EAHRC
EAST AFRICAN HEALTH RESEARCH COMMISSION
Research for Health and Prosperity

ORIGINAL ARTICLE

Thyroid Dysfunction, Associated Factors and Glycaemic Control Among Patients with Diabetes Mellitus in a Tertiary Hospital

Elizabeth Msangi[a*], Fatma Muhali[b], Grace Shayo[a]

[a]School of Clinical Medicine, Department of Internal Medicine, Muhimbili University of Health and Allied Sciences, Dar es salaam, Tanzania; [b] Endocrinology Unit, Internal Medicine Department, Muhimbili National Hospital, Dar Es Salaam, Tanzania.

Correspondence to Elizabeth Msangi (lmsangi96@gmail.com)

ABSTRACT

Background: Diabetes mellitus and thyroid disorders are among the most common endocrine diseases. Thyroid dysfunction is more prevalent among diabetic patients than in the general population. These two disorders affect each other, making their management dependent on the control of both conditions. This study examined the prevalence of thyroid dysfunction, associated factors and glycaemic control among diabetic patients at Muhimbili National Hospital.

Methods: This cross-sectional study among diabetic outpatients was conducted from September to November 2021. Data was collected on sociodemographic, anthropometric and clinical characteristics. All patients underwent thyroid gland neck examination. Blood samples were drawn for random blood glucose (RBG), glycated haemoglobin (HbA1C), thyroid function tests [Triiodothyronine (T3), Tetraiodothyronine (T4) and Thyroid Stimulating Hormone (TSH)]. HbA1C ≥7% was defined as poor glycaemic control, while thyroid hormone levels outside the reference range were considered indicative of thyroid dysfunction.

Categorical variables were summarized as proportions, while continuous variables were summarized as means. Chi-square or Fischer's exact test was used to compare proportions in categorical variables. Logistic regression was used to analyse the predictors for thyroid dysfunction. The Akaike information model was used for analysis of the factors in the multivariate model where a p value of <.05 was considered statistically significant.

Results: A total of 403 diabetic patients were studied. Of these, 75.7% were overweight or obese. Thyroid dysfunction was present in 16/403 (3.97%) participants. Of the patients with thyroid dysfunction, 5/16 (31.25%) had hypothyroidism and 11/16 (68.75%) had hyperthyroidism, both being subclinical. Female sex was the only significant predictor of thyroid dysfunction in this study population [AOR 2.9 (1.01-8.3); p=.047]. Overall, 14/16 (87.5%) patients with thyroid dysfunction had a poor glycaemic control.

Conclusion: In this study conducted in Tanzania, thyroid dysfunction had a low prevalence among patients with diabetes mellitus, with females being at greater risk. Subclinical hyperthyroidism was more common than hypothyroidism. Poor glycaemic control was observed in approximately three quarters of the studied diabetic patients. Hypertension and overweight or obesity conditions were also common in the population studied. Future studies on thyroid dysfunction in diverse populations, including patients with type I diabetes mellitus, in sub-Saharan Africa are warranted.

BACKGROUND

Endocrinological non-communicable diseases are currently on the rise. Diabetes Mellitus (DM) and thyroid dysfunction (TD) are the two most common, with interactions that complicate their management.[1]

Globally, the prevalence of DM in 2019 was 9.3%, corresponding to 463 mil people, and this is estimated to rise to 10.3% by 2030 and 10.9% by 2045, corresponding to about 700 mil people affected. Urban areas have a higher prevalence of DM compared to rural areas (10.8% versus 7.2%) and high income countries compared to low income countries (10.4 versus 4%).[2] Overall, in Africa, the regional prevalence of diabetes was about 3.1% in 2019.[2] In a nationwide study on non-communicable diseases, STEPS survey of 2012, the prevalence of diabetes in Tanzania was found to be 9.1%.[3]

In areas of the world that are iodine sufficient, the prevalence of hyperthyroidism in the general population has been found to be between 0.2 to 1.3%, while that of hypothyroidism is noted to be higher in the iodine deficient areas. Thyroid dysfunction has not been extensively investigated in Africa, however, in the southern highlands of Tanzania, where iodine deficiency was estimated at 90%, hypothyroidism was found in half of all the studied school aged children.[4]

