Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 504-510 | ISSN:2251-6727

Study on Billewicz Clinical Scoring Index for Diagnosis of Patients with Symptoms of Hypothyroidism.

Dr Jubin Sajan[1*], Dr Premkumar Gunaseelan[2], Dr P Santhosh Kumar[3]

[1]Postgraduate Resident, Department of General Medicine, Aarupadai Veedu Medical College, Vinayaka Mission's Research Foundation (VMRF-DU), Puducherry, India (Corresponding author)

[2]Professor, Department of General Medicine, Aarupadai Veedu Medical College, Vinayaka Mission's Research Foundation (VMRF-DU), Puducherry, India

[3]Assistant Professor, Department of General Medicine, Aarupadai Veedu Medical College, Vinayaka Mission's Research Foundation (VMRF-DU), Puducherry, India

(Received: 16 September 2024 Revised: 11 October 2024 Accepted: 04 November 2024)

KEYWORDS
Billewicz Clinical Scoring Index, Hypothyroidism, Thyroid Dysfunction, Thyroid Function Test, Primary Care, Screening Tool

ABSTRACT:

Background: Thyroid disease encompasses a broad range of clinical manifestations. Thyroid Stimulating Hormone (TSH) testing is widely regarded as the most effective method for detecting thyroid dysfunction. In primary care settings where thyroid function tests are often unavailable, symptom-based scoring indexes (Wayne's index for hyperthyroidism and the Billewicz Clinical Scoring Index (BCSI) for hypothyroidism) can be valuable in predicting thyroid dysfunction, potentially reducing unnecessary testing. **Objective:** To evaluate the efficacy of the Billewicz Clinical Scoring Index in diagnosing hypothyroidism. **Methods:** This hospital-based, cross-sectional study involved 191 patients aged 18 years and older with symptoms suggestive of hypothyroidism, who attended the General Medicine outpatient department at Aarupadai Veedu Medical College and Hospital. Exclusion criteria included critically ill patients and those already receiving thyroid medication. Patients were evaluated using the BCSI, followed by thyroid function testing (Free T3, Free T4, and TSH). Data were analyzed using SPSS version 23.0. **Results:** The BCSI predicted hypothyroidism in 43.45% of patients, subclinical hypothyroidism in 22.5%, and normal thyroid function in 34%. Laboratory results confirmed hypothyroidism in 30.4% of patients, subclinical hypothyroidism in 44.0%, and euthyroid status in 25.7%. There was significant concordance between BCSI predictions and laboratory findings, with 69.8% of BCSI-predicted hypothyroid cases confirmed by laboratory tests, while 31.32% were identified as subclinical hypothyroidism. Among patients predicted to be euthyroid by BCSI, 1.53% were found to have hypothyroidism and 23.07% had subclinical hypothyroidism. The BCSI demonstrated a sensitivity of 98.3%, specificity of 80.5%, positive predictive value of 68.7%, negative predictive value of 99.1%, and an overall accuracy of 85.9%. **Conclusion:** The Billewicz Clinical Scoring Index is a reliable, cost-effective tool for the preliminary assessment of hypothyroidism in primary care settings. Its strong concordance with laboratory diagnostics underscores its utility in screening and guiding further diagnostic and management decisions.

Introduction

Thyroid dysfunction encompasses a spectrum of clinical presentations, with hypothyroidism being a particularly prevalent endocrine disorder characterized by inadequate thyroid hormone production. Thyroid Stimulating Hormone (TSH) testing is widely acknowledged as the most definitive method for detecting thyroid dysfunction. However, a comprehensive evaluation that includes TSH, Free T3, and Free T4 measurements offers a more detailed assessment of the disease's severity and progression.(1)

While laboratory-based biochemical tests remain the gold standard for thyroid function assessment, clinical symptom-based scoring systems, such as Wayne's Index for hyperthyroidism and the Billewicz Clinical Scoring Index (BCSI) for hypothyroidism, have traditionally been used to evaluate thyroid health. These scoring methods are especially useful in environments where laboratory testing may not be readily available or feasible.(2, 3)

