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(RESEARCH ARTICLE)

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Risk factors of ischemic heart disease among hypothyroid patients in Bangladesh

Rezwana I [1], Pathan M F [2], Amin F [3], Rahman M. A [4], Hasan M.M [5], Roy NC [6], Dutta M [7], Bhowmik GC [8], Roy H [9] and Barua S [10,*]

[1] *Dr. Israt Rezwana, Registrar, Department of Endocrinology, Sir Salimullah Medical College & Hospital, Dhaka.*
[2] *Prof. Dr. Md. Faruque Pathan, Director of BIRDEM Academy, Department of Endocrinology, Dhaka.*
[3] *Prof. Dr. Feroz Amin, Head of the Dept. Department of Endocrinology BIRDEM General Hospital, Dhaka.*
[4] *Dr. Md. Arifur Rahman, Registrar, Department of Gastroenterology, Dhaka Medical College Hospital,Dhaka*
[5] *Dr. Md. Mehdi Hasan, Assistant Registrar, Department of Cardiology, National Institute of Cardiovascular Diseases & Hospital, Dhaka.*
[6] *Dr. Nikhil Chandra Roy, Assistant Professor, Department of Gastroenterology, Bangladesh Medical College & Hospital, Dhaka.*
[7] *Dr. Mita Dutta, Medical Officer, Dept. of Endrocrinology, Bangabandhu Sheikh Mujib Medical University, Shahbagh, Dhaka.*
[8] *Dr. Goutom Chandra Bhowmik Assistant Registrar, Department of Cardiology, National Institute of Cardiovascular Diseases & Hospital, Dhaka.*
[9] *Dr. Haripada Roy, Junior Consultant, Department of Cardiology, Kotalipara Upzilla Health Complex, Kotalipara, Gopalgonj, Bangladesh.*
[10] *Dr Sushanta Barua, Assistant Registrar, Department of Cardiology, National Institute of Cardiovascular Diseases & Hospital, Dhaka.*

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Abstract

Background: Hypothyroidism in patients with cardiac diseases is associated with worse outcomes. However, this has not yet been adequately investigated in Bangladeshi people.

Objective: To find out the Risk Factors of Ischemic Heart Disease Patients Among Hypothyroid Patients

Materials and methods: This cross-sectional observational study, conducted at the Department of Endocrinology and Allied Medicine, BIRDEM General Hospital, recruited 90 consecutive patients with ischemic heart disease but no prior history of hypothyroidism. Serum levels of TSH, FT4, and anti-thyroid peroxidase (TPO) antibodies were measured using an automated analyzer with a chemiluminescent immunoassay method. Subclinical hypothyroidism (SCH) was defined as a TSH level between 4.12 mIU/L and 10 mIU/L, while overt hypothyroidism was defined as a TSH level above 10 mIU/L. We used chi-square tests, the independent sample t-test, One-way ANOVA, The significance level was set at $p < 0.05$.

Results: Of the 90 enrolled participants, 68 (75.6%) were euthyroid, 15 (16.7%) had subclinical hypothyroidism (SCH), and 7 (7.8%) had overt hypothyroidism. Of the patients with hypothyroidism, 7(31.8%) were anti-TPO antibody positive. Hypothyroidism was significantly more prevalent in females, non-smokers, obese individuals, those with HbA1c ≥ 10%, and patients with LVEF < 50%. In the hypothyroid group, mean ± SD systolic blood pressure, diastolic blood pressure, BMI, and HbA1c were also significantly higher. Although 95.5% of hypothyroid patients had dyslipidemia, there were no significant differences observed in specific lipid profiles between hypothyroid and euthyroid patients. Heart failure patients showed significantly more hypothyroidism and lower mean ± SD FT4

* Corresponding author: Barua S

compared to patients without heart failure. Interestingly, mean ± SD TSH was significantly lower in females and the hypothyroid group. Predictors for hypothyroidism in IHD patients were female gender, non-smoker, higher BMI, higher SBP, and HbA1c ≥10%. Among these, the strongest predictor was BMI with an odds ratio of 7.920.

Conclusion: This study highlights the association between hypothyroidism and IHD, particularly in patients with the identified risk factors. It emphasizes the importance of screening for thyroid function in IHD patients, especially those with the mentioned characteristics.