The magnitude of thyroid dysfunction is higher amongst individuals who have diabetes mellitus compared to the general population. This is important because the interaction between these disorders affects the management of each condition. In addition to iodine deficiency, various factors have been

implicated to causing thyroid dysfunction among diabetic and non-diabetic populations. Age, smoking, female sex, pregnancy, obesity, diabetes duration of >5 years and drugs such as beta-blockers and amiodarone have been found to affect the thyroid, leading to its dysfunction.[2,3,5-8]

Thyroid dysfunction, both hypothyroidism and hyperthyroidism, affects glucose control through several mechanisms that have been postulated. Hyperthyroidism tends to increase serum glucose levels by decreasing the half-life of circulating insulin and accelerating the absorption of glucose from the gastrointestinal tract.[7] Thyroid hormones stimulate the formation of Glucose Transporter (GLUT 2) receptors in the cell membranes of hepatocytes, hence increasing the release of glucose from the liver through hepatic gluconeogenesis, resulting in hyperglycaemia.[9] In a hypothyroid state, there is reduced hepatic glucose production, and patients tend to have decreased insulin requirements, leading to the occurrence of hypoglycaemic states.[10] Increased insulin resistance result in hyperinsulinemia, which stimulates the proliferation of thyroid tissue, leading to nodular goitre.[11] When thyroid dysfunction is treated, insulin or oral hypoglycaemic drug doses may need to be increased because of the increased requirements.

There are no published studies on the prevalence of thyroid dysfunction among patients with diabetes mellitus in Tanzania. This study therefore aimed to determine the prevalence of thyroid dysfunction, factors associated with it and its effect on glycaemic control among diabetic patients, thereby contributing to improved glycaemic control and overall patient outcomes.

MATERIALS AND METHODS

This study was a hospital-based cross-sectional study involving outpatient diabetic patients attending the diabetic clinic at Muhimbili National Hospital (MNH). MNH is the largest tertiary level hospital in Tanzania, situated in Dar es Salaam Tanzania. The diabetic clinic at MNH operates 3 days a week; Tuesdays, Wednesdays and Thursdays. The clinic receives about 50-70 patients in a day, both insured and non-insured. The clinic is run by 5 Endocrinologists and 3 nurses. Routine diabetic services such as fasting blood glucose (FBG), random blood glucose (RBG), vital signs assessment, weight and height measurements and medication refills are provided at each visit. Prior the onset of the study, ethical approval was obtained from the Muhimbili University of Health and Allied Sciences and Muhimbili National Hospital. Ethical clearance was granted under reference number MUHAS-REC-07-2021-765. Participants included diabetic patients aged 18 years and above who provided written informed consent before participating in the study. No minors were involved in the study. Participants were recruited consecutively from 06th September 2021 to 26th November 2021.

A structured Clinical Research Form (CRF) was used to collect socio-demographic and clinical data. Approximately 10 mls of venous blood was drawn by a laboratory technician from the anterior cubital vein for analysis. The ARCHITECT chemiluminescent magnetic microparticle analyser, model i1000SR (Abbott Diagnostics, Chennai India), was used for the analysis of thyroid function tests and glycosylated haemoglobin (HbA1C). Blood samples were centrifuged, and then the supernatant or serum was analysed for free triiodothyronine (fT3), free thyroxine (fT4) and thyroid-stimulating hormone (TSH).

Blood pressure was measured by a nurse using a standard digital sphygmomanometer (model RAK289, Shenzhen Technology Company, China). Participants were asked to remain seated with the left arm relaxed and supported on a table at chest level, with both feet placed on the floor. The midline of the inflatable cuff was positioned over the brachial artery. Two blood pressure measurements were taken 5 minutes apart, and the average value was recorded.

Participant's height and weight were measured by a nurse at the triage area of the diabetic clinic. The research assistant performed thyroid gland palpation to assess for thyroid enlargement.

