**Thyroid Carcinoma in Nigeria: Current Perspectives and Comprehensive Review**

**Abstract:**

**Background:**
Malignant thyroid disease is an emerging yet underreported public health issue in Nigeria and Sub-Saharan Africa. Although generally associated with a favourable prognosis when detected early, substantial gaps in diagnosis, treatment, and data reporting hinder optimal care in the region.

**Objective:**
To provide a comprehensive evaluation of the current state of malignant thyroid disease in Nigeria, focusing on diagnostic patterns, treatment challenges, and opportunities for systemic healthcare improvements.

**Methods:**
A narrative review of peer-reviewed literature from the past two decades was conducted, incorporating global, Sub-Saharan African, and Nigerian studies. The review examined histopathological trends, diagnostic infrastructure, access to therapy, and policy gaps in thyroid cancer management.

**Findings:**
The review highlights significant systemic deficiencies, including poor cancer registration systems, limited correlation between cytology and histology, inadequate molecular diagnostic capabilities, and restricted access to radioactive iodine therapy. These barriers contribute to delayed diagnoses, outdated treatment protocols, and poor outcomes. Comparative analysis indicates that Nigeria lags behind both regional and global standards of thyroid cancer care.

**Conclusion:**
To improve thyroid cancer outcomes in Nigeria, urgent investments are needed in cancer registries, diagnostic infrastructure, workforce training, and nuclear medicine. Integrating thyroid cancer services into national health insurance and adopting context-specific clinical guidelines are critical steps toward aligning with global best practices.

**Keywords:**

**Cancer burden, Diagnostic challenges, Fine needle aspiration biopsy, Histopathology, Molecular genetics, Nigeria, Radioactive iodine therapy, Resource-limited settings, Sub-Saharan Africa, Thyroid carcinoma,** Thyroid **epidemiology, Thyroid cancer management,**

**Introduction:**

Malignant thyroid neoplasms comprise a heterogeneous group of tumours originating from follicular or parafollicular thyroid cells. Although they account for only 1–2% of all cancers, their impact is significant due to increasing incidence, especially in women 1-3. It is one of the commonest malignancies of the endocrine system 73. Despite well-characterised behaviour in developed countries, regional disparities persist in histologic profiles, diagnostic capabilities, and outcomes4-5.

Epidemiologically, globally, thyroid cancer is the ninth most common cancer, with over 586,000 new cases and 43,000 deaths annually6. In high-income countries, increasing incidence is largely attributed to overdiagnosis through high-resolution imaging 7. In contrast, Sub-Saharan Africa exhibits a lower incidence but worse outcomes due to late presentation and diagnostic delays 8,9. Nigerian studies confirm that thyroid cancer constitutes 0.5–1.5% of all malignancies, with female predominance and a median age of presentation around 40–50 years, 10-12.

Various intrinsic and extrinsic risk factors play a role in thyroid carcinogenesis. Intrinsic non-modifiable factors encompass biological sex, age, and hereditary conditions 77. Ionising radiation is recognised as a well-established extrinsic factor. Other potential extrinsic factors include pesticides, persistent organic pollutants (POPs), endocrine-disrupting chemicals (EDCs), bisphenol A (BPA), phthalates, heavy metals, and polychlorinated biphenyls (PCBs)78,79(Figure 1).



 **Figure 1. Identified and credible environmental risk factors linked to thyroid cancer79**

Risk factors for thyroid malignancies include radiation exposure, especially in childhood13, and hereditary predispositions, such as a family history of thyroid cancer and genetic syndromes, including RET proto-oncogene mutations in medullary thyroid carcinoma.