In primary care settings, particularly in resource-limited environments, access to thyroid function tests can be

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 504-510 | ISSN:2251-6727

limited due to financial or logistical constraints. In these situations, clinical scoring tools become invaluable for predicting thyroid dysfunction,(4) providing an alternative means of assessment.(5) The Billewicz Clinical Scoring Index (BCSI) was developed as a systematic method for diagnosing hypothyroidism by evaluating specific clinical symptoms and physical signs. The scoring system assigns a range from +67 to -47, with scores of +25 or higher indicating hypothyroidism, and scores of -30 or below ruling out the disease.(6) By systematically assessing symptoms, the BCSI facilitates a structured approach to evaluating thyroid function when biochemical testing is not accessible.(7, 8)

Evaluating the efficacy of the BCSI in diagnosing hypothyroidism is essential, as it could help reduce the overuse of costly thyroid function tests by providing an accurate preliminary assessment tool. Such an approach is particularly advantageous in primary care and low-resource settings, where it enables more efficient allocation of testing resources and offers a reliable method for guiding further diagnostic and treatment decisions.(7, 9)

The primary aim of this study is to assess the efficacy of the Billewicz Clinical Scoring Index (BCSI) in diagnosing hypothyroidism among patients presenting with symptoms indicative of thyroid dysfunction. The specific objectives are to evaluate thyroid function in these patients using the BCSI and to correlate the findings with laboratory-based thyroid function tests, including Free T3, Free T4, and TSH levels.

Materials and Methods

This hospital-based, cross-sectional study was conducted at Aarupadai Veedu Medical College and Hospital, a tertiary care facility serving a broad and diverse patient population. The primary objective was to assess the diagnostic accuracy of the Billewicz Clinical Scoring Index (BCSI) for hypothyroidism. Eligible participants included male and female patients aged 18 years and older who attended the General Medicine outpatient department with symptoms indicative of hypothyroidism. Patients who were critically ill or already receiving thyroid medication were excluded from the study to ensure that the sample was representative of untreated cases.

A sample size of 191 patients was determined based on an anticipated hypothyroidism prevalence of 41%, with a relative precision of 17% and a 5% significance level, using the formula ($N = Z^2 p(1 - p) / (pd^2)$). A consecutive sampling method was used to recruit eligible participants until the target sample size was reached. Each patient presenting with symptoms of hypothyroidism was initially evaluated using the Billewicz Clinical Symptom Scoring Index, which assigns scores to a range of clinical signs and symptoms commonly associated with hypothyroidism. Following this preliminary clinical assessment, thyroid function tests (Free T3, Free T4, and TSH) were performed to verify the thyroid status of each patient, as these tests are considered the most reliable for screening primary thyroid dysfunction in outpatient settings.(10) Details of the BCSI, including the specific symptoms, signs, and scoring system, are provided in Table 1.(2)

A comprehensive history was recorded for each participant using a structured proforma, capturing demographic data, clinical symptoms, and physical findings. Subsequently, BCSI scores were compared to thyroid function test results to evaluate the correlation and the accuracy of the scoring index in diagnosing hypothyroidism.(11) A p-value threshold of less than 0.05 was set to define statistical significance. Independent variables in this study included age, sex, and clinical signs and symptoms of thyroid dysfunction, while the outcome variables were Free T3, Free T4, and TSH levels. To control potential confounding, variables such as smoking status, alcohol consumption, and use of medications like statins and glucocorticoids were considered.

Statistical Analysis: Data were meticulously entered into an Excel spreadsheet and analyzed using SPSS version 23.0. Descriptive statistics—including mean, standard deviation, frequency, and percentage—were used to summarize demographic and clinical data. The chi-square test was employed to evaluate categorical variables. To assess the diagnostic performance of the BCSI, diagnostic metrics such as sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy were calculated. Statistical significance was established at a p-value of less than 0.05, indicating meaningful associations between BCSI and laboratory results.