Keywords: Antithyroid peroxidase; Cardiovascular disease; Hypothyroidism; Ischemic heart disease; Left ventricular ejection fraction & non-communicable diseases

1. Introduction

Ischemic heart disease (IHD), also known as coronary artery disease (CAD) and atherosclerotic cardiovascular disease (ACD), is the leading global cause of death, disability and suffering[1]. It is acknowledged as a significant threat to sustainable development in the 21st century[2]. An increasing number of individuals with non-fatal IHD experience chronic disabilities and impaired quality of life[3].The primary culprit behind IHD is atherosclerosis, an inflammatory arterial disease linked to lipid deposition and metabolic alterations triggered by multiple risk factors in over 70% of susceptible individuals[4]. IHD manifests clinically as myocardial infarction and ischemic cardiomyopathy[1].Globally, IHD affects an estimated 126 million people, representing approximately 1.72% of the world's population. In 2017 alone, IHD caused nine million deaths[1]. The current prevalence rate of 1,655 per 100,000 population is projected to exceed 1,845 by 2030, with Eastern European countries experiencing the highest burden. Notably, individuals of South Asian descent have a substantially increased risk of CAD compared to most other ethnicities. Cultural and environmental factors unique to South Asian populations may influence the impact of genetic variations on CAD risk[5].Like other countries, Bangladesh is experiencing a shift in disease burden from communicable to non-communicable diseases (NCDs) [6]. A 2011 report by the Department of Public Health and Primary Care at the University of Cambridge highlighted that Bangladesh likely has the highest rates of cardiovascular disease (CVD) among South Asian nations yet receives the least research attention. In the global fight against CVD, Bangladesh remains a 'missing in action' country[7].Obesity, diabetes mellitus, hypertension, tobacco consumption, dyslipidemia, globalization are the leading risk factors of IHD[8]. Despite substantial progress in prevention and control, the etiology of CVD is not completely understood[9], as evidenced by failures of new treatments[10]. Moreover, men have substantially higher rates of ischemic heart disease (IHD) than women at the same level of established risk factors[9], generating the possibility of discovering new potentially modifiable risk factors [11]. The hypothalamic–pituitary-thyroid axis interacts with the hypothalamic–pituitary–gonadal axis [12]. In humans, both overt and subclinical thyroid dysfunction, especially the former, are associated with higher risk of CVD events [13, 14, 15]. As such, thyroid function might play a role in CVD[11] . Observationally, higher TSH, even within the normal range, is associated with higher risk of CVD events[16]. In some, but not all observational studies, hypothyroidism is associated with unhealthier lipids and glucose metabolism, such as an association of higher TSH with higher total cholesterol[17], higher low-density lipoprotein (LDL)-cholesterol[17], lower high-density lipoprotein (HDL)-cholesterol [18], and higher HbA1c, and of higher FT4 with lower LDL-cholesterol[19] , higher HDL-cholesterol[20], and lower fasting glucose[19]. Observationally, people who are TPOAb-positive have higher TSH and faster carotid intima media thickness (cIMT) progression [21]. A meta-analysis of cohort studies has shown that higher and lower TSH are both associated with higher risk of CVD events [22]. Subclinical hypothyroidism has been associated with increased incidence of atherosclerosis and myocardial infarction in several studies[23]. Some prospective studies also indicate that treatment of subclinical hypothyroidism, including groups with minimally elevated TSH levels, results in improvement in surrogate markers for ASCVD (Atherosclerotic cardiovascular disease) such as atherogenic lipids and carotid intima media thickness [24]. Presence of antithyroid peroxidase (TPO) antibody in subclinical hypothyroidism indicates heightened risk[25]. However, in another study, cardiovascular risk associated with subclinical hypothyroidism did not differ by TPO-Ab status[26].In our country (Bangladesh), there is paucity of information, especially in recent time regarding this association between overt and subclinical hypothyroidism and IHD. One study [27] has been conducted in the Department of Physiology, Dhaka Medical College, to see the thyroid hormone status in IHD. It showed that serum FT_3 and FT_4 were significantly lower and serum TSH was significantly higher in IHD patients than that of healthy subjects. Another study [28] was done at Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from November 2012 to April 2013 to see effect of hypothyroidism on the echocardiographic changes of the heart and also on the effect of therapy on the cardiac changes. They found lower left ventricular ejection fraction in hypothyroid group, which was significantly improve after treatment. However, the prevalence of hypothyroidism in IHD has not yet been investigated adequately in Bangladesh. As a result the burden of the problem is not that much addressed. So the current study is conducted to observe the risk factors of IHD among hypothyroidism in patient.

2. Material and Methods

This study employed a cross-sectional design to assess the risk factors for Ischemic Heart Disease (IHD) among hypothyroidism patients in Bangladesh. The research was conducted over two phases:

Phase 1: March 2018 to November 2019 **Phase 2:** March 2022 to March 2023

Setting: Department of Endocrinology and Metabolism and Allied Medicine Department, BIRDEM General Hospital, Shah Bagh, Dhaka.

2.1. Participants

2.1.1. Inclusion criteria

- Diagnosed and documented IHD (chronic coronary syndrome)
- No prior history of hypothyroidism
- Attending outpatient or inpatient departments at BIRDEM General Hospital

2.1.2. Exclusion criteria

- Pregnant women
- Women taking oral contraceptives
- Patients on medications affecting thyroid function (thyroid replacement, anti-thyroid drugs, Amiodarone, Corticosteroids, Lithium)
- Recent iodine contrast media exposure
- Severely ill patients (sepsis, predominant systemic disease)
- Acute coronary syndrome
- Other structural heart disease

2.2. Ethical Considerations

Formal ethical approval was obtained from the Institutional Review Board (IRB) of BIRDEM Academy.