**¹⁴. Iodine imbalance, whether due to deficiency or excess, has also been implicated, with higher rates of follicular carcinoma observed in goitre-endemic regions¹⁵,¹⁶. Hormonal influences and autoimmune thyroiditis, particularly Hashimoto’s thyroiditis, have been associated with papillary thyroid carcinoma¹⁷. Additionally, environmental and occupational exposures have been proposed as potential contributors to thyroid cancer in Nigeria; however, robust evidence remains scarce due to the limited availability of comprehensive, population-based studies¹⁸.**

The pathophysiology of thyroid malignancies is broadly categorised based on histogenesis and molecular characteristics. Differentiated thyroid carcinomas (DTCs), which include papillary thyroid carcinoma (PTC; 85–90%) and follicular thyroid carcinoma (FTC; 5–10%), arise from follicular epithelial cells and represent the most prevalent subtypes¹⁹. Thyroid carcinomas predominantly originate from two distinct cellular lineages within the thyroid gland. The majority arise from follicular epithelial cells, which give rise to the well-differentiated papillary thyroid carcinoma (PTC) and follicular thyroid carcinoma (FTC), as well as the poorly differentiated and undifferentiated forms, such as anaplastic thyroid carcinoma (ATC). These neoplasms account for the vast majority of thyroid malignancies. In contrast, medullary thyroid carcinoma (MTC) originates from the parafollicular or C-cells of the thyroid, which are neuroendocrine and responsible for the production of calcitonin 73,74. Medullary thyroid carcinoma (MTC), originating from parafollicular C-cells, may occur sporadically or as part of hereditary syndromes such as multiple endocrine neoplasia type 2 (MEN2) ²⁰. Anaplastic thyroid carcinoma (ATC), though rare, is the most aggressive form, characterised by rapid progression and poor prognosis²¹. At the molecular level, key genetic alterations such as **BRAF V600E mutations, RET/PTC rearrangements**, and **RAS gene mutations** have been implicated in the initiation and progression of thyroid tumours²²,²³.

Thyroid malignancies most commonly present as a painless neck mass19,24. However, some are asymptomatic, detected incidentally during physical examination or imaging for other reasons19,24-27. As the disease advances, symptoms such as hoarseness, dysphagia, and cervical lymphadenopathy may occur, reflecting local invasion or nodal metastasis. In Nigeria, delayed presentation is prevalent, often characterised by large, longstanding multinodular goitres, extrathyroidal extension, or distant metastases at initial diagnosis²⁵⁻²⁷.

**Diagnostic approaches involve the following**: High-resolution neck ultrasound (US) is the first-line imaging modality, providing essential information on nodule size, composition, vascularity, and suspicious features such as microcalcifications or irregular margins²⁸. Fine-needle aspiration biopsy (FNAB) remains the gold standard for preoperative diagnosis and risk stratification; however, its utilisation in rural and underserved regions of Africa is limited by poor accessibility and resource constraints²⁹. Additional investigations include thyroid scintigraphy and serum markers, such as calcitonin and carcinoembryonic antigen (CEA), particularly in medullary thyroid carcinoma³⁰. Definitive diagnosis relies on histopathological evaluation and immunohistochemistry, which are critical for tumour classification and molecular profiling³¹. In Nigeria, the diagnostic process is often hampered by a shortage of trained cytopathologists and limited access to immunohistochemistry services, contributing to diagnostic delays and misclassification³².

Management and treatment are multidisciplinary, but Surgery remains the mainstay (lobectomy or total thyroidectomy) 33. Radioactive iodine (RAI) ablation is used in intermediate/high-risk DTC34. Thyroid hormone suppression therapy: Suppresses TSH stimulation 35. Certainly. Here's an expanded, scholarly version of your statement:

The loss of sensitivity to radioactive iodine (RAI) therapy in thyroid cancer can result from disruptions in the normal regulatory mechanisms that govern iodide uptake and metabolism within thyroid follicular cells. One critical factor in this process is the expression and functional activity of the sodium-iodide symporter (NIS), a membrane glycoprotein responsible for actively transporting iodide into thyroid cells—a prerequisite for effective RAI therapy⁷⁵. In certain thyroid malignancies, particularly those harbouring specific genetic alterations, such as BRAF V600E mutations, the mitogen-activated protein kinase (MAPK) signalling pathway becomes constitutively activated. This overactivation can downregulate the transcription and membrane localisation of NIS, thereby impairing iodide uptake⁷⁶. Consequently, these tumours exhibit reduced RAI avidity, leading to diminished treatment efficacy and posing significant therapeutic challenges in the management of advanced or recurrent disease. Targeted therapies (e.g., kinase inhibitors) are reserved for advanced or refractory cases 36. Sub-Saharan data show limited access to RAI and oncology specialists 37,39. Prognosis and Outcomes vary by histologic subtype. PTC and FTC: Excellent prognosis (>90% 10-year survival)40. MTC: Intermediate, dependent on stage and genetic profile 41. Treatment of ATC is poor, with a median survival of <6 months 42. Delays in the diagnosis and inadequate follow-up worsen outcomes in Nigeria and many African countries 43,44.

Challenges and deficiencies in the management of malignant thyroid disease in Africa are multiple-fold. The management of malignant thyroid disease in various African countries is hindered by numerous systemic and infrastructural challenges. The primary issue is the ongoing underreporting of cases, attributed to the lack of comprehensive national cancer registries, which leads to insufficient epidemiological data and poorly formulated health policies. The diagnostic challenges are exacerbated by insufficient expertise in cytopathology and the limited implementation of standardised reporting systems, such as the Bethesda System, resulting in inadequate cytologic-histologic concordance. Advanced molecular diagnostic services remain largely inaccessible in many Nigerian settings, significantly limiting the application of precision medicine approaches, including testing for BRAF, RAS, RET/PTC, and TERT mutations. This gap hampers accurate risk stratification and the delivery of targeted therapies. As a result, clinicians are compelled to depend on obsolete treatment methods. Access to radioactive iodine (RAI) therapy is significantly restricted, with only a limited number of specialised centres providing these services, often impeded by high costs, equipment malfunctions, and regulatory limitations. The identified limitations hinder the comprehensive and effective management of differentiated thyroid cancers in the region 45.

**Materials and Methods**

This review employed a structured literature search of peer-reviewed articles, original studies, systematic reviews, and regional health data on malignant thyroid diseases. Electronic databases, including PubMed, Scopus, African Journals Online (AJOL), and Google Scholar, were searched for studies published between 2010 and 2024. Search terms included: "malignant thyroid disease," "thyroid cancer," "differentiated thyroid carcinoma," "anaplastic thyroid carcinoma," "medullary thyroid carcinoma," "thyroid cancer Nigeria," and "thyroid cancer sub-Saharan Africa."

Inclusion criteria were: studies reporting original data or systematic reviews on thyroid malignancies with relevance to clinical presentation, diagnosis, histopathology, and epidemiology. Preference was given to studies conducted in Nigeria, sub-Saharan Africa, and globally recognised studies. Exclusion criteria were non-English articles, studies with incomplete datasets, or those focusing exclusively on benign thyroid disorders.

Data were extracted on prevalence, histologic patterns, diagnostic methods, and treatment outcomes. Comparative analysis was conducted to identify patterns across regions.

**Histological Distribution of Thyroid Cancers**

The histological distribution of thyroid malignancies demonstrates significant regional variation. While papillary thyroid carcinoma (PTC) remains the most prevalent subtype While the global prevalence of papillary thyroid carcinoma (PTC) is approximately 85%, it is comparatively lower in Sub-Saharan Africa (60–70%) and Nigeria (55–65%). In contrast, follicular thyroid carcinoma (FTC) is more common in these regions, accounting for 25–35% of cases versus the global average of around 10%. Medullary and anaplastic thyroid carcinomas remain uncommon worldwide but exhibit slightly higher frequencies in Nigeria, ranging from 2–4% and 4–6%, respectively (Figure 2).