Results

The study included a total of 191 patients who met the eligibility criteria. The participants had a mean age of 40.1 ± 13.4 years, with the majority being female (84.8%). The distribution of comorbid conditions among the participants was as follows: diabetes (23.6%),

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 504-510 | ISSN:2251-6727

coronary artery disease (6.8%), hypertension (19.4%), smoking (6.3%), and alcohol consumption (8.9%). Using the Billewicz Clinical Scoring Index, all participants were evaluated based on specific symptoms and signs associated with hypothyroidism as shown in Table 2. According to the BCSI, hypothyroidism was predicted in 43.45% of participants, subclinical hypothyroidism in 22.5%, and normal thyroid function in 34%, as shown in Figure 1. The average thyroid hormone levels across the study population, based on the thyroid profile values, are presented in Table 3. Based on laboratory thyroid profiles, hypothyroidism was detected in 30.4% of patients, subclinical hypothyroidism in 44%, and euthyroid status in 25.7%, as shown in Figure 1.

A contingency table illustrates the relationship between blood TSH levels and Billewicz Clinical Scores, categorized into Normal, Subclinical, and Hypothyroid groups. The rows represent clinical score categories, while the columns reflect TSH level categories. Among individuals with normal Billewicz scores, 49 exhibited normal TSH levels, 15 had subclinical TSH levels, and 1 had hypothyroid TSH levels, totaling 65 individuals. In the subclinical score category, all 43 individuals had subclinical TSH levels, with no cases of normal or hypothyroid TSH levels observed. The hypothyroid score group consisted of 83 individuals, of whom 26 had subclinical TSH levels and 57 had hypothyroid TSH levels, with none showing normal TSH levels. The chi-square (χ^2) value for the table was 42.0 with 3 degrees of freedom, and the p-value was less than 0.001, indicating a statistically significant association between Billewicz Clinical Scores and TSH levels. This significant correlation suggests that the Billewicz Clinical Scores accurately reflect thyroid status as determined by TSH levels, with distinct distributions of TSH across different clinical score categories.

The diagnostic performance of the BCSI revealed a sensitivity of 98.3%, specificity of 80.5%, positive predictive value (PPV) of 68.7%, negative predictive value (NPV) of 99.1%, and an overall diagnostic accuracy for hypothyroidism of 85.9%.

Discussion

The Billewicz Clinical Scoring Index (BCSI) is a structured, systematic tool developed specifically for the clinical evaluation of hypothyroidism. Created in 1969 by Billewicz and colleagues, the BCSI was originally intended to quantify hypothyroid symptoms, facilitating diagnosis at a time when biochemical testing was less advanced and widely unavailable. Despite considerable progress in laboratory testing, including sensitive assays for Thyroid Stimulating Hormone (TSH), Free T3, and Free T4, the BCSI remains useful in certain clinical scenarios, particularly as a supportive or alternative assessment method.(12, 13) It is especially valuable in resource-constrained environments or when patients present with subtle or borderline hypothyroid symptoms that may not be immediately discernible through laboratory testing alone.

Hypothyroidism often presents vague, nonspecific symptoms, making symptom-based diagnosis challenging. The BCSI addresses this by incorporating a variety of clinical signs and symptoms, such as fatigue, weight gain, cold intolerance, dry skin, and voice changes. By scoring these symptoms, the BCSI provides a comprehensive clinical overview, enabling more informed decision-making when immediate access to laboratory testing is unavailable.(14, 15)

In this study, the BCSI was employed to assess thyroid function, predicting hypothyroidism in 43.45% of patients, subclinical hypothyroidism in 22.5%, and normal thyroid function in 34%. Laboratory testing later confirmed hypothyroidism in 30.4% of patients, subclinical hypothyroidism in 44.0%, and a euthyroid state in 25.7%. Notably, there was a high level of concordance between the BCSI predictions and laboratory findings. Among patients identified by BCSI as hypothyroid, 69.87% were confirmed by lab tests, with 31.32% diagnosed with subclinical hypothyroidism. Only 1.53% of patients predicted to be euthyroid by the BCSI had hypothyroidism, while 23.07% had subclinical hypothyroidism.(16, 17)