A total of 403 patients were studied. The sample size was determined using a reported prevalence of 61% for thyroid dysfunction among outpatients with diabetes mellitus at Kenyatta National Hospital.[19] Being a cross-sectional study, Kelsey formular below was used for sample size calculation: $n=z^2p(100-p)/\mathcal{E}^2$

where z = 1.96, p = 61%, and the Margin of error ($\mathcal{E}$) = 5%.

$n=1.96^2 \times 61(100-61)/5^2$;

n=365, as the minimum sample size.

Main Study Outcomes

Thyroid Status

This was defined as follows:

Status	Laboratory Values	Interpretation
Normal	Normal TSH & fT4	Euthyroid
Hypothyroidism	Elevated TSH & Normal Ft4	Subclinical hypothyroidism
	Elevated TSH & Low Ft4	Overt hypothyroidism
	Decreased/Normal TSH & Decreased fT4	Secondary hypothyroidism
Hyperthyroidism	Decreased TSH & Elevated Ft4	Overt hyperthyroidism
	Decreased TSH & Normal Ft4	Subclinical hyperthyroidism

Thyroid stimulating hormone, TSH, Triiodothyronine Ft3 and free thyroxine/ Tetraiodothyronine Ft4

The reference values used were in the following ranges; Normal TSH was between 0.35 to 4.94mIu/L; Normal Triiodothyronine (fT3) was between 1.71 to 3.7 pg/mL and normal free thyroxine/ Tetraiodothyronine (fT4) was between 0.7 to 1.48 ng/Dl

Glycaemic Control

This was defined as good if glycosylated haemoglobin (HbA1C) was <7% and poor if HbA1C was ≥7%.[12]

Body Mass Index (BMI) was interpreted using recommendations set by the World Health Organization (WHO), that is; underweight (BMI of <18.5 kg/m^2), normal weight (BMI of 18.5 to 24.9 kg/m^2), overweight (BMI of 25 to 29.9 kg/m^2) and obese (BMI of >30 kg/m^2).[13]

The prevalence of thyroid dysfunction was calculated as the sum total of patients with hypothyroidism and hyperthyroidism divided by the total number of diabetic patients studied. Risk factors, clinical characteristics and laboratory investigations among diabetic patients with and without thyroid dysfunction were summarised using proportions and means for categorical and continuous variables, respectively. Categorical variables were compared using Chi- square test or Fischer's exact test, as appropriate. Logistic regression analysis was performed to determine predictors of thyroid dysfunction. The Akaike information criteria was used to select models in the multivariate analysis. A p value <.05 was considered statistically significant. Data was analysed using STATA version 15.

RESULTS

This study recruited 403 patients with diabetes mellitus. Two thirds of the participants were female, of whom 241/268 (90%) were postmenopausal. The mean (SD) age of the study participants was 61±11 years. Three quarters of all participants, 305/403 (75.7%), were either overweight or obese. The study also found that 316/403 (78.4%) of patients with diabetes mellitus were hypertensive as summarised in Table 1.

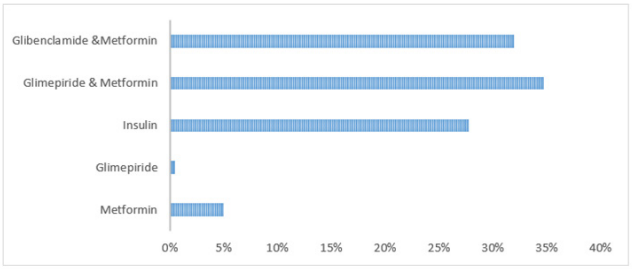
TABLE 1: Socio-demographic and Clinical Characteristics of the Study Population, N=403

