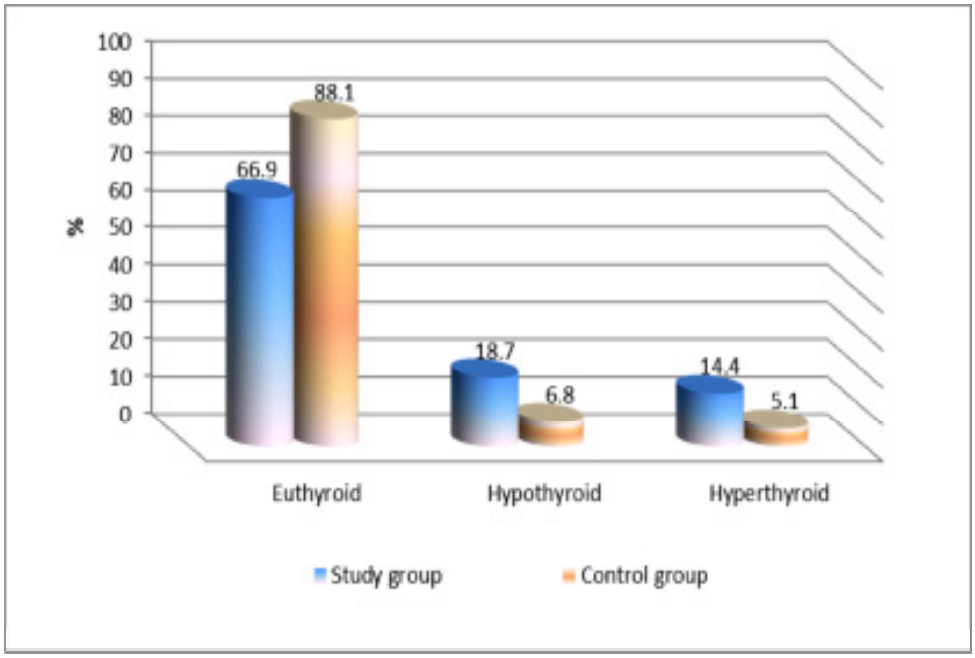

Fig 1: Distribution of the studied groups regarding final diagnosis of subclinical thyroid dysfunction (STD).

Figure (1) demonstrated that prevalence of STD which was 33.1% among group I versus 11.9% among group II.

Table (2): Distribution of the subclinical thyroid dysfunction (STD) and its associated factors among healthcare workers.

	Group I				χ^2 test	p value	Odds ratio (CI 95%)
	With STD (No =39)		Without STD (No =79)				
	No.	%	No.	%			
Age (years): Mean ±SD Range	7.92±36.61 27– 44		9.66±38.78 49–30		t-test = 1.21	0.226	___
Sex:							
Male	8	20.5	33	41.8	4.31	**0.037***	2.78 (1.13–6.81)
Female	31	79.5	46	58.2			
Residence:							
Urban	19	48.7	46	58.2	0.61	0.435	0.68 (0.32–1.47)
Rural	20	51.3	33	41.8			
Marital status:							
Unmarried	12	30.8	15	19.0	1.44	0.230	1.05 (0.88–2.54)
Married	27	69.2	64	81.0			
Smoking:							
Yes	6	15.4	3	3.8	4.98	**0.025***	4.61 (1.09–19.54)
NO	33	84.6	76	96.2			
Comorbidities ##:							
Yes	15	38.5	11	13.9	7.78	**0.005***	3.86 (1.56–9.57)
NO	24	61.5	68	86.1			
Family history of TD:							
Yes	10	25.6	9	11.4	2.94	0.086	2.69 (0.99–7.28)
NO	29	74.4	70	88.6			
Occupation:							
Physicians	23	59.0	32	40.5	2.87	0.091	2.11 (0.97 –4.61)
Nurses	16	41.0	47	59.5			
Working unit at hospital :							
Medical	18	46.2	34	43.0	0.11	0.751	1.13 (0.52 –2.45)
Surgical	21	53.8	45	57.0			
Years of experience:							
≤ 10 years	16	41.0	37	46.9			Reference
10– 20 years	11	28.2	25	31.6	1.21	0.547	1.02 (0.41 –2.55)
> 20 years	12	30.8	17	21.5			1.63 (0.64 –3.19)
Working hours:							
≤ 8 hours	5	12.8	24	30.4	4.34	**0.038***	2.97 (1.03 –8.51)
> 8 hours	34	87.2	55	69.6			