The diagnostic performance of the BCSI in this study indicated a sensitivity of 98.3%, specificity of 80.5%, positive predictive value of 68.7%, negative predictive value of 99.1%, and an overall diagnostic accuracy of 85.9%. These metrics highlight the BCSI as a reliable initial assessment tool for hypothyroidism, demonstrating significant agreement with laboratory diagnostics. Such concordance underscores the BCSI's role as a cost-effective, non-invasive tool that can support clinical decision-making by guiding the need for additional laboratory testing and shaping subsequent management strategies.(18, 19)

Implementing the BCSI in primary care settings offers a valuable approach to assessing thyroid function based on clinical symptoms, enhancing clinical decision-making without relying solely on laboratory tests. This can

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 504-510 | ISSN:2251-6727

mitigate the overuse of thyroid function testing, which can be costly and, in some cases, unavailable in low-resource settings. By identifying patients at higher risk of thyroid dysfunction, the BCSI facilitates targeted testing and focused treatment planning, contributing to improved patient outcomes while conserving healthcare resources.

Conclusion

The study assessed the effectiveness of the Billewicz Clinical Scoring Index (BCSI) in diagnosing hypothyroidism among 191 patients, with a notable predominance of female participants (84.8%). The BCSI predicted hypothyroidism in 43.45% of the patients, subclinical hypothyroidism in 22.5%, and normal thyroid function in 34%. Laboratory thyroid profiles subsequently confirmed hypothyroidism in 30.4% of patients, subclinical hypothyroidism in 44.0%, and a euthyroid state in 25.7%.

A significant concordance was observed between BCSI predictions and laboratory results. Among those predicted by the BCSI to be hypothyroid, 69.87% were confirmed by laboratory testing, while an additional 31.32% were found to have subclinical hypothyroidism. Conversely, only 1.53% of patients predicted to be euthyroid by the BCSI had hypothyroidism, and 23.07% had subclinical hypothyroidism.

These findings suggest that the Billewicz Clinical Scoring Index is a reliable tool for the preliminary assessment of hypothyroidism, demonstrating substantial agreement with laboratory diagnostics and effectively distinguishing between clinical and subclinical hypothyroidism.(20) This concordance underscores the BCSI's utility in the clinical setting as a cost-effective and non-invasive screening tool that can guide further laboratory evaluation and inform subsequent management decisions.