2.3. Sample Size

A total of 90 patients were recruited based on the defined inclusion and exclusion criteria.

2.4. Data Collection

- **Sociodemographic and Clinical Data:** A structured questionnaire collected information on demographics, medical history, and current medications. Written informed consent was obtained before participation.
- **Anthropometric Measurements:** Height, weight, waist circumference, hip circumference, and waist-hip ratio were measured following standardized protocols. Body Mass Index (BMI) was calculated.
- **Blood Pressure Measurement:** Blood pressure was measured using a calibrated sphygmomanometer.
- **Laboratory Investigations:** Fasting blood samples were collected to measure TSH and FT4 levels. Anti-TPO antibodies were tested in patients diagnosed with overt or subclinical hypothyroidism. Assays were performed in BIRDEM Laboratory following standard protocols.

2.5. Data Management and Analysis

Data were collected using a pre-designed questionnaire and entered SPSS version 25. Descriptive statistics were used to summarize participant characteristics. Independent sample t-tests were employed to compare continuous variables between groups. One-way ANOVA tests were used for comparisons across more than two groups. Categorical data were analyzed using Chi-square tests or Fisher's exact tests, as appropriate. Binary logistic regression analysis was performed to identify independent predictors of hypothyroidism. Statistical significance was set at $p < 0.05$.

3. Results

A total of 90 responders with clinically manifest IHD, were analyzed in the present study to measure thyroid function test. The demographic characteristics of the study population are depicted in Table 1. Mean (±SD) age of the study population was 61.88±11.85 years. A good number 42.2 % (38/90) of participants were more than 65 years. It appears

that females were more dominant in the study than males. About 51.1% (46/90) of the participants were female. Table 2 represents the clinical condition of the studied patients. Mean (±SD) duration of patients experiencing IHD, HTN and DM was 6.82 ± 4.61 years, 9.44±5.60 years and 12.77±6.66 years respectively. 30 (33.3%) participants were ex-smoker, all of them were male. In addition to this, 22.2% study population had history of intervention for IHD, among them 75.0% had PCI. Family history of hypothyroidism was revealed in 10.0% participants. A good number of participants that is 61.1% was taking lipid lowering agent. On examination arrhythmia was found in only 1(1.1%) patient. Cutaneous marker of cardiovascular disease i.e. xanthelasma was present in 5(5.6%). Mean (±SD) systolic blood pressure and diastolic blood pressure was 127.44±14.63 mmHg and 76.22±9.34 mmHg. Anthropometric measurements of the participant's shows mean (±SD) BMI of studied population were 25.12±3.89 Kg/m^2, among them 47.8% were obese and 26.7% were overweight. 90.9% male participants had waist circumference >90 cm, whereas 100% female had waist circumference >80 cm. Mean (±SD) waist circumference and waist hip ratio was 102.82±7.41 cm and 0.97±0.05 respectively. The results of the participants' laboratory measurements are presented in Table 3. From the table, it appears that mean (±SD) TSH was 4.20 ± 6.31 mIU/L. Other than that, mean (±SD) FT4 in the studied patients was 13.96 ± 2.74 pmol/L. In addition, mean (±SD) fasting plasma glucose was 9.67±3.41 mmol/L, mean (±SD) HbA1C was 10.45 ± 2.79 % and 53.3% had HbA1C ≥10%. The lipid profile shows mean (±SD) serum cholesterol level among the studied patients was 156.30 ± 47.01 mg/dl, mean (±SD) HDL 30.53±8.89 mg/dl, mean (±SD) LDL 86.85±40.29 mg/dl and mean (±SD) TG 211.64±150.05 mg/dl. In echocardiography mean (±SD) LVEF was 50.24±9.46 % and 45.6% patients were suffering from mild to moderate LV dysfunction. Table 4 is the display of frequency of hypothyroidism in IHD patient. Here 22(24.4%) patient was detected to have hypothyroidism, among them 7.8 % had overt hypothyroidism and 16.7% had subclinical hypothyroidism. Figure 1 shows that among the hypothyroid group 31.8 % patient was anti TPO (thyroid peroxidase) antibody positive and 68.2% patient was anti TPO antibody negative. Table 5 shows in overt hypothyroid group more participants (42.9%) were anti TPO antibody positive in comparison to subclinical hypothyroid (26.7%) group, though the difference was not significant ($p>0.05$). The table 6 shows that gender, history of intervention for IHD, presence of heart failure was statistically different in stable angina and old MI group($p<0.05$). The table 7 shows that age, HbA1C and LVEF was statistically different in with or without heart failure groups ($p<0.05$). The above table-8 shows the thyroid function categories and mean (± SD) FT4 was statistically different in with and without HF groups ($p<0.05$). Table-9 shows no parameters were significantly different between types of heart failure ($p>0.05$). Table 11 shows that female gender, nonsmoker, obese, HbA1C≥ 10% and LVEF <50 % has significant p value (<0.05) and was associated with hypothyroidism. In hypothyroid group mean (±SD) SBP, DBP, BMI and HbA1C was also significantly ($p<0.05$) more. Table 12 shows that mean TSH was significantly ($p<0.05$) more in female gender and hypothyroid patients, on the other hand FT4 was significantly less in female gender and hypothyroid patient. Table 13 shows the Odds ratio of risk factors of hypothyroid individuals of studied population. It appears from the table that univariate binary logistic regression analysis was conducted to find out any association of hypothyroidism with patient's age, gender, smoking status, duration of IHD, family history of hypothyroidism, systolic blood pressure, diastolic blood pressure, BMI, HbA1C, Total cholesterol and LDL. A significant association was found for hypothyroidism of IHD patients with female gender, nonsmoker, obesity, higher SBP and HbA1C≥10 ($p<0.05$). Among them the strongest predictor of hypothyroidism was BMI with a odds ratio of 7.920.