BMI (kg/m²):** Normal Overweight Obese	8 13 18	20.5 33.3 46.2	29 41 9	36.7 51.9 11.4	17.94	**0.002***	Reference 1.15 (0.82 –3.13) 7.25 (2.37 –22.21)
MAP (mmHg)#: Mean±SD Range	96.63±17.91 130.0–80.0		81.89±15.82 110.0–80.00		**t-test** = 4.56	**<** **0.001***	——

*: Statistically significant TD: thyroid disorder **: BMI: Body Mass Index # MAP: Mean arterial blood pressure **##:** like diabetes mellitus, cardiovascular and autoimmune diseases

Table (2) compared HCWs with STD and those without. Female gender, smoking, comorbidities, working >8 hours daily and obesity were statistically significantly higher among those with STD compared with others 79.5%, 15.4, 38.5, 87.2 and 46.2%, versus only 58.2, 3.8, 13.9, 69.6 and 11.4 of those without STD (p=0.037, 0.025, 0.005, 0.038 and 0.002; respectively). Also, workers with STD were statistically significantly higher MAP (96.63±17.91 mmHg) in comparison with those without STD (81.89±15.82 mmHg) (p <0.001)

Table (3): Binary logistic regression for predictors of subclinical thyroid dysfunction.

Variables	**p value**	**OR**	**95% CI**	
			Upper	**Lower**
Sex (Female)	**0.005***	3.25	1.75	8.91
Smoking (Yes)	**0.004***	3.12	3.09	3.47
Comorbidities (Yes)	**0.035***	1.36	1.07	2.91
Working hours (> 8 hours)	**0.042***	1.73	1.02	4.19
BMI (Obese)	**0.009***	2.68	1.39	4.07

*: Statistically significant OR: Odds Ratio CI: Confidence Interval BMI: Body Mass Index

Table (3) showed multiple regression which was done to analyze the effects of factors like female gender, smoking, associated comorbidities as diabetes mellitus and hypertension, working >8 hours daily and obesity and these factors were significantly affect likelihood to develop STD (p values are 0.005, 0.004, 0.035, 0.042 and 0.009; respectively).

Discussion

Subclinical thyroid disease (STD) is an early state of mild thyroid hormone abnormality (Razvi et al., 2010) comprises subclinical hypothyroidism, defined as elevated TSH with normal FT3 and FT4, and subclinical hyperthyroidism, with decreased TSH and normal FT3 and FT4 (Park et al., 2018).

The current study revealed that the prevalence of STD was 33.1% among HCWs versus 11.9% among controls with overall prevalence of 22.5% (Fig 1) which agreed with Ren et al., 2023 in their work on analysis of factors associated with abnormal thyroid function among medical staff in Shenyang, Liaoning Province in China, who reported that STD prevalence was about 30%. A higher prevalence of STD 49.76% was reported among adult Saudis in Saudi Arabia and the most prevalent type of STD was subclinical hypothyroidism which was 39.2% (Alqahtani, 2021).A much less STD prevalence was reported to be between 4 and 15% of the general population of adult age group (Ragusa et al., 2019) and 10% was reported at the primary care settings in another region in Saudi Arabia (Alhazmi et al., 2022).

Female gender, smoking, associated comorbidities as diabetes mellitus and hypertension, working >8 hours daily and obesity were statistically significantly higher among those with STD compared with the control group (Table 2). Also multiple regression was done to analyze the effects of factors like female gender, smoking, associated comorbidities as diabetes mellitus and hypertension, working >8 hours daily and obesity and showed that they were significantly affect likelihood to develop STD (Table 3).