References

1. Sheehan MT. Biochemical Testing of the Thyroid: TSH is the Best and, Oftentimes, Only Test Needed - A Review for Primary Care. Clin Med Res. 2016;14(2):83-92.
2. Kalra S, Khandelwal SK, Goyal A. Clinical scoring scales in thyroidology: A compendium. Indian J Endocrinol Metab. 2011;15(Suppl 2):S89-94.
3. Fatourechi V. Subclinical hypothyroidism: an update for primary care physicians. Mayo Clin Proc. 2009;84(1):65-71.
4. Elendu C, Amaechi DC, Amaechi EC, Chima-Ogbuiyi NL, Afuh RN, Arrey Agbor DB, et al. Diagnostic criteria and scoring systems for thyroid storm: An evaluation of their utility - comparative review. Medicine (Baltimore). 2024;103(13):e37396.
5. Chaganti R, Rustam F, De La Torre Díez I, Mazón JLV, Rodríguez CL, Ashraf I. Thyroid Disease Prediction Using Selective Features and Machine Learning Techniques. Cancers (Basel). 2022;14(16).
6. Seshadri MS, Samuel BU, Kanagasabapathy AS, Cherian AM. Clinical scoring system for hypothyroidism: is it useful? J Gen Intern Med. 1989;4(6):490-2.
7. Zulewski H, Müller B, Exer P, Miserez AR, Staub JJ. Estimation of tissue hypothyroidism by a new clinical score: evaluation of patients with various grades of hypothyroidism and controls. J Clin Endocrinol Metab. 1997;82(3):771-6.
8. Billewicz W, Chapman R, Crooks J, Day M, Gossage J, Wayne SE, et al. Statistical methods applied to the diagnosis of hypothyroldism. QJM: An International Journal of Medicine. 1969;38(2):255-66.
9. Roti E, Minelli R, Gardini E, Braverman LE. The use and misuse of thyroid hormone. Endocr Rev. 1993;14(4):401-23.
10. Garber JR, Cobin RH, Gharib H, Hennessey JV, Klein I, Mechanick JI, et al. Clinical practice guidelines for hypothyroidism in adults: cosponsored by the American Association of Clinical Endocrinologists and the American Thyroid Association. Endocr Pract. 2012;18(6):988-1028.
11. Mutalazimah M, Mulyono B, Murti B, Azwar S, Kurnia P. Comparison of Thyroid Dysfunction Questionnaire (TDQ) and Previous Thyroid Dysfunction Instruments. Advanced Science Letters. 2018;24:116-20.
12. Nazarpour S, Ramezani Tehrani F, Rahmati M, Minooee S, Simbar M, Noroozzadeh M, et al. Validation of Billewicz Scoring System for Detection of Overt Hypothyroidism During Pregnancy. Int J Endocrinol Metab. 2018;16(3):e64249.

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 504-510 | ISSN:2251-6727

13. Stockigt J. Assessment of thyroid function: towards an integrated laboratory--clinical approach. Clin Biochem Rev. 2003;24(4):109-22.

14. Vanderpump MP, Tunbridge WM, French JM, Appleton D, Bates D, Clark F, et al. The incidence of thyroid disorders in the community: a twenty-year follow-up of the Whickham Survey. Clin Endocrinol (Oxf). 1995;43(1):55-68.

15. Aoki Y, Belin RM, Clickner R, Jeffries R, Phillips L, Mahaffey KR. Serum TSH and total T4 in the United States population and their association with participant characteristics: National Health and Nutrition Examination Survey (NHANES 1999-2002). Thyroid. 2007;17(12):1211-23.

16. Tunbridge WM, Evered DC, Hall R, Appleton D, Brewis M, Clark F, et al. The spectrum of thyroid disease in a community: the Whickham survey. Clin Endocrinol (Oxf). 1977;7(6):481-93.

17. Canaris GJ, Manowitz NR, Mayor G, Ridgway EC. The Colorado thyroid disease prevalence study. Arch Intern Med. 2000;160(4):526-34.

18. Hussain Z, Rao S, Jabamalai F. Thyroid symptom scoring index: an auxiliary guide to thyroid function tests: a prospective comparative study from a general hospital in South India. International Surgery Journal. 2019;6:4476.

19. Danese MD, Powe NR, Sawin CT, Ladenson PW. Screening for mild thyroid failure at the periodic health examination: a decision and cost-effectiveness analysis. Jama. 1996;276(4):285-92.

20. Brenta G, Vaisman M, Sgarbi JA, Bergoglio LM, Andrada NCd, Bravo PP, et al. Clinical practice guidelines for the management of hypothyroidism. Arquivos Brasileiros de Endocrinologia & Metabologia. 2013;57:265-91.

Table 1: Billewicz diagnostic index for hypothyroidism

SYMPTOMS	**PRESENT**	**ABSENT**
Diminished sweating	+6	-2
Dry skin	+3	-6
Cold intolerance	+4	-5
Weight increase	+1	-1
Constipation	+2	-1
Hoarseness	+5	-4
Deafness	+2	0
SIGNS	**PRESENT**	**ABSENT**
Slow movements	+11	-3
Coarse skin	+7	-7
Cold skin	+3	-2
Periorbital puffiness	+4	-6
Pulse rate	+4	-4
Ankle jerk	+15	-6

