SOCIODEMOGRAPHIC PATTERNS OF HYPERTHYROID PATIENTS UNDERGOING RADIOACTIVE IODINE THERAPY IN NORTHERN MALAYSIA: AN OBSERVATIONAL STUDY

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Abstract

Introduction: Sociodemographic data of hyperthyroid patients undergoing RAI therapy remains limited. This study aims to assess the sociodemographic profile of hyperthyroid patients referred for RAI therapy in northern Malaysia.

Methods: In this study, the participants involved were the hyperthyroid patients referred for RAI therapy at the Department of Nuclear Medicine, Hospital Pulau Pinang, from May 2019 to May 2020. Self-reported sociodemographic and clinical information were documented. Descriptive statistics were applied with continuous variables presented as mean and standard deviation and categorical variables as frequencies and percentages.

Results: Among the 123 patients studied, the majority were female, with a mean age of 43.9 years. Most patients were of Malay ethnicity, hailing from Kedah, married, and acquired lower education. They were employed with an average monthly income of RM2303.88. The patients were primarily diagnosed with Graves' disease without other comorbidities and were in a hyperthyroid state biochemically. A significant portion underwent RAI therapy for the first time, receiving a fixed cumulative dose of 555 MBq.

Conclusions Overall, the sociodemographic patterns observed in this cohort align with established trends of thyroid disease related to age, gender, demographics, and etiology. However, the ethnic distribution contradicts previous literature, as Malay ethnicity exhibited the highest percentage of thyroid disorders in this study. Despite medical therapy, many patients had poor thyroid function control at the time of referral, necessitating RAI therapy for definitive management. Further, most patients had lower educational backgrounds, lower incomes, and were employed. Additionally, the presence of common non-communicable diseases in Malaysia was noted among the patients.

Keywords: Hyperthyroidism, Sociodemographic, Radioactive Iodine therapy, Malaysia

Introduction

Hyperthyroidism is a clinical condition resulting from the excessive production and secretion of thyroid hormones by an overactive thyroid gland (1). Depending on its biochemical values, hyperthyroidism can be classified as overt or subclinical. Overt hyperthyroidism occurs when the serum thyroid-stimulating hormone (TSH) is subnormal with elevated serum triiodothyronine (T3) or tetraiodothyronine/thyroxine (T4). Subclinical hyperthyroidism is characterized by low serum TSH levels but with T3 and T4 within the normal range (1). Individuals with normal thyroid function are referred to as euthyroid (2).

On a global scale, hyperthyroidism is a common endocrine disorder. In the United States, its prevalence stands at 1.2%, while in Malaysia, it is higher at 3.4% (3). Although it can affect any age group, it typically manifests in individuals between 20 to 50 years (4). There is a significant female preponderance, with a ratio of 4:1 compared to the male population (5). Factors such as residing in iodine-deficient regions, smoking, alcohol consumption, stress, the presence of autoimmune and syndromic conditions,

and exposure to therapeutic drugs increase the risk of developing hyperthyroidism (6).

Patients suffering from hyperthyroidism exhibit a wide range of symptoms, including weight loss, palpitations, breathlessness, tremors, lethargy, heat intolerance, excessive sweating, increased bowel movements, anxiety, nervousness, muscle weakness, oligo- or amenorrhea, and loss of libido (7). Other common signs associated with hyperthyroidism are tachycardia, atrial fibrillation, fine tremor, skin erythema, sweaty palms, palmar erythema, onycholysis, prominent eyes and eyelid retraction, muscle weakness, systolic hypertension, thyroid bruit, and cardiac failure (7). These symptoms are particularly pronounced in younger patients and individuals with bigger goiters (1). Conversely, older patients tend to exhibit fewer symptoms (8). Additionally, hyperthyroidism also manifests as thyrotoxic periodic paralysis, a rare condition characterized by a blend of hyperthyroidism, acute muscle weakness, and hypokalemia, predominantly observed in Asian men (6). Moreover, rare but life-threatening manifestation known as a thyroid storm can occur, which represents an extreme state of hyperthyroidism. This condition manifests as tachycardia, fever, agitation, altered mental form, signs of cardiac failure, and abnormal liver function (9).