**Diagnostic Framework and Obstacles**

In terms of diagnostic infrastructure, there is a marked disparity between global standards and Nigerian practice. While neck ultrasound and fine-needle aspiration biopsy (FNAB) are standard tools globally, their application in Nigeria is limited by equipment deficits and a shortage of trained cytopathologists. Advanced diagnostic modalities such as serum calcitonin assays and immunohistochemistry (IHC), routinely used in high-resource settings for medullary thyroid carcinoma and tumour subtyping, are rarely available in Nigeria due to cost constraints, limited laboratory infrastructure, and lack of technical expertise (Table 1).

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|  | **Figure 2: Comparative Prevalence of Thyroid Malignant Neoplasms Across Regions**  |  |  |



**Table 1: Frequently Employed Diagnostic Modalities and Their Application in Nigeria**

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| **Diagnostic Tool** | **Standard Use Globally** | **Utilisation in Nigeria** | **Challenges in Nigeria** |
| Neck Ultrasound | High | Moderate to High | Equipment gaps in rural centres4646,47 |
| FNAB | Gold standard | Low to Moderate | Lack of cytopathologists48-50 |
| Serum Calcitonin (MTC) | Routine for MTC | Rare | Cost and limited lab capacity 51-53 |
| Immunohistochemistry (IHC) | Standard in histology | Low | Cost, expertise, and reagent access 54-56 |
|  |

**Global and Regional Variations in Thyroid Cancer**

Thyroid cancer remains the most common endocrine malignancy, with marked regional variations in presentation, histological subtype, and diagnostic approach. Globally, papillary thyroid carcinoma (PTC) dominates, accounting for approximately 85% of cases. However, in sub-Saharan Africa, including Nigeria, there is a relatively higher prevalence of follicular thyroid carcinoma (FTC), attributed to endemic iodine deficiency 57,58. Additionally, the higher prevalence of long-standing goitres—an established risk factor for follicular thyroid carcinoma (FTC)—alongside the relatively lower exposure to ionizing radiation, a known risk factor for papillary thyroid carcinoma (PTC), in Nigeria and other sub-Saharan African countries, may help explain these observed variations in histological patterns.

**Diagnostic Challenges in Nigeria and Sub-Saharan Africa for Thyroid Malignancies**

In Nigeria, multiple studies have reported follicular thyroid carcinoma (FTC) frequencies ranging from 25% to 35%, which are notably higher than the global averages 59-61. Anaplastic thyroid carcinoma, though rare worldwide (<2%), is reported at slightly higher proportions (up to 6%) in Nigerian cohorts, likely due to late presentations and missed early diagnosis 62,63.

Diagnostic pathways in developed countries rely on high-resolution ultrasound, FNAB with cytological grading (e.g., Bethesda system), and adjunct immunohistochemistry 64,65. In contrast, Nigeria and other sub-Saharan countries face major diagnostic limitations, including inadequate cytopathology services, poor access to IHC, and limited training in ultrasound-guided FNAB 66-69. These gaps contribute to diagnostic delays and reliance on postoperative histology for definitive diagnosis.

**Environmental and genetic risk factors**

Environmental and occupational exposures, though postulated in Nigerian studies, lack robust epidemiological backing 70. Additionally, the genetic landscape remains underexplored, with few studies on BRAF, RAS, or RET mutations in Nigerian thyroid cancer patients 71,72. Globally, molecular diagnostics have become integral to management, aiding prognostication and targeted therapy 73,74.

**Treatment options and challenges**

Treatment modalities in high-income settings typically include total thyroidectomy, radioactive iodine therapy, and targeted therapies (e.g., tyrosine kinase inhibitors for advanced MTC and ATC) 75. However, in Nigeria, access to radioactive iodine and oncologic surgery remains limited, particularly outside tertiary centres 76,77.

Despite some local advancements in training and equipment availability, thyroid cancer care in Nigeria continues to be challenged by inadequate early detection, uneven distribution of specialists, and financial barriers to care 78.

