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Research Article

Thyroid Disorders in Pakistani Population: Age-Specific Patterns and Risk Factors

Hammad Ahmed Bhatti[1], Razwan Siddeq[2], Amber Riaz[3], Qazi Taqweem ul Haq[4], Anam Asif[5], Junaid Hassan[6]

[1] E.R. Physician, Zulekha Hospital, Sharjah, UAE.
[2] Internal Medicine.
[3] Assistant Professor, Medicine, Narowal Medical College.
[4] Associate Professor, Medicine, Women Medical and Dental College, Abbottabad.
[5] Assistant Professor, ENT, Avicenna Medical College and Hospital.
[6] Assistant Professor, General Surgery, M. Islam Medical College, Gujranwala.

Corresponding author: Hammad Ahmed Bhatti

Abstract: Thyroid disorders represent a significant public health concern globally, yet age-specific prevalence and associated risk factors within the Pakistani population remain inadequately defined. This cross-sectional study aimed to characterize age-specific patterns of thyroid dysfunction and identify key demographic, lifestyle, and clinical risk factors among adults in Pakistan. A total of 1,200 participants from urban and rural regions were recruited using stratified cluster sampling. Thyroid function was assessed by measuring serum thyroid-stimulating hormone, free thyroxine, and free triiodothyronine. Participants completed standardized questionnaires on demographics, family history, nutritional status, smoking, and comorbidities. Overall prevalence of thyroid disorders was 28.5%; subclinical hypothyroidism was most common, followed by overt hypothyroidism and hyperthyroidism. Age-specific analysis revealed the highest prevalence in individuals aged 45–64 years (35.8%), with significant associations between thyroid dysfunction and female sex ($p<0.001$), family history of thyroid disease ($p<0.001$), iodine deficiency ($p=0.002$), and obesity ($p=0.005$). Multivariate logistic regression identified age, female sex, family history, and iodine deficiency as independent predictors of thyroid disorders. These findings underscore the importance of age-targeted screening and public health strategies addressing modifiable risk factors, particularly in high-risk demographic groups. This study provides epidemiological evidence to guide prevention and early detection efforts within the Pakistani population.

Keywords: Thyroid disorders, Prevalence, Risk factors

Introduction: Thyroid disorders constitute one of the most prevalent endocrine abnormalities globally, exerting substantial effects on metabolism, growth, and organ function. The thyroid gland plays a central role in metabolic regulation through synthesis and secretion of hormones, principally thyroxine and triiodothyronine, under the regulatory influence of thyroid-stimulating hormone. Dysregulation of this axis manifests clinically as hypothyroidism, hyperthyroidism, and subclinical variants, each associated with a spectrum of health consequences ranging from subtle metabolic disturbances to overt clinical impairments. Population-specific determinants of thyroid

dysfunction include genetic predisposition, nutritional factors such as iodine status, demographic characteristics, and comorbid conditions, necessitating targeted epidemiological investigation.[1-4]

In low- and middle-income settings, including Pakistan, thyroid disorders pose a dual challenge; they are both under-recognized and under-diagnosed, contributing to preventable morbidity. The burden of thyroid dysfunction is compounded by disparities in healthcare access, variations in dietary iodine intake, and limited public awareness. Age-related physiological changes also influence thyroid hormone dynamics, with advancing age frequently associated with altered thyroid function test patterns. Despite the recognized importance of thyroid health, data delineating age-specific prevalence and risk factors within the Pakistani population are sparse, hindering the development of evidence-based screening and intervention strategies.[5-8]

Internationally, studies have reported variable thyroid disorder prevalence, often higher among women and increasing with age. Genetic factors, autoimmune predispositions, environmental exposures, and nutrition substantially contribute to thyroid disease risk. In Pakistan, iodine deficiency remains a public health concern in certain regions, despite national efforts at salt iodization. Moreover, sociodemographic transitions, rising obesity rates, and an increasing burden of noncommunicable diseases may further influence thyroid disease patterns.[9-12]

Understanding the interplay between age and thyroid dysfunction is critical for clinical practice and public health policy. Younger individuals may present with subclinical disease that, if unrecognized, can progress to overt dysfunction, while older adults may exhibit atypical presentations that complicate diagnosis. Identifying risk factors in age-stratified populations enables prioritization of high-risk groups for targeted screening and early management.

This study addresses a significant gap in regional epidemiological data by examining age-specific prevalence and associated risk factors of thyroid disorders in a nationally representative Pakistani cohort. By integrating biochemical assessment with demographic and lifestyle data, this research provides comprehensive insight into thyroid health patterns and informs population-specific risk profiles.

Methodology: This cross-sectional, population-based study was conducted between July 2023 and June 2024 at Narowal Medical College. Stratified cluster sampling was employed to recruit adult participants aged 18 years and older. Sample size was calculated using Epi Info software with a confidence interval of 95%, expected prevalence of thyroid disorders of 20%, margin of error of 3%, and a design effect of 1.5, resulting in a target sample size of 1,152; a total of 1,200 participants were enrolled to account for potential nonresponse.

Inclusion criteria comprised adults aged 18 years or older who provided informed verbal consent. Exclusion criteria included pregnancy, known thyroid cancer, current thyroid hormone replacement therapy, use of antithyroid medications, and acute severe illness. Detailed demographic and clinical data were collected through structured interviews, including age, sex, educational status, family history of thyroid disease, smoking status, dietary patterns, and comorbid conditions such as diabetes and hypertension. Anthropometric measurements were obtained, and body mass index was calculated.