The diagnosis of overt hyperthyroidism is confirmed when serum TSH levels are subnormal, accompanied by elevated serum-free T4, T3, or both. Subclinical hyperthyroidism is diagnosed when TSH levels are low, with serum-free T4 and T3 falling within the normal range (1). Upon confirmation of the diagnosis, patients must undergo a thorough evaluation, including a detailed medical history, physical examination, additional biochemical tests apart from thyroid function tests, and imaging studies to identify the underlying etiology. In some cases, insights into the cause can be gleaned from the patient's clinical history and physical examination alone (10).

Graves' Disease (GD) is identified by the presence of ophthalmopathy, dermopathy, and acropachy (10). In cases lacking these distinctive features, testing for antibodies to the TSH receptor (TRAb), radioactive iodine uptake (RAIU), or ultrasonography can be valuable (1). In the diagnosis of toxic multinodular goiter (TMNG) and toxic adenoma (TA), a combination of laboratory assessments and radionuclide imaging using Iodine 123 (^{123}I) or ^{99m}Tc pertechnetate (^{99m}Tc) is confirmatory (1).

Optimal treatment outcomes for hyperthyroidism can be achieved through medical, surgical, or radioactive iodine therapy (RAI therapy) (11). Thionamide drugs, such as methimazole, carbimazole, and propylthiouracil, inhibit the organification process of thyroid hormone synthesis, reducing circulating thyroid hormone levels (12-14). Near or total thyroidectomy proves highly effective in managing hyperthyroidism in GD, TMNG, and TA, boasting the highest success rates and the lowest relapse rates compared to other treatment methods (1, 15, 16). Surgical intervention is particularly beneficial for individuals with large goiters, recurrent disease, active Graves' ophthalmopathy, poorly controlled hyperthyroidism during pregnancy, and uncontrolled hyperthyroidism despite high doses of thionamide medications (16).

RAI therapy (^{131}I), was first introduced in 1941 to treat hyperthyroidism (17). Accordingly, ^{131}I, is a beta emitter with a maximum energy of 0.61 MeV, an average energy of 0.192 MeV, and a tissue range of 0.8 mm, possesses a physical half-life of eight days (18). Beta emission damages the thyroid's DNA, leading to extensive local destruction of thyroid cells over 6 to 18 weeks (7, 16). Consequently, a gradual reduction in thyroid volume occurs, effectively controlling hyperthyroidism (18).

The RAI therapy is recommended for conditions such as GD, TMNG, TA, non-toxic multinodular goiter, and thyroid carcinoma (19, 20). However, it is absolutely contraindicated during pregnancy, breastfeeding, and in cases of uncontrolled hyperthyroidism (19). Administered orally, the radioactive iodine rapidly concentrates in the thyroid through a sodium iodide transporter and undergoes organification similarly to iodine (12). The goal of RAI therapy is to manage hyperthyroidism by rendering patients euthyroid or hypothyroid, achievable through fixed activity or calculation-based activity administration (1, 19). Patient preparation is crucial to enhance therapy efficacy, necessitating the withholding of medications and contrast agents that could interfere with RAI therapy for the specified duration (19). Pre-treatment discussions should address issues such as low-iodine diet, radiation precautions, resumption of medication, pregnancy timing, therapy complications, and follow-up procedures (19). Comprehensive written and verbal information is mandatory before the therapy (19). Numerous studies have confirmed that RAI therapy offers superior outcomes with lower relapse and recurrence rates compared to thionamide drugs (21-23). The success rate is even higher with a larger radioiodine dose (24). Moreover, it is a cost-effective option and has become the treatment of choice in countries such as the United States and Brazil (1, 23).