Table 1 Demographic characteristics of the study population (n=90)

Variables	**Frequency (%)**
Age (years)	
≤35	2(2.2)
36-44	4(4.4)
45-54	14(15.6)
55-64	32(35.6)
≥65	38(42.2)
Mean ± SD	61.88±11.85
Gender	
Male	44 (48.9)
Female	46 (51.1)

Within parentheses are percentages over total.

Table 2 Clinical characteristics of the study population (n=90)

Variables	**Mean ± SD**	**Frequency (%)**
Duration of IHD (years)	6.82±4.61	
Duration of HTN (years)	9.44±5.60	
Duration of DM (years)	12.77±6.66	
Smoking status		
Never		60(66.7)
Ex smoker		30(33.3)
Current		0(0)
Family H/O hypothyroidism		
Absent		81(90.0)
Present		9(10.0)
H/O intervention for IHD		
Absent		70(77.8)
Present		20(22.2)
Type of Intervention		
CABG		5(25.0)
PCI		15(75.0)
H/O taking Anti lipid drug		
Yes		55(61.1)
No		35(38.9)
Arrhythmia		
Absent		89(98.9)
Present		1 (1.1)
Xanthelasma		
Absent		85(94.4)
Present		5(5.6)
BMI ($Kg/m^{2)}$	25.12±3.89	
Underweight(<18.4)		3(3.3)
Normal (18.5-22.9)		20(22.2)
Over weight (23-24.9)		24(26.7)
Obese (≥25)		43(47.8)
WC (cm)	102.82±7.41	
Male (> 90 cm)		40(90.9)
(<90 cm)		4(9.1)
Female (> 80 cm)		100(100.0)
(<80 cm)		0(0.0)

HC (cm)	104.61±7.43	
WHR	0.97± .05	
Systolic blood pressure (mmHg)	127.44±14.63	
Diastolic blood pressure (mmHg)	76.22±9.34	

Within parentheses are percentages over total; IHD= Ischemic heart disease, HTN=Hypertension, DM= Diabetes mellitus, CABG=Coronary artery bypass grafting, PCI=Per cutaneous coronary intervention, BMI=Body mass index, WC= Waist circumference, HC = Hip circumference, WHR= Waist hip ratio.

Table 3 Laboratory parameters of the study population (n=90)

Variables	**Mean ± SD Frequency (%)**
FPG (mmol/L) HbA1C (%) <10% ≥ 10%	9.67±3.41 10.45 ±2.79 2 (46.7) 48 (53.3)
TSH (mIU/L)	4.20±6.31
FT4 (pmol/L)	13.96±2.74
Total Cholesterol (mg/dl)	156.30±47.01
LDL (mg/dl)	86.85± 40.29
HDL (mg/dl)	30.53±8.89
TG (mg/dl)	211.64±150.05

Within parentheses are percentages over total; FPG=Fasting blood glucose, TSH= Thyroid stimulating hormone, FT4=Free T4, LDL =Low-density lipoprotein , HDL=High-density lipoprotein , TG=Triglyceride, LVEF= Left ventricular ejection fraction.