**Future Prospects:**

There is a notable scarcity of large-scale, multicentre studies addressing the epidemiology of thyroid cancer in Nigeria. Limited access to molecular diagnostic tools hinders the progress of precision medicine. The availability of cytopathology services is uneven, particularly in rural and northern areas. Future research should focus on the molecular profiling of thyroid cancer patients in Nigeria and the creation of regional cancer registries. Investment in pathology training and the decentralisation of diagnostic services is crucial.

**Conclusion:**

Malignant thyroid disease represents an emerging and increasingly recognised oncologic burden in Nigeria and across Sub-Saharan Africa. This review highlights not only the evolving histopathological and molecular landscape of thyroid malignancies but also the critical gaps in diagnostic infrastructure, treatment accessibility, and research capacity in the region. Despite global advances in molecular profiling, precision therapy, and standardised care algorithms, many institutions in Nigeria continue to rely on limited cytological techniques, with significant variations in diagnostic accuracy and therapeutic outcomes.

**Recommendations:**

To overcome current gaps in thyroid cancer care in Nigeria, there is a need to establish national cancer registries, strengthen workforce training in endocrine oncology, and expand access to molecular diagnostics and radioactive iodine therapy. Integrating thyroid care into national health insurance, developing local clinical guidelines, and promoting public awareness are essential. Additionally, fostering research collaboration and digital health solutions will improve diagnostics and patient follow-up. These strategic actions can align thyroid cancer management in Nigeria with global standards.

**Disclaimer:**

The author(s) affirm that no generative artificial intelligence technologies—including large language models (e.g., ChatGPT, Copilot) or text-to-image generators—were utilised in the writing, editing, or preparation of this manuscript.

**Acknowledgement:**

We are deeply grateful to the management of the Benue State University and the College of Health Sciences for the use of its library resources for this all-important review article.