In Malaysia, RAI therapy has become increasingly popular in managing hyperthyroidism. This treatment is preferred when there is a need for definitive control of hyperthyroidism and potential risks associated with medical treatment or surgical procedures (1). Despite numerous studies on RAI therapy in hyperthyroidism, data on the sociodemographic profiles of patients receiving this treatment in Malaysia remain limited. Sociodemographic information plays a vital role in identifying populations at risk of developing hyperthyroid disease, improving control strategies, reducing morbidity and mortality, and planning targeted interventions. Therefore, this study aims to assess the sociodemographic characteristics of hyperthyroid patients referred for RAI therapy in northern Malaysia.

Methodology

Sample Collection

A prospective observational study was conducted at the Department of Nuclear Medicine, Hospital Pulau Pinang, from May 2019 to May 2020. This department serves as the sole public sector-based RAI treatment center under the purview of the Malaysian Ministry of Health in Northern Malaysia. It caters to patients from four different states, namely, Pulau Pinang, Perak, Kedah, and Perlis. Given the descriptive nature of this study, all consenting adult subjects diagnosed with underlying hyperthyroidism and referred to the Department of Nuclear Medicine, Hospital Pulau Pinang, for RAI therapy were included, provided they met the specified inclusion and exclusion criteria. The inclusion criteria encompassed patients aged 18 and older with underlying hyperthyroidism who were referred for RAI therapy. Meanwhile, the exclusion criteria were individuals unable to read and comprehend Malay or English languages and those with cognitive impairments.

As for the RAI procedure, the patient's overall condition was assessed by the attending doctor on the day of RAI therapy. The doctor provided comprehensive information about the disease, benefits, and potential side effects of RAI therapy and addressed any concerns of the patients. This procedure aligns with the standard operating procedure (SOP) of the Nuclear Medicine Department, Hospital Pulau Pinang.

During this appointment, patients underwent thorough screening to determine their eligibility for participation in the study. Patients who fulfilled the inclusion and exclusion criteria and consented to participate were recruited in this study. The researchers employed the convenient sampling method as the method for participant selection. Patients were given a set of questions in their preferred language (Malay or English) that covered sociodemographic details such as age, gender, ethnicity, religion, education level, employment status, household income, marital status, and residence.

In addition to sociodemographic information, data on the etiology of hyperthyroidism, the level of TSH at the time of referral, the number of previous RAI therapies, and other comorbidities were extracted from the patient's case notes. Upon completion of the sociodemographic data and the consent forms, the RAI therapy was administered to the patients.

To minimize radiation exposure to investigators and healthcare staff, patient recruitment and data collection occurred before RAI therapy administration. Patients with incomplete or withdrawn data were excluded from the study to ensure the integrity and reliability of the research findings.

Data collected on paper forms were entered into an access database and cross-verified against the source documents to ensure accuracy. The researchers conducted statistical analysis and data exploration using Statistical Package for the Social Sciences (SPSS) version 24, developed by IBM. Descriptive statistics were employed to analyze each variable. Continuous variables were presented as mean and standard deviation, while categorical variables were represented as frequencies and percentages.

Results

In this study, 124 patients who fulfilled the inclusion and exclusion criteria were recruited. One patient was excluded due to incomplete responses, resulting in a final sample size of 123 subjects.

The participants had a mean age of 43.9 years (SD = 13.8), with a significant majority being females (68.3%). Most participants were of Malay ethnicity and were Muslims (80.5%). Approximately half of the participants were employed (50.4%), and most of them had attained lower levels of education (65.9%). The study population primarily consisted of married individuals (71.5%) with a mean household income of RM2,303.88 per month (SD = 1558), and slightly over half were from Kedah (53.7%).

Based on a clinical perspective, a significant percentage of the participants were diagnosed with Graves' disease (57.7%) and hyperthyroidism (57.7%). One-third of the participants had other comorbidities (35.8%). Notably, 81.3% of the participants were undergoing RAI therapy for the first time, with a cumulative RAI dose of 555 MBq (Megabecquerel).