Characteristic/Variable	Frequency, n (%)
Age in years, mean ±SD	61±11
<60	173(42.9)
≥60	230(57.1)
Sex	
Male	135(33.5)
Female	268(66.5)
LNMP (females)	
Pregnant	1(0.37)
Premenopausal	26(9.7)
Postmenopausal	241(89.9)
Marital status	
Single	19(4.71)
Cohabiting/married	269(61.8)
Widowed/divorced	135(33.5)
Education level	
≤Primary	188(46.7)
≥Secondary	215(53.3)
Duration of diabetes in years, mean ± SD	10±8
<5	144(35.7)
5-10	83(20.6)
>10	176(43.7)
Hypertension	
Yes	316(78.4)
No	87(21.6)
BMI, mean± SD	28.64±5.55
Underweight	8(2)
Normal	90(22.3)
Overweight	164(40.7)
Obese	141(35)
Smoking exposure	
Yes	92(22.8)
No	311(77.2)
HbA1C, mean ± SD	8.62 ± 2.36
<7	104(25.8)
≥7%	299(74.2)
TSH, mean±SD	1.65 ±1.57
fT3, mean±SD	3.43± 0.56
fT4, mean±SD	1.03 ± 0.35

Abbreviations: BMI, Body mass index; HbA1C, glycated hemoglobin TSH, Thyroid stimulating hormone, fT3, free triiodothyronine, fT4- free thyroxine

Regarding antidiabetic treatment, the most commonly prescribed regimen was glimepiride plus metformin, followed by glibenclamide plus metformin and insulin therapy. Only a small proportion of participants were receiving metformin alone or glimepiride alone (Figure 1).

FIGURE 1: Hypoglycemic Agents Used by the Study Population



Of the 403 diabetic patients studied, 16/403(3.97%) were found to have thyroid dysfunction. Of the patients with thyroid dysfunction, 5/16(31.25%) had hypothyroidism while 11/16(68.75%) had hyperthyroidism. No patient was found to have overt clinical thyroid dysfunction.

In the socio-demographic characteristics, there was no statistically significant difference between patients with thyroid dysfunction and those who were euthyroid. There was no statistically significant difference in the rate of thyroid dysfunction across age groups, sex, cigarette smoking status, BMI categories and Hypertension status. Thyroid dysfunction was present in 8/173 (4.6%) patients aged <60 years compared to 8/230 (3.5%) in those aged 60 years or older. It was found in 13/268 (4.9%) females compared to 3/135 (2.2%) males; 3/92 (3.3%) participants with exposure to cigarette smoking compared to 13/311 (4.2%) non-smokers; 5/144 (3.5%) patients with diabetes duration of less than five years compared to 10/176 (5.7%) among those with diabetes duration of more than 10 years; 2/90 (2.2%) participants with a normal body mass index compared to 7/164 (4.3%) overweight and 7/141 (5%) obese participants, as summarised in Table 2.

Only female sex significantly predicted thyroid dysfunction among diabetic patients, with approximately 3 times higher odds of thyroid dysfunction compared to males [OR 2.24(0.63-8.01)], and [AOR 2.9, (1.01-8.3); *P*=.047]. Increasing duration of diabetes mellitus diagnosis was associated with higher, although non-significant increased, odds of thyroid dysfunction [OR 1.67, (0.56-5.02); *P* =.36]. Diabetic patients who were not exposed to drugs known to impair thyroid function, such as beta blockers, had lower but non-significant odds of thyroid dysfunction compared to those exposed to such drugs [OR 0.92 (0.2-4.2); *P* =.92], as summarised in Table 3.

In this study, 14/16 (87.5%) of participants with thyroid dysfunction had poorly controlled diabetes mellitus with HbA1C levels of ≥7%, while 285/387 (73.6%) euthyroid participants had poor glycaemic control. These difference in proportions between participants with and without thyroid dysfunction was not statistically significant, *P*=.38.