Table 2: Symptoms according to Billewicz index

Symptom	**Absent (n)**	**Absent (%)**	**Present (n)**	**Present (%)**
Weight gain	124	65	67	35
Slow movements	143	75	48	25
Coarse skin	105	55	86	45
Cold intolerance	86	45	105	55
Constipation	134	70	57	30
Hoarseness of voice	153	80	38	20
Hair loss	115	60	76	40

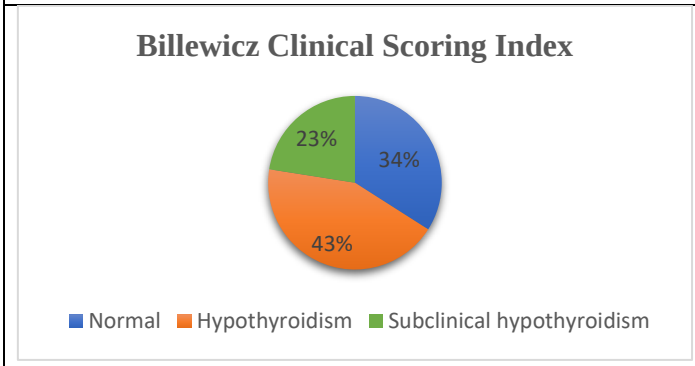
Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 504-510 | ISSN:2251-6727

Paresthesia	172	90	19	10
Hearing impairment	182	95	9	5
Menorrhagia	162	85	29	15
Memory loss	95	50	96	50
Fatigue	76	40	115	60
Dry skin	86	45	105	55
Depression	153	80	38	20
Muscle cramps	143	75	48	25
Bradycardia	134	70	57	30
Hyporeflexia	162	85	29	15
Periorbital puffiness	172	90	19	10
Anemia	143	75	48	25
Edema	129	67.5	62	32.5

Table 3: Mean level of thyroid hormone levels

Hormone Levels	**Mean**	**SD**
FT3	2.72	0.76
FT4	1.57	2.55
TSH	12.29	25.03

Thyroid disorders predicted by Billewicz clinical scoring index among patients



Thyroid status of patients based on thyroid profile

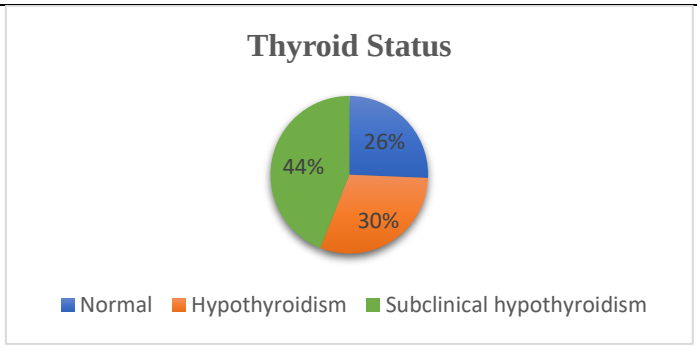


Figure 1: Thyroid disorders predicted by Billewicz clinical scoring index and thyroid profile

Table 4: Comparison of the thyroid status predicted by Billewicz clinical scoring index with detected thyroid disorder

Contingency Table							
Scoring index	**Blood report (TSH)**						
Billewicz Clinical score	Normal	Sub clinical	Hypothyroid	Total	χ^2	df	p-value
Normal	49	15	1	65	42.0	3	<0.001
Subclinical	0	43	0	43			
Hypothyroid	0	26	57	83			
Total	49	84	58	191			

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 504-510 | ISSN:2251-6727

Table 5: Diagnostic characteristics of Billewicz clinical scoring index

Statistics	**Value**	**95% CI**
Sensitivity	98.3%	90.8% to 100.0%
Specificity	80.5%	72.7% to 86.8%
Positive Predictive Value (*)	68.7%	57.6% to 78.4%
Negative Predictive Value (*)	99.1%	94.9% to 100.0%
Accuracy (*)	85.9%	80.1% to 90.5%