Table 1: Demographic Data and Clinical Characteristics

Characteristics	n (%)	Mean (SD)
Gender		
Male	39 (31.7)	
Female	84 (68.3)	
Age (years)		43.85 (13.81)
Ethnicity		
Malay	99 (80.5)	
Chinese	22 (17.9)	
Indian	2 (1.6)	
Religion		
Islam	99 (80.5)	
Non-Islam	24 (19.5)	
Education Level		
Lower education	81 (65.9)	
Higher education	42 (34.1)	
Employment Status		
Employed	62 (50.4)	
Unemployed	61 (49.6)	
Household Income (RM)		2,303.88 (1,558.34)

Table 1: Demographic Data and Clinical Characteristics (continued)

Characteristics	n (%)	Mean (SD)
Marital Status		
Married	88 (71.5)	
Single	35 (28.5)	
States of Malaysia		
Kedah	66 (53.7)	
Pulau Pinang	34 (27.6)	
Perak	15 (12.2)	
Perlis	8 (6.5)	
Etiology		
Graves' Disease	71 (57.7)	
Multinodular Goiter	52 (42.3)	
Comorbidity		
Yes	44 (35.8)	
No	79 (64.2)	
Thyroid-Stimulating Hormone (TSH)		
Hyperthyroid	71 (57.7)	
Subclinical hyperthyroid	18 (14.6)	
Euthyroid	34 (27.6)	
Number of Treatment		
1	100 (81.3)	
2	23 (18.7)	
Cumulative RAI dose (MBq)		
555	99 (80.5)	
1110	24 (19.5)	

Note: RM – Ringgit Malaysia; MBq – Megabecquerel

Discussion

Demographics and Clinical Data

This observational study, conducted in the northern region of Malaysia, evaluates the sociodemographic factors among hyperthyroid patients undergoing RAI therapy. The analysis revealed a mean age of 43.9 (SD = 13.8). This finding aligns closely with similar studies conducted in local regions, where the mean age for RAI therapy in Northern Malaysia and the Northeast coast state of Malaysia was reported as 46.0 years (SD = 13.6) and 47.3 years (SD = 11.94), respectively (25, 26). These results also correspond with the mean age of a West African population undergoing RAI therapy, which was documented as 47.3 years (25). In contrast, a study in Poland reported a slightly higher mean age of 53.3 years (SD = 14.4) among patients undergoing RAI therapy (26). These subtle variations in age are consistent with the global trend of hyperthyroidism predominantly affecting individuals in this age group (6). Various factors, including genetics, environmental influences, medications, stress, smoking, goitrogens, iodine and selenium deficiency, pregnancy, irradiation, allergies, immune reconstitution, infections, and viruses, contribute to the increased risk of hyperthyroidism within this age bracket (27-29).

In this study, the prevalence of female subjects was significantly higher, constituting 68.3% of the patient population in contrast to 31.7% of male patients. This finding aligns with several local studies and international research that indicated a higher incidence of thyroid disease among women (1, 8, 30-32). These findings were further substantiated by a comprehensive cross-sectional multicenter study conducted in Malaysia, where female subjects were twice the number of males (33). This gender discrepancy in thyroid disorders has been attributed to factors such as estrogen hormone levels, pregnancy, menstrual cycles, menopause, and family history, which increases the likelihood of thyroid disorders in females (28, 34, 35). The robust consistency of these findings across various studies underscores the significance of gender-related factors in understanding thyroid diseases.