TABLE 2: Socio-demographic Characteristics of the Patients as Related to Thyroid Function Status

Characteristic/ Variable	Total	Thyroid function status		*P Value*
		Normal	Abnormal	
Age(years)				.11
<60	173	165(95.4)	8(4.6)	
≥60	230	222(96.5)	8(3.5)	
Gender				.28*
Male	135	132(97.8)	3(2.2)	
Female	268	255(95.1)	13(4.9)	
Education level				.85*
≤Primary	188	181(96.3)	7(3.7)	
Secondary	138	133(96.4)	5(3.6)	
College/University	77	73(94.8)	4(5.2)	
Smoking exposure				.5*
Yes	92	89(96.7)	3(3.3)	
No	311	298(95.8)	13(4.2)	
Duration of Diabetes, years				.21*
<5	144	139(96.5)	5(3.5)	
5-10	83	82(98.8)	1(1.2)	
>10	176	166(94.3)	10(5.7)	
BMI				.7*
Underweight	8	8(100)	0	
Normal	90	88(97.8)	2(2.2)	
Overweight	164	157(95.7)	7(4.3)	
Obese	141	134(95)	7(5)	
Hypertension				1.0*
Yes	316	303(95.9)	13(4.1)	
No	87	84(96.6)	3(3.4)	

*NB: For the cells with counts less than 5, with an asterik *, Fischer's exact test was used instead of Chi Square test for ***p value*** estimation. BMI, Body Mass Index

TABLE 3: Predictors of Thyroid Dysfunction Among Patients with Diabetes Mellitus

Characteristic/ Variable	N (%)	COR (95%CI)	*P value*	AOR (95%CI)	*P value*
Age(years)					
<60	8(4.6)	1			
≥60	8(3.5)	0.9(0.5-2.6)	.42		
Gender					
Male	3(2.2)	1			
Female	13(4.9)	2.24(0.63-8.01)	.20	2.9(1.01-8.3)	.047

Continue

TABLE 3: Continued

Characteristic/ Variable	N (%)	COR (95%CI)	*P value*	AOR (95%CI)	*P value*
Smoking exposure					
No	13(4.2)	1			
Yes	3(3.3)	0.77(0.22-2.78)	.69		
Hypertension					
Yes	13(4.1)	1			
No	3(3.4)	0.83(0.23-3)	.78		
Duration of diabetes, years					
<5	5(3.5)	1			
5-10	1(1.2)	0.34(0.04-2.95)	.33		
>10	10(5.7)	1.67(0.56-5.02)	.36		
BMI					
18.5-24.9	2(2.2)	1			
25-29.9	7(4.3)	1.96(0.4-9.7)	.41		
≥30	7(5)	2.3(0.47-11.3)	.31		
HbA1C (%)					
<7%	2(2)	1			
≥7	14(4.9)	2.5(0.56-11.2)	.23		
Use of drugs known to cause thyroid dysfunction					
Yes	47(11.7)	1			
No	356(88.3)	0.92(0.2-4.2)	.92		

DISCUSSION

Due to absence of published studies on the prevalence of thyroid dysfunction among patients with diabetes mellitus in Tanzania, this study was conducted. In this study, the prevalence of thyroid dysfunction was 3.97% with hyperthyroidism prevailing more than hypothyroidism in the population of diabetic patients studied. The prevalence estimate was 3.97% (95CI: 2.1%-5.9%) based on a sample size of 403 participants. The relatively narrow confidence interval suggests that the study sample size provided acceptable precision around the observed prevalence estimate. Female sex was the most significant predictor of thyroid dysfunction. Majority of the study participants had a poor glycaemic control regardless of their thyroid function status.

The prevalence of thyroid dysfunction in this study was lower than that reported in other studies, which ranged from 9.9% to 61%.[2, 14, 15-18] The low prevalence of thyroid dysfunction observed in the present study could be due to differences in profile of autoimmune disorders or iodine deficiencies across various geographical regions. Hyperthyroidism was more prevalent than hypothyroidism among those with thyroid dysfunction, contrary to findings in other studies which found hypothyroidism to be more prevalent in the population of patients with diabetes mellitus.[15,19,20] In the context of our study population, thyroid dysfunction appears to have a relatively low prevalence, however, continued research is needed to evaluate future trends.