Table 4 Thyroid status in patients with IHD (n=90)

	Frequency	**Percentage (%)**
Total patients	90	100.0
Euthyroid[1]	68	75.6
Hypothyroid	22	24.4
Overt hypothyroid[2]	7	7.8
Subclinical hypothyroid[3]	15	16.7

[1]Euthyroid = TSH 0.45 – 4.12 mIU/L, [2]Overt hypothyroid= TSH> 10 mIU/L , [3]Subclinical hypothyroid= TSH> 4.12 – up to 10 mIU/L

3.1. Anti thyroid antibody in hypothyroid group (n=22)

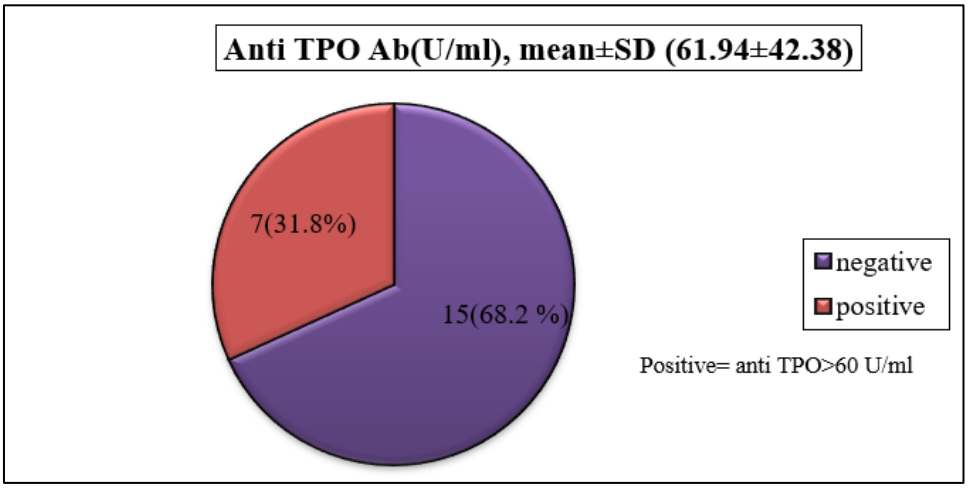

Figure 1 Distribution of hypothyroid patients according to Anti thyroid peroxidase antibody (n=22)

Table 5 Anti TPO antibody in subclinical and overt hypothyroidism (n=22)

Anti TPO antibody	Subclinical hypothyroidism Frequency (%)	Overt hypothyroidism Frequency (%)	p value
Negative	11(73.3)	4(57.1)	0.630[a]
Positive	4(26.7)	3(42.9)	
Mean ± SD(U/ml)	61.92± 46.49	61.99±35.25	0.945[b]

Within parentheses are percentage over total.

P value calculated by a= Fisher exact test and b=Mann - Whitney U test.

3.2. Type of IHD in study population(n=90)

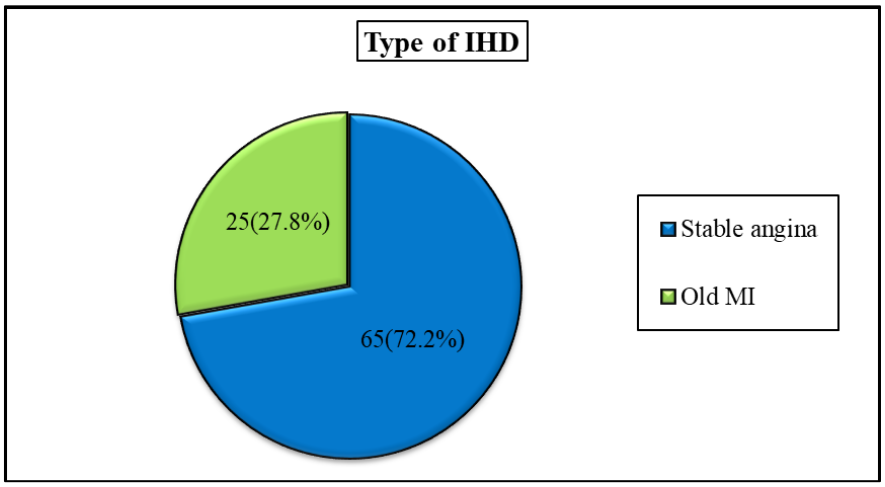

Figure 2 Distribution of the study participants according to the type of IHD (n=90)

The figure 2 is showing that 72.2% participants had stable angina and 27.8% had old MI (Myocardial infarction).

Table 6 Comparison of demographic, clinical and laboratory variables in different IHD groups (n=90)

Variables	Stable angina(n=65)	Old MI(n=25)	p value
	Frequency (%)	Frequency (%)	
Gender			
Male Female	26(40.0) 39(60.0)	18(72.0) 7(28.0)	**0.007**[a]
H/O intervention for IHD			
Absent Present	55(84.5) 10(15.4)	15(60.0) 10(40.0)	**0.012**[a]
Family H/O hypothyroidism			
Absent Present	59(90.8) 6(9.2)	22(88.0) 3(12.0)	0.704[b]
Presence of HF			
Yes No	11(16.9) 54(83.1)	14(56.0) 11(44.0)	**0.000**[a]
SBP(mmHg) Mean ± SD	128.69±14.03	124.20±15.92	0.312[c]
DBP(mmHg) Mean ± SD	76.77±9.57	74.80±8.71	0.400[c]
T cholesterol(mg/dl) Mean ± SD	156.27±49.25	156.36±41.56	0.725[c]
LDL(mg/dl) Mean ± SD	86.98±40.19	86.52±41.36	0.968[c]
HbA1C(%)			
<10 ≥10	32(49.2) 33(50.8)	10(40.0) 15(60.0)	0.432[a]