Based on the research findings, Malay patients constituted a significant majority, comprising 81.3% of the total sample. This ethnic distribution mirrors previous studies by Fong et al. (30) and Illiani et al. (36). These findings can be attributed to the fact that the majority of Malaysians belong to Malay ethnicity. As such, it would be reasonable to expect Malay patients to outnumber other ethnic groups in the study. However, the present findings diverged from those reported by Shahar et al. (33) in a large cross-sectional multicentre study investigating goiter risk factors in rural areas of Peninsular Malaysia. Shahar et al. (33) found a higher prevalence of goiter among individuals of Indian ethnicity. It is important to note that these findings are subject to debate due to the relatively small sample size of the Indian ethnic group used in the study, and most of the Indian subjects were from a specific narrow geographical location. These limitations may have influenced the reported outcomes. In addition, their study did not specify the exact cause of goiter, nor did it evaluate the association between hyperthyroidism and ethnicity. Therefore, the relationship between race and hyperthyroidism still needs to be explored. Clarifying these associations warrants further investigation to discern the nuanced factors contributing to ethnic disparities in hyperthyroidism prevalence.

Within the Malaysian educational framework, higher education refers to tertiary-level studies, whereas lower education encompasses primary, secondary, and post-secondary levels. In the present study, a substantial proportion of patients possessed low educational qualifications (65.9%). This finding supports those of Domènech et al. (37), where 50% of their study cohort had low education levels, and 33% had higher education qualifications. However, the classification of education level in this study differs from that of Zafar et al. (38), who categorized education as literate (educated) or illiterate

(uneducated). According to their criteria, most subjects fell into the literate category (76%). Applying this criterion to the present study cohort would make all participants 100% literate. Literacy plays a pivotal role in healthcare (39), enhancing the ability to seek information, comprehend the diseases, participate in decision-making, adhere to treatment plans, and foster behavioral changes (40). Given the intricate nature of RAI therapy, understanding the disease process, adhering to pre-therapy preparation and post-therapy precautions, recognizing side effects, and complying with treatment guidelines, literacy emerges as a critical factor influencing successful outcomes. Awareness of a patient's academic background is also essential for clinicians, enabling them to tailor treatment approaches for individual patients effectively. Tailored interventions based on patients' literacy levels can enhance their comprehension, engagement, and adherence to RAI therapy protocols, ultimately contributing to better treatment outcomes and overall patient well-being.

The analysis in this study revealed that half of the patients were employed (50.4%), while the remaining were unemployed (49.6%). Comparable employment figures were reported by Domènech et al. (37), although Illiani et al. (36) recorded a higher percentage of employed subjects at 65.4%. A plausible explanation for the high unemployment rate in the present study cohort could be the more significant number of married female patients who were financially dependent on their spouses.

In Malaysia, household incomes are generally categorized into three levels: bottom 40 (B40), middle 40 (M40), and top 20 (T20). At the time of data collection, the monthly mean household incomes for these groups were as follows: B40: RM 2,848; M40: RM 5,662; T20: RM 14,305. In the current study, patients' mean income predominantly fell within the B40 group (RM 2,303.88). It is important to note that direct comparisons with other local studies are challenging as these studies adopted income structures that were different than that reported in the Malaysian Household Income and Basic Amenities Survey Report 2019 (41).

Further, an individual's employment status and income significantly influence their financial ability to access RAI therapy. In Penang, RAI therapy services are provided at two centers: the Nuclear Medicine Department at Hospital Pulau Pinang and the Nuclear Medicine Unit at Advanced Medical and Dental Institute, University Sains Malaysia. However, patients, particularly those residing in neighboring states, encounter the additional financial strain of travel expenses, in addition to treatment costs. Additional financial burden poses significant challenges in accessing RAI therapy and, in some cases, leads to refusal, particularly among those facing economic disadvantages. These financial barriers and income disparities highlight the socioeconomic complexities, underlining the need for interventions that consider these specific financial circumstances to ensure equitable healthcare access to RAI therapy for all patients, irrespective of their socioeconomic circumstances.

In this study, most of respondents were married (71.5%). This finding aligns with a study by Illiani et al. (36), where 69.9% of respondents were also married. According to the Marriage and Divorce Statistics, Malaysia 2019, the median age for marriage in the country falls between 25-29 years for both sexes (42). Since hyperthyroidism peaks in the third to fifth decades of life, it is understandable that a higher number of married patients were observed in the current study compared to single patients. This demographic trend reflects the typical age range for marriage and the corresponding peak incidence of hyperthyroidism, providing valuable context to the prevalence of marital status among the respondents.