This study found that females had increased odds of having thyroid dysfunction compared to males. This finding is similar to those of other studies that demonstrated a higher prevalence of thyroid disorders among females.[3, 7, 13, 15, 18] These findings may be explained by the effects of oestrogen hormone on the thyroid gland. Oestrogen activates oestrogen receptors found on the thyroid follicles leading to their enlargement, eventually causing impaired thyroid hormone production. Oestrogen also stimulates the production of thyroxin binding globulins, causing an increase in the levels of bound thyroxin hormone, hence hypothyroidism. These are some of the reasons why there is a female predilection to thyroid disorders when compared to males.[21,22] Therefore, although thyroid dysfunction affects both sexes, clinicians should be aware of the increased risk among female patients.

In this study, majority of the diabetic patients had a poor glycaemic control. However, there was no significant difference in glycaemic control between participants with thyroid dysfunction and those who were euthyroid. These findings differ from those of previous studies which reported that patients with thyroid dysfunction had poorly controlled glycaemic targets compared to those who were euthyroid.[18,23] Chronic hyperglycaemia has been found to affect the hypothalamic pituitary axis by reducing the TSH response to thyrotropin releasing hormone (TRH), leading to lower TSH levels. Moreover, chronic hyperglycaemia causes impaired conversion of T4 to T3, the biologically active form of thyroid hormone, resulting in lower serum T3 levels.[9,11] Nevertheless, this study may not have had adequate power to detect differences in glycaemic control between the groups, therefore, additional research on this topic is warranted in our setting.

Study Limitations

This study assessed the prevalence of thyroid dysfunction and associated risk factors among diabetic patients in Tanzania. Since the study was conducted at a tertiary

hospital, the findings may not be generalizable to primary healthcare settings or rural Tanzanian populations, where patient characteristics, disease patterns, healthcare access, and diagnostic resources may differ. Patients attending tertiary facilities may also present with more severe disease. The Electrochemiluminescence Immunoassay Analyzer (ECLIA) is considered more sensitive than Chemiluminescent Micro-particle Immunoassay analyzer (CMIA) for the quantitative determination of TSH, fT4 and fT3 in human serum. Due to the unavailability of ECLIA, CMIA was used and therefore some cases of thyroid dysfunction may not have been identified/ detected. Pregnancy status was ascertained using the last normal menstrual period, and no urinary pregnancy test was done. BMI and hypertension were not adjusted for in the multivariate model even though they are strong confounders for both insulin resistance and thyroid function.

CONCLUSION

In this study conducted in Tanzania, thyroid dysfunction had a low prevalence among patients with diabetes mellitus, with females being at greater risk. Subclinical hyperthyroidism was more common compared to hypothyroidism. Poor glycaemic control was observed in approximately three quarters of the studied diabetic patients. Hypertension and overweight or obesity conditions were also common in the population studied. Future studies on thyroid dysfunction in diverse populations, including patients with type I diabetes mellitus, in sub-Saharan Africa are warranted.