Within parentheses are percentages over total; HF=Heart failure, SBP=Systolic blood pressure, DBP=Diastolic blood pressure; p values were calculated by using a=chi square test, b=Fisher exact test ,

Table 7 Comparison of demographic, clinical and laboratory variables in with or without heart failure group (n=90)

Variables	**With HF(n=25)**	**WithoutHF(n=65)**	**p value**
	Frequency (%)	**Frequency (%)**	
Age (years)			
<65 ≥65	9(36.0) 16(64.0)	43(66.2) 22(33.8)	**0.009**[a]
Gender			
Male Female	13(52.0) 12(48.0)	31(47.7) 34(52.3)	0.714[a]

Family H/O hypothyroidism			
Absent Present	23(92.0) 2(8.0)	58(89.2) 7(10.8)	1.00[b]
SBP(mmHg) Mean ± SD	129.80±15.17	126.54±14.44	0.145[c]
DBP(mmHg) Mean ± SD	73.40±8.50	77.31±9.48	0.084[c]
T cholesterol(mg/dl) Mean ± SD	156.84±45.05	156.09±48.09	0.935[c]
LDL(mg/dl) Mean ± SD	85.72±45.18	87.29±38.61	0.742[c]
HbA1C(%)			
<10 ≥10	7(28.0) 18(72.0)	35(53.8) 30(46.2)	**0.028[a]**
LVEF(%)			
<50 ≥50	23(92.0) 2(8.0)	19(29.2) 45(70.8)	**0.000[a]**

Within parentheses are percentages over total; p values were calculated by using a=chi square test ,b=Fisher exact test , c= Mann- whitney U- test.

Table 8 Thyroid function categories, anti TPO Ab, FT4 and TSH level in with or without HF groups

Parameters	**With HF (n=25)**	**Without HF (n=65)**	**p value**
	Frequency (%)	**Frequency (%)**	
Thyroid function categories(n=90)			
Euthyroid Hypothyroid	13(52.0) 12(38.0)	55(84.6) 10(15.4)	**0.001[a]**
Anti TPO Ab(n=22)			
Positive Negative	5(41.7) 7(58.3)	2(20.0) 8(80.0)	0.381[b]
FT4 (pmol/L)	12.46±2.90	14.54±2.47	**0.001[c]**
(n=90) Mean ± SD			
TSH (mIU/L)	7.25±10.76	3.02±2.72	0.180[d]
(n=90) Mean ± SD			

Within parentheses are percentage over total; p values were calculated by using a= Chi square test, b=Fisher exact test,c= Independent sample t-test,

Table 9 Thyroid function test in different types of heart failure(n=25)

Types of HF	FT4(pmol/L) (mean±SD)	p value	TSH (mIU/L) (mean±SD)	p value
HFrEF	12.97±3.11	0.575[a]	5.62±9.12	0.141[b]
HFmrEF	11.75±2.92		6.18±8.66	
HFpEF	13.25±0.63		2.63±2.10	

HFrEF= Heart failure with reduced ejection fraction, HFmrEF = Heart failure with mildly reduced ejection fraction, HFpEF = Heart failure with preserved ejection fraction; P value was calculated by using a= One way ANOVA test, b= Kruskal wallis test.

Table 10 Comparison of clinical, biochemical characteristics and risk factors of studied patients between euthyroid and hypothyroid group (n=90)

Variables	Euthyroid(n=68) Frequency %	Hypothyroid(n=22) Frequency %	p value
Age (years)			
<65 ≥65 Mean±SD	40(58.8) 28(41.2) 61.69±11.30	12(54.5) 10(45.5) 62.45±13.69	0.724[a] 0.795[c]
Gender			
Male Female	39(57.4) 29(42.6)	5(22.7) 17(77.3)	**0.005[a]**
Smoking			
Never Ex smoker	40(58.8) 28(41.2)	20(90.9) 2(9.1)	**0.006[a]**
Hypertension			
Absent Present	12(17.6) 56(82.4)	1(4.5) 21(95.5)	0.174[b]
Dyslipidemia			
Absent Present	4(5.9) 64(94.1)	1(4.5) 21(95.5)	1.00[b]
Family H/O hypothyroidism			
Absent Present	63(92.6) 5(7.4)	18(81.8) 4(18.2)	0.214[b]
H/O intervention for IHD			
Absent Present	53(77.9) 15(22.1)	17(77.3) 5(22.7)	1.00[b]
Duration of IHD (yrs)			
Mean±SD	6.71±4.58	7.18±4.8	0.723[d]
H/O taking anti lipid drug			
Yes No	40(58.8) 28(41.2)	15(68.2) 7(31.8)	0.434[a]