**References:**

1. **Davies L, Welch HG. Increasing incidence of thyroid cancer in the United States, 1973–2002.**JAMA.2006;295(18):2164–7.
doi:10.1001/jama.295.18.2164. PMID: 16684987.
2. Cabanillas ME, McFadden DG, Durante C. Thyroid cancer. Lancet. 2016;388(10061):2783–95.
3. Kitahara CM, Sosa JA. The changing incidence of thyroid cancer. Nat Rev Endocrinol. 2020;16(11):601–11.
4. Aschebrook‑Kilfoy B, Ward MH, Sabra MM, Devesa SS. Thyroid cancer incidence patterns in the United States by histologic type, 1992–2006. *Thyroid*. 2011;21(2):125–34. doi: [10.1089/thy. 2010.0021](https://doi.org/10.1089/thy.2010.0021). PMID: 21186939; PMCID: PMC3025182.
5. Sahabi SM, Abdullahi K. Epidemiological survey of malignant neoplasms in Sokoto, Nigeria (2006–2015). World J Res Rev. 2017;4(4):10–15. doi:10.13140/RG.2.2.32660.10882
6. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide. CA Cancer J Clin. 2021;71(3):209–49.
7. Pellegriti G, Frasca F, Regalbuto C, Squatrito S, Vigneri R. Worldwide increasing incidence of thyroid cancer: update on epidemiology and risk factors. J Clin Endocrinol Metab. 2013;98(8):3140–52.
8. Ukekwe FI, Olusina DB, Okere PCN. Patterns of thyroid cancers in Southeastern Nigeria: a fifteen-year histopathologic review (2000–2014). *J Clin Diagn Res*. 2017;11(8):EC16–EC19. doi: 10.7860/JCDR/2017/26971.10418. PMID: 28969135.
9. Afolabi AO, Alegbeleye BJ, Olagunju N. Occult thyroid carcinoma: a tertiary hospital experience in Ibadan, Nigeria. *Iberoam J Med*. 2021;3(3):212–220.
doi: 10.5281/zenodo.4771174.
10. Zabah SM, Jawa MA, Gowon FP, Yau OE, Ikwu EF. A ten-year review of thyroid lesions in a tertiary hospital in Abuja, Nigeria. *Afr Trop Pathol*. 2024;9(2):118–125.
11. Nzegwu MA, Njeze GE, Olusina DB, Ugochukwu AI. A histological update of thyroid lesions in Enugu, Nigeria: a 5-year retrospective study (2000–2004). Asian J Exp Biol Sci. 2010;1(2):430–3.
Available from: <https://www.researchgate.net/publication/281446916>
12. Okafor EN, Ugonabo MC, Chukwukelu EE, Okonkwo IN, Ezigbo E, Odurukwe O. Prevalence and pattern of thyroid disorders among patients attending University of Nigeria Teaching Hospital, Enugu, Southeastern Nigeria. Niger Med J. 2019;60(2):62–7. Doi: 10.4103/nmj.NMJ\_34\_19. PMID: 31258377; PMCID: PMC6595474.
13. Mettler, F. A., Jr., Bhargavan, M., Yoshizumi, T., & Beeson, P. (2008). Cumulative effective dose from medical imaging in a US population. *Radiology*, *248*(3), 960–969. doi:10.1148/radiol.2483071375.
14. **Wells SA Jr, Asa SL, Dralle H, Elisei R, Evans DB, Gagel RF, et al.**
Revised American Thyroid Association guidelines for the management of medullary thyroid carcinoma. J Clin Oncol. 2013;31(29):3779–87.
doi:10.1200/JCO.2013.50.4459 PMID: 24145383.
15. Zimmermann MB, Galetti V. Iodine intake as a risk factor for thyroid cancer: a comprehensive review of animal and human studies. Endocr Rev. 2015;36(4):376–408. doi: 10.1210/er.2014-1108. PMID: 25691693.
16. Ekanem IA, Parkin DM; Calabar Cancer Registry. Five-year cancer incidence in Calabar, Nigeria (2009–2013). Cancer Epidemiol. 2016; 42:167–72.
Doi: 10.1016/j.canep.2016.04.014.
17. Jonklaas, J., Nogueras-Gonzalez, G., Munsell, M., Litofsky, D., Ain, K. B., Bigos, S. T., ... & from the National Thyroid Cancer Treatment Cooperative Study Group. (2012). The impact of age and gender on papillary thyroid cancer survival. The Journal of Clinical Endocrinology & Metabolism, 97(6), E878-E887.
18. Gbaa, Z. L., Ugwu, V. I., Annenga, R., Ojo, B. A., Umobong, E., Zaka, A. N., ... & Edo, A. V. (2024). Spectrum of Thyroid Diseases at Benue State University TeachingHospital Makurdi, Nigeria: A Histopathological Survey. Journal of BioMedical Research and Clinical Practice, 7(1-2).
19. **Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforov YE, et al. 2015 American Thyroid Association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer. Thyroid. 2016;26(1):1–133. doi:10.1089/thy.. 2015.0020. PMID: 26462967; PMCID: PMC4739132.**