REFERENCES

1. Jain G,Marwaha TS, Khurana A,Dhoat PS. Prevalence of Thyroid disorders in Patients of type 2 Diabetes Mellitus.Int J Med and Dent Sci 2013; 2(2) :153–61.
2. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract [Internet]. 2019;157:107843. Available from: https://doi.org/10.1016/j.diabres.2019.107843
3. Mary M et al. Tanzania Steps Surveys Report Natl Institute Med Res. 2013;1–154.
4. Ogbera, Anthonia & Kuku, Sonny. Epidemiology of thyroid diseases in Africa. Indian Journal of Endocrinology and Metabolism.(2011) 15. 82. Doi: 10.4103/2230-8210.83331.
5. Kavanagh S, Boparai P. Thyroid dysfunction and drug interactions. Pharm J. 2015;294(7865):598–600.
6. Tanyeri F, Alvur M, Yildizbas Z, Cengiz K. Evaluation of thyroid hormones and cortisol levels in patients with type II diabetes mellitus. Diabetes Res. 1992;21(3):51–7.
7. Hage M, Zantout MS, Azar ST. Thyroid Disorders and Diabetes Mellitus.J Thyroid Res.2011;2011:439463
8. Kjaergaard, A.D., Marouli, E., Papadopoulou, A. et al. Thyroid function, sex hormones and sexual function: a Mendelian randomization study.(2021) Eur J Epidemiol 36, 335–344 . https://doi.org/10.1007/s10654-021-00721-z9. Jameson JL, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscalzo J. Nervous System Dysfunction. Harrison's Princ Intern Med [Internet]. 2018;152. Available from: http://library1.nida.ac.th/termpaper6/sd/2554/19755.pdf
10. Kadiyala R, Peter R, Okosieme OE. Thyroid dysfunction in patients with diabetes: Clinical implications and screening strategies. Int J Clin Pract. 2010;64(8):1130–9.
11. Kalra S, Aggarwal S, Khandelwal D. Thyroid Dysfunction and Type 2 Diabetes Mellitus : Screening Strategies and Implications for Management. Diabetes Ther [Internet].2019;10(6):2035–44. Available from: https://doi.org/10.1007/s13300-019-00700-4
12. Care D, Suppl SS. Glycemic targets: Standards of medical care in diabetes–2021. Diabetes Care. 2021;44(January):S73–84.
13. Nuttall FQ. Body mass index: Obesity, BMI, and health: A critical review. Nutr Today. 2015;50(3):117–28.
14. Bremner AP, Feddema P, Leedman PJ, Brown SJ, Beilby JP, Lim EM, et al. Age-related changes In thyroid function: A longitudinal study of a community-based cohort. J Clin Endocrinol Metab. 2012;97(5):1554–62.
15. Al-geffari M, Ahmad NA, Al-sharqawi AH, Youssef AM, Alnaqeb D, Al-rubeaan K. Risk Factors for Thyroid Dysfunction among Type 2 Diabetic Patients in a Highly Diabetes Mellitus Prevalent Society. 2013;2013:1–7.
16. Ogbonna SU, Ezeani IU. Risk factors of thyroid dysfunction in patients with type 2 diabetes mellitus. Front Endocrinol (Lausanne). 2019;10(JULY):1–8.
17. S R. Thyroid Disorders and Diabetes Mellitus: Double Trouble. J Diabetes Res Ther (ISSN 2380-5544). 2016;2(1).
18. Elgazar EH, Esheba NE, Shalaby SA, Mohamed WF. Thyroid dysfunction prevalence and relation to glycemic control in patients with type 2 diabetes mellitus. Diabetes Metab Syndr Clin Res Rev [Internet]. 2019;13(4):2513–7. Available from: https://doi.org/10.1016/j.dsx.2019.07.020
19. Ngugi R. Prevalence of Thyroid Dysfunction in Ambulant Patients With Type 2 Diabetes Attending Diabetes Clinics At Kenyatta National Hospital: A Cross sectional study. MMED[Dissertation]. East Africa, Kenya: 2014;
20. Demitrost L, Ranabir S. Thyroid dysfunction in type 2 diabetes mellitus: A retrospective study. Indian J Endocrinol Metab. 2012;16(8):334.
21. Kokernot WH. Brief article. Vic Poet. 2005;43(1):99–108.
22. Chiovato L, Lapi P, Fiore E, Tonacchera M. Thyroid autoimmunity and female gender. J Endocrinol Invest. 1993 May;16(5):384–91.
23. Du W, Wang F, Zhao M, Zhang H, Zhang X, Zhao J, et al. Prevalence of thyroid disorders and associated risk factors with various glycemic status in North China. Biotechnol Biotechnol Equip [Internet]. 2019;33(1):1244–50. Available from: https://doi.org/10.1080/13102818.2019.1656106

Peer Reviewed

Acknowledgements: The authors sincerely thank all the study participants and the staff of endocrinology unit of Muhimbili National Hospital for taking part in this study.

Competing Interests: Authors declare no competing interest.

Funding: The study did not receive any funding.

Received: 23 May 2024 ; **Accepted:** 11 June 2026

Cite this article as Msangi E, Muhali F, Shayo G. Thyroid Dysfunction, Associated Factors and Glycaemic Control Among Patients with Diabetes Mellitus in a Tertiary Hospital. *East Afr Health Res J.* 2026;10(1):122-127. https://doi.org/10.24248/eahrj.v10i1.877