These findings were supported by Pearce et al., 2013 who revealed that the incidence of thyroid dysfunction was more frequent in females with a peak age at 30–50 years and Peeters, 2017 also declared that a higher incidence STD associated with female sex and a suboptimal iodine status. In accordance with Park et al., 2018 from Korea who revealed that STD showed a higher prevalence in females (6% to 10%) approximately double the rate than males (2% to 4%) and reach up to 20% of females more than 60 years of age.

Alhazmi et al., 2022 in their study on the STD; reported the prevalence of this thyroid abnormalities was more common among females compared to males especially middle-aged by rate of 7%.

Female predominance suggesting that estrogen could be considered as a risk factor and also higher prevalence of autoimmune diseases in females in their reproductive age (about 5%) and associated adverse pregnancy outcomes. Thyroid autoimmunity is supported by Kim and Park, 2014 who found positive thyroperoxidase antibodies (TPO Ab) and thyroglobulin antibodies (Tg Ab) in their STD patients. Regarding postmenopausal age in females, the higher prevalence is attributed to hormone replacement therapy and elevated level of TSH and thyroid binding protein (Bremner et al., 2012; Chaker et al., 2018).

There was a significant association between smoking and STD among the studied HCWs (Table 2). Studies investigating the association between smoking and STD provided controversial relationship. Some studies agreed with the current study and showed that smoking is a risk factor for developing thyroid dysfunction and provided a strong evidence that regular cigarette smoking is associated with decreased level of TSH with increased TPO and Tg antibodies level (Wiersinga, 2013; Zhang et al., 2019). A study in Korea contradicted the current study by reporting no significant association between smoking and thyroid dysfunction as found that smoking is not associated with presence of TPO antibodies (TPOAb) (Park et al., 2018).

Among smokers, duration of smoking and daily smoking intake significantly affect TSH and TPOAb levels as their levels declined with increase in the years of smoking and daily smoking intake (Zhang et al., 2019).

Regarding associated comorbidities as autoimmune diseases, diabetes mellitus and hypertension which was reported in the current study (Table 2);this was supported by both Alzahrani et al., 2020 study done at Makkah city in Saudi Arabia who found that subclinical hypothyroidism and comorbidities as autoimmune thyroiditis (Hashimoto thyroiditis), thyroid malignancy, diabetes mellitus and psychiatric disorders among their patients and Elebrashy et al., 2016 from Egypt who found that thyroid dysfunction is more common among Egyptian females with type 2 diabetes compared to non-diabetic one which may be due to the role of autoimmunity in type 2 diabetes pathogenesis.

Also increased the risk of cardiovascular diseases in those with subclinical thyroid dysfunction may be due to the direct effect of thyroid

hormones on the cardiovascular system and decreasing vascular resistance and deficiency of these hormones increases the risk of several cardiovascular risk factors including hypertension, dyslipidemia and ischemic heart diseases (Chaker et al., 2015; Singh et al., 2024).

The current study revealed a significant association between increased workload and STD (Table 2). This was in agreement with the study conducted by Chen et al., 2017 from Taiwan which showed that STD was more frequent with those who had more work shifts. High work stress and night shifts cause disruption of the circadian rhythm which may lead to hormonal irregularities as increased TSH levels among HCWs as TSH secretion possess a circadian rhythmicity (Moon et al., 2016; Coppeta et al., 2020). In contrast to Attarchi et al., 2013 who found no significant association between TSH levels and shift work.

Increased BMI was a significantly associated with STD among the studied group (Table 2) which was consistent with Janota et al., 2023 who showed that obesity was a risk factor for STD. Adverse outcomes of subclinical hypothyroidism including hyperlipidemia which will be leveled-in this particular group due to the slowing of metabolic rate, energy expenditure and reduced sensitivity to adrenergic stimulation (Chaker et al., 2018).

Conclusion and Recommendations

STD was more prevalent among HCWs. Screening of all HCWs for STD by TSH testing and analysis of the work environment to assess all risk factors associated with this disorder is suggested. Repeating the screening of TSH should be done after 3 months in cases of subclinical hypothyroidism for diagnosis of overt hypothyroidism. Stress management and decreasing the workload along with providing psychological support are highly recommended.

Conflict of Interest

No conflict of interest was declared by the authors.

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