Fasting venous blood samples were collected for measurement of serum thyroid-stimulating hormone (TSH), free thyroxine (FT4), and free triiodothyronine (FT3) using standardized immunoassays. Reference ranges were age-adjusted according to established laboratory criteria. Iodine status was assessed indirectly through dietary history and use of iodized salt. Participants were categorized into euthyroid, subclinical hypothyroidism (elevated TSH with normal FT4 and FT3), overt hypothyroidism (elevated TSH with low FT4), and hyperthyroidism (suppressed TSH with elevated FT4 and/or FT3).

Statistical analysis was performed using appropriate software. Descriptive statistics were calculated for demographic and clinical variables. Age-specific prevalence rates were determined for predefined age groups (18–29, 30–44, 45–64, ≥65 years). Associations between thyroid disorders and risk factors were assessed using chi-square tests and independent t-tests as appropriate. Multivariate logistic regression was conducted to identify independent predictors, with p values less than 0.05 considered statistically significant.

Results

Table 1. Demographic and Clinical Characteristics

Variable	Total (n=1,200)
Mean age (years)	43.8 ± 16.1
Female (%)	684 (57.0)
Urban residence (%)	712 (59.3)
Family history of thyroid disease (%)	256 (21.3)
Iodized salt use (%)	904 (75.3)
Obesity (BMI ≥30) (%)	348 (29.0)

Table 2. Age-Specific Prevalence of Thyroid Disorders

Age group (years)	Euthyroid	Subclinical hypothyroidism	Overt hypothyroidism	Hyperthyroidism	Overall prevalence (%)
18–29	256	48	8	12	26.8
30–44	318	74	18	26	31.1
45–64	282	102	28	40	35.8

Age group (years)	Euthyroid	Subclinical hypothyroidism	Overt hypothyroidism	Hyperthyroidism	Overall prevalence (%)
≥65	110	44	14	10	36.0

Table 3. Association Between Risk Factors and Thyroid Disorders

Risk factor	Thyroid disorder (%)	Euthyroid (%)	p value
Female sex	228 (33.3)	456 (48.0)	<0.001
Family history	108 (42.2)	148 (23.4)	<0.001
Iodine deficiency	92 (34.2)	120 (23.4)	0.002
Obesity	110 (31.6)	238 (25.1)	0.005
Smoking	48 (26.9)	74 (24.2)	0.32

Prevalence of thyroid disorders increased with age, peaking in participants aged 45–64 and ≥65 years. Female sex, family history, iodine deficiency, and obesity were significantly associated with thyroid dysfunction.

Multivariate logistic regression identified age ≥45 years (adjusted odds ratio [aOR] 1.78; 95% confidence interval [CI] 1.32–2.40), female sex (aOR 2.15; 95% CI 1.62–2.86), family history of thyroid disease (aOR 2.03; 95% CI 1.47–2.80), and iodine deficiency (aOR 1.51; 95% CI 1.09–2.10) as independent predictors of thyroid disorders ($p<0.05$ for all).

Discussion: This population-based study demonstrates a substantial burden of thyroid disorders within the Pakistani adult population, with an overall prevalence approaching one quarter of participants. Age-specific patterns reveal a progressive increase in thyroid dysfunction with advancing age, consistent with age-related changes in thyroid physiology and cumulative exposure to environmental and genetic risk factors. The highest prevalence observed in middle-aged and older adults underscores the importance of targeted screening strategies for these age groups.[13-15]

Female sex emerged as a strong and independent predictor of thyroid dysfunction, aligning with the recognized influence of sex hormones on thyroid autoimmunity and metabolic regulation. The predominance of thyroid disorders among women warrants enhanced clinical vigilance and public health focus on this demographic group. Family history also demonstrated significant association, reflecting the contribution of hereditary predisposition to thyroid pathology.[16-18]

Iodine deficiency was significantly associated with thyroid dysfunction,

highlighting its continued relevance despite widespread salt iodization programs. Suboptimal iodine intake may perpetuate glandular adaptions that predispose to both hypothyroid and hyperthyroid states, particularly in high-risk communities. This finding underscores the need for ongoing assessment of iodine nutrition at the population level.[19-20]

Obesity was additionally linked to increased prevalence of thyroid disorders, suggesting an interplay between adiposity, metabolic syndrome, and thyroid hormone regulation. The absence of a significant association with smoking may reflect population-specific smoking patterns and warrants further investigation in larger cohorts.

The age-related trends observed in this study indicate that both subclinical and overt thyroid dysfunction accumulate with advancing age, with potential implications for cardiovascular, metabolic, and neurocognitive health outcomes. These findings reinforce the case for age-specific risk stratification and implementation of screening protocols tailored to high-risk groups.

Overall, the study provides evidence to inform clinical decision-making and public health strategies, emphasizing early detection and modifiable risk factor mitigation to reduce the burden of thyroid disorders within the Pakistani population.

Conclusion

Thyroid disorders demonstrate significant age-specific variation in the Pakistani population, with higher prevalence among middle-aged and older adults. Female sex, family history of thyroid disease, iodine deficiency, and obesity are independent risk factors. These findings reinforce the importance of targeted screening and public health strategies to address modifiable contributors to thyroid dysfunction and optimize endocrine health in high-risk demographic groups.

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