The Department of Nuclear Medicine at Hospital Pulau Pinang is the sole hospital facility of the Ministry of Health providing RAI therapy in Northern Malaysia, encompassing Penang and three neighboring states: Kedah, Perak, and Perlis. In this study, 53.7% of subjects hailed from Kedah, 27.6% from Penang, 12.2% from Perak, and 6.5% from Perlis. Iodine deficiency is recognized as one of the risk factors for hyperthyroidism. In Malaysia, this deficiency is influenced by low iodine content in soil and water, local dietary habits, and low consumption of marine seafood. According to the National Iodine Deficiency Disorders Survey by Selamat et al. (43), six states in Malaysia were identified as having marked iodine deficiency within their population. Kedah, Penang, and Perak were ranked as the top three states with iodine deficiency (43). The geographical distribution of subjects in this study aligns with the findings of this survey, reinforcing the impact of regional iodine deficiency on the prevalence of hyperthyroidism among the studied population. Understanding these geographical patterns is vital for tailoring public health interventions to mitigate iodine deficiency-related hyperthyroidism in specific regions.

Only 35.8% of respondents in this study had additional comorbidity. Most of the respondents were free from other diseases (64.2%). The prevalent comorbidities included hypertension, diabetes, and dyslipidemia, which are also the most common non-communicable diseases in Malaysia. This finding is consistent with published data in the country and results from the Malaysian National Health and Morbidity Survey 2019. In contrast, Rehman et al. (44) reported a higher percentage of patients with comorbidities in their study of Pakistani subjects (58.7%). This disparity could be attributed to variations in the overall quality of health status between the two populations. Furthermore, since the cohort comprised older patients, the likelihood of having other health disorders or complications secondary to hyperthyroidism was naturally higher. The coexistence of hyperthyroidism with comorbid conditions, such as hypertension, hyperlipidemia, and diabetes, can exacerbate preexisting conditions and elevate the risk of cardiovascular diseases (45-47). Understanding these complex interactions between hyperthyroidism

and comorbidities is crucial for comprehensive patient management, emphasizing the need for tailored treatment strategies addressing both the thyroid disorder and its associated health complications.

GD and MNG were the only two etiologies identified in this study. Among the subjects, 57.7% were diagnosed with GD, while 42.3% had MNG. Comparing these findings with Fong et al. (30), a slightly higher prevalence of GD was noted in a comparable demographic setting (67.4%), whereas GD prevalence in Kelantan was lower (47.4%) (31). In a West African study, Onimode et al. (25) also reported a higher percentage of GD cases (81.9%). These variations fall within the global prevalence norms of GD. The higher proportion of MNG cases in this study, compared to Fong et al. (30) and Onimode et al. (25), can be attributed to the utilization of thyroid scintigraphy in their studies. Thyroid scintigraphy enables accurate classification of hyperthyroidism and evaluation of thyroid nodules (1), allowing precise diagnosis accurately (48). In contrast, the present study relied primarily on clinical, biochemical, or radiological evaluations, potentially missing accurate diagnoses for GD, MNG, and TA. Furthermore, higher MNG etiology in this study can also be attributed to geographical factors, especially in iodine deficiency areas such as Kedah, Pulau Pinang, and Perak. Iodine deficiency is a precursor for MNG development. Since most subjects originated from these areas, the higher proportion of MNG cases likely reflects the actual magnitude of the disease in these iodine-deficient areas.