20. Ukekwe, F. I., Olusina, D. B., & Okere, P. C. (2017). Patterns of thyroid cancers in southeastern Nigeria: a 15 year histopathologic review (2000-2014). Journal of clinical and diagnostic research: JCDR, 11(8), EC16.
21. Smallridge RC, Ain KB, Asa SL, Bible KC, Brierley JD, Burman KD, et al. American Thyroid Association guidelines for management of anaplastic thyroid cancer. J Clin Oncol. 2012;30(17):1996–2004. doi:10.1200/JCO.2011.39.9784. PMID: 22529256.
22. **Xing M. Molecular pathogenesis and mechanisms of thyroid cancer. Endocr Rev. 2007;28(7):742–62. doi:10.1210/er.2007-0004. PMID: 17720714.**
23. Ito, T., Seyama, T., Mizuno, T., Tsuyama, N., Hayashi, Y., Dohi, K., ... & Akiyama, M. (1993). Genetic alterations in thyroid tumor progression: association with p53 gene mutations. Japanese Journal of Cancer Research, 84(5), 526-531.
24. Mazzaferri EL. Management of a solitary thyroid nodule. N Engl J Med. 1993;328(8):553–9. doi:10.1056/NEJM199302253280807. PMID: 7677339.
25. Solomon R, Iliyasu Y, Mohammed AZ. Histopathological pattern of thyroid lesions in Kano, Nigeria: a ten-year retrospective review (2002–2011). *Niger J Basic Clin Sci*. 2015; 12:55–60.
26. Abdulkareem FB, Banjo AAF, Elesha SO. Histologic review of thyroid lesions: a 13-year retrospective study (1989–2001). *Niger Postgrad Med J*. 2005; 12:210 –14.
27. Ariyibi OO, Duduyemi BM, Akang EE, Oluwasola AO. Histopathological patterns of thyroid neoplasms in Ibadan, Nigeria: a twenty-year retrospective study (1987–2006). *Int J Trop Dis Health*. 2013;3(2):148–56. doi:10.9734/IJTDH/2013/2936.
28. Moon WJ, Jung SL, Lee JH, Na DG, Baek JH, Lee YH, et al. Benign and malignant thyroid nodules: US differentiation—multicentre retrospective study. *Radiology*. 2008;247(3):762–70. doi:10.1148/radiol.2473070954. PMID: 18430703.
29. Robenshtok, E., Tzvetov, G., Grozinsky-Glasberg, S., Shraga-Slutzky, I., Weinstein, R., Lazar, L., ... & Benbassat, C. (2011). Clinical characteristics and outcome of familial nonmedullary thyroid cancer: a retrospective controlled study. Thyroid, 21(1), 43-48.
30. Podany, P., & Gilani, S. M. (2021). Hyalinizing trabecular tumor: Cytologic, histologic and molecular features and diagnostic considerations. Annals of Diagnostic Pathology, 54, 151803.
31. Nggada HA, Gali BM, Khalil MIA. Thyroid carcinoma in North Eastern Nigeria: a review of 26 cases. Highland Med Res J. 2006;4(1):46–52.
32. **33.** Sosa JA, Bowman HM, Tielsch JM, Powe NR, Gordon TA, Udelsman R. The importance of surgeon experience for clinical and economic outcomes from thyroidectomy. Ann Surg. 1998;228(3):320–30.
33. **34.** Tuttle RM, Haugen B, Perrier ND. Updated American Joint Committee on Cancer/Tumour–Node–Metastasis staging system for differentiated and anaplastic thyroid cancer (eighth edition): what changed and why? Thyroid. 2017;27(7):911–7.
34. **35.** Jonklaas J, Bianco AC, Bauer AJ, Burman KD, Cappola AR, Celi FS, et al. Guidelines for the treatment of hypothyroidism: prepared by the American Thyroid Association Task Force on Thyroid Hormone Replacement. Thyroid. 2014;24(12):1670–751.
35. Schlumberger M, Leboulleux S, Catargi B, Deandreis D, Zerdoud S, Bardet S, et al. Sorafenib in locally advanced or metastatic, radioactive iodine-refractory differentiated thyroid cancer: a randomised, double-blind, phase 3 trial. N Engl J Med. 2015;372(7):621–30.
36. **Jedy-Agba E, Curado MP, Ogunbiyi O, Oga E, Fabowale T, Igbinoba F, et al. Cancer incidence in Nigeria: a report from population-based cancer registries. Lancet Glob Health. 2016;4(11):e846–55.**
37. Solomon, R., Iliyasu, Y., & Mohammed, A. Z. (2015). Histopathological pattern of thyroid lesions in Kano, Nigeria: A 10-year retrospective review (2002-2011). Nigerian Journal of Basic and Clinical Sciences, 12