Table 11 Comparison of clinical, biochemical characteristics and risk factors of studied patients between euthyroid and hypothyroid group (n=90) continued

Variables	Euthyroid(n=68) Frequency %	Hypothyroid(n=22) Frequency %	p value
SBP (mmHg) Mean±SD	125.66±15.3	132.95±10.76	**0.036[d]**
DBP (mmHg) Mean±SD	75.22±9.59	79.32±67.91	**0.020[d]**
BMI (Kg/m2)			
Overweight(23-24.9)	22(46.8)	2(10.0)	**0.004[a]**
Obese (>25)	25(53.2)	18(90.0)	
Mean±SD	24.67±4.09	26.59±2.72	**0.007[d]**
Waist circumference(cm) Mean±SD	101.74±7.42	106.18±6.63	0.081[d]
HbA1C (%)			
<10	37(54.4)	5(22.7)	**0.010[a]**
≥10	31(45.6)	17(77.3)	
Mean±SD	10.08±2.84	11.57±2.63	**0.029[c]**
LVEF (%)			
<50	25(36.8)	17(77.3)	**0.001[a]**
≥50	43(63.2)	5(22.7)	
Mean±SD	50.93±9.03	48.14±10.64	0.231[c]
Total Cholesterol(mg/dl) Mean±SD	151.95±46.2	169.72±47.85	0.166[d]
LDL (mg/dl) Mean±SD	83.29±38.62	97.86±44.18	0.127[d]

Within parentheses are percentages over total; p values were calculated by using a=chi square test ,b=Fisher exact test ,c= Independent sample t-test, d= Mann- whitney U- test.

Table 12 Comparison of FT4 and TSH level across different clinical and biochemical characteristics of study population

Variables	FT4 Mean ± SD	p	TSH Mean ± SD	P
Age (years)				
<65	13.83±2.59	.606[a]	3.52±3.31	0.613[b]
≥65	14.14±2.97		5.13±8.89	0.623[b]
Gender				
Male	14.53±2.13	**0.054[a]**	2.98±5.04	**0.007[b]**
Female	13.42±3.16		5.37±7.18	
H/O intervention for IHD				
Intervention	14.23±3.02	0.662[a]	6.38±11.36	0.473[b]

No intervention	13.89±2.68		3.58±3.75	
Type of intervention				
CABG	14.01±2.73	0.854[a]	2.28±1.15	0.349[b]
PCI	14.31±3.20		7.76±12.98	
BMI (Kg/m$^{2)}$				
Overweight (23-24.9)	14.27±2.38	0.110[a]	2.72 ±3.08	0.058[b]
Obese (>25)	13.14±2.91		5.95±8.48	
Anti TPO Ab				
Positive	10.13±2.26	0.166[a]	11.94±10.69	0.945[b]
Negative	11.77±2.57		10.77±9.97	
Thyroid status				
Hypothyroid	11.24±2.54	**0.000[a]**	11.14±9.96	**0.000[b]**
Euthyroid	14.84±2.18		1.95±0.92	

P values were calculated by using a= Independent sample t-test, b = Mann-whitney U-test).

Table 13 Factors influencing hypothyroidism in individuals with IHD (n=90)

Parameters	**OR**	**95% CI**		**p value**
		Lower	**Upper**	
Age (<65yrs vs ≥ 65 yrs)	0.840	0.319	2.212	0.724
Gender (female vs male)	0.219	0.072	0.662	**0.007**
Smoking (never vs ex smoker)	0.143	0.031	0.661	**0.013**
Duration of IHD(years)	1.023	0.992	1.134	0.673
Family H/O thyroid disease	0.357	0.087	1.471	0.154
BMI (overweight vs obese)	7.920	1.649	38.039	**0.010**
SBP(mmHg)	1.038	1.001	1.077	**0.046**
DBP(mmHg)	1.046	0.995	1.100	0.080
HbA1C (<10% vs ≥ 10 %)	4.058	1.343	12.258	**0.013**
T cholesterol(mg/dl)	1.008	.998	1.018	0.126
LDL(mg/dl)	1.009	0.997	1.021	0.144

OR= Odds ratio; p value was calculated by univariate logistic regression.