In suspected cases of hyperthyroidism, biochemical evaluation is mandatory. The diagnosis is confirmed when TSH levels are subnormal with elevated serum T4 or T3 levels. In clinical practice, thionamides and beta blockers are commonly initiated as the first-line approach to manage the symptoms. These medications are often used as an adjunct before RAI therapy, especially in severe hyperthyroidism, cardiovascular disease cases, and older patients (18, 49). This approach is crucial to mitigate the surge of thyroid hormone soon post-RAI therapy and minimize hyperthyroidism-related complications (18). All subjects in this cohort were treated with thionamide drugs before RAI therapy initiation. Despite these treatments, only 27.4% of the participants achieved biochemical euthyroidism, while a significant 57.3% remained in a hyperthyroid state and 12.2% in subclinical hyperthyroidism. These findings highlight the challenges associated with controlling hyperthyroidism through medical therapy alone.

RAI therapy aims to destroy hyperactive thyroid tissue, leading to hypothyroidism or euthyroidism in patients. Achieving euthyroidism in the first attempt is the ideal goal. However, selecting an optimal dosing method has been a topic of extensive research, with conflicting results from different studies. Various approaches, including fixed doses and calculation-based methods, have been explored, although a consensus on the best strategy still needs to be discovered. While some studies suggest superiority in calculated amounts, others do not provide conclusive evidence (50-52). Considering the complexity of calculated dose methods, the risk of unnecessary additional radiation exposure, multiple hospital visits, and increased costs, many centers have opted fixed-dose regimens (53, 54). This center adopted a fixed dose of 555 MBq for RAI therapy. Gupta et al. (54) demonstrated a high cure rate with this dose, although more significant goiter cases exhibited increased failure rates. Factors such as male gender, earlier onset of hyperthyroidism, and severity of the condition have been associated with poor responses to this dosage in a single trial (55), necessitating multiple treatments in some cases. In the current study, only a small proportion of subjects required a second RAI therapy (19.5%), indicating a generally positive response to the treatment. Most patients underwent RAI therapy for the first time, receiving a fixed dose of 555 MBq during each session. However, for patients needing a second therapy, the cumulative dose increased to 1110 MBq. While the expected proportion of patients requiring multiple treatments aligns with this increase in cumulative doses, it is crucial to continue monitoring and refining the treatment approach to enhance the efficacy and minimize the need for additional therapy sessions.

Conclusion

In this cross-sectional study, most of the patients referred for RAI therapy were of Malay ethnicity, from Islamic faith, and were predominantly married females in their 40s residing in the state of Kedah. Furthermore, a prevalent characteristic included a lower educational background and unemployment, with an average monthly income of RM 2,302.88. Most patients were diagnosed with GD without additional comorbidities and were biochemically hyperthyroid at the time of referral. Additionally, a significant proportion of patients were undergoing RAI therapy for the first time, receiving a cumulative dose of 555 MBq. These sociodemographic insights provide essential information for formulating public health initiatives, healthcare practices, and research endeavors and influence the development of national policies. Therefore, understanding these patterns is pivotal for tailoring healthcare services to the specific needs of this patient population, ensuring equitable access to treatments, and promoting overall well-being among individuals undergoing RAI therapy.

Limitations of the Study

The primary limitation of this study stems from its single-center focus, potentially limiting the generalizability of the sociodemographic distribution observed among hyperthyroid patients referred for RAI therapy in Malaysia. Further, the study was conducted exclusively in English and Malay languages, which excluded approximately 10% of patients not proficient in these languages, impacting their participation in the study. These factors could introduce bias and limit the overall representativeness

of the findings, underscoring the need for caution when applying the results to the broader hyperthyroid patient population in Malaysia.

Recommendations

It is essential to consider larger sample sizes, data from multiple radioactive iodine centers, and languages that reflect the diversity of the Malaysian population. This approach helps in mitigating sampling bias effectively.

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Competing Interests

The authors declare that they have no competing interests.

Ethical Clearance

This study received approval from the Medical Research and Ethics Committee (MREC) and the Ministry of Health Malaysia (MOH), registered under NMRR-19-530-47103 (IIR). Written informed consent was obtained from all participants involved in this study.

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