4. Discussion

This study investigated the link between hypothyroidism and IHD in Bangladeshi patients. The overall prevalence of hypothyroidism in IHD patients was 24.4%, with 16.7% having subclinical and 7.8% having overt hypothyroidism. This prevalence is higher than what's been reported in the general population of Bangladesh but aligns with findings in other IHD studies. Therefore, the screening of thyroid functions seems to be warranted in coronary patients of all age. In this study like previous study female hypothyroid patients outnumbered the male hypothyroid patient, the ratio being 3.4:1 and difference was statistically significant. One of the keys to diagnosing autoimmune hypothyroidism is determining the presence of elevated anti-thyroid antibody titers which include anti-thyroglobulin antibodies (TgAb) and anti-microsomal/thyroid peroxidase antibodies (TPOAb)[24]. According to Hallowell et al[29], only positive TPOAb tests were significantly associated with hypothyroidism. In a study done in BIRDEM general hospital out of 47 hypothyroid

patients, 32 (68%) patients were autoimmune positive, among autoimmune hypothyroid patients, 22% were positive for anti TPO antibody[6] . So present study analyzed only presence of TPOAb in hypothyroid group. In this study31.8% of hypothyroid patients had positive anti-TPO antibodies, indicating an autoimmune cause. Most participants, both hypothyroid and euthyroid, had abnormal lipid levels. However, hypothyroid patients had a higher mean total and LDL cholesterol, though many were taking lipid-lowering medications. Sharma *et al*[30]*. (* in their study at Eastern India found the corresponding values as 172.06 (± 27.5), 99.10 (± 27.43) in subclinical hypothyroid and 204.46±26.43 and 134.56±25.77 in overt hypothyroid group. It would be noteworthy that in that study patient getting statin therapy was excluded [30]. Hence, our study shows dissimilar findings as that of the previous study which may be explained by history of taking lipid lowering agent by 61.1% participants. For people at high CV risk, an LDL-C reduction of ≥50% from baseline and an LDL-C goal <1.8 mmol/L (<70 mg/dL) are recommended [31]. This study found that mean (±SD) LDL was more (97.86±44.18 mg/dl) in hypothyroid group in comparison to euthyroid group (83.29±38.62) though a higher number of hypothyroid patient in comparison to euthyroid patient (68.2 % vs 58.8%) patient was taking lipid-lowering agents. In present study it was also ascertained that participants with hypothyroidism had significantly more often uncontrolled diabetes mellitus. Average HbA1C was significantly greater in hypothyroid group than euthyroid group. According to Xu et al[32] (2019), the proportion of individuals with high glucose levels in the group of people with SCH was much higher than in controls. The risk of diabetes mellitus was likewise 2.29 times increased among people with SCH[32]. L-thyroxin substitution improved the ability of insulin to stimulate glucose disposal, beneficially influenced insulin resistance, the main pathophysiological mechanism of type 2 diabetes [33]. Increased insulin resistance in hypothyroid subjects may be the cause of poorly compensated diabetes as observed in the present study. A significant relationship between central obesity and SCH was found by[34] Santhoshakumari and Sneha (2019). In present study mean (±SD) waist hip ratio was 0.97±.05 indicating central obesity and mean (±SD) waist circumference in hypothyroid patient was 106.18±6.63 which is not significantly different from euthyroid patient, whereas mean (±SD) BMI in hypothyroid group was 26.59±2.72 kg/m^2 which is significantly more than euthyroid group (24.67±4.09 kg/m^2). A recent study conducted among confirmed CAD supported our findings partly as it reported no significant differences of BMI and waist circumferences among euthyroid and SCH individuals [35]. In this study, 95.5% hypothyroid patient had hypertension. We found mean (±SD) SBP was 132.95±10.76 mmHg and mean (±SD) DBP was 79.32±67.91 mmHg in hypothyroid individuals which is statistically different from euthyroid individuals ($p<0.05$). The hypothyroid population is characterized by significant volume changes, initiating a volume-dependent, low plasma renin activity mechanism of blood pressure elevation, especially diastolic blood pressure[36]. So, our finding relates to available literature in regard of DBP. Like other studies, non-smokers were more likely to be hypothyroid. Patients with lower LVEF (weaker heart function) were more likely to have hypothyroidism. Patients with heart failure had a higher prevalence of hypothyroidism. Binary logistic regression analysis in hypothyroid group was assessed. The predictors included age, smoking, gender, duration of IHD, family history of hypothyroidism, BMI, SBP, DBP, HbA1C, total cholesterol and LDL. A significant association was found for hypothyroidism of IHD patients with gender, smoking, BMI, SBP and HbA1C ($p<0.05$). Among them the strongest predictor of hypothyroidism was BMI (obese) with a odds ratio of 7.920 followed by HbA1C (≥10) with odds ratio 4.05. In a study statistically significant predictors of SCH in acute MI were increasing age, female sex, higher TPOAb levels, higher serum creatinine levels and the time of blood sampling [37].

5. Conclusion

This study highlights the association between hypothyroidism and IHD, particularly in patients with the identified risk factors. It emphasizes the importance of screening for thyroid function in IHD patients, especially those with the mentioned characteristics. The findings can be valuable for clinicians managing IHD and for public health initiatives to address both conditions in Bangladesh.

Compliance with ethical standards

Conflict of interest

There was no conflict of interest.

Statement of ethical approval

An appropriate statement of ethical approval was taken from BIRDEM academy.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study having option of withdraw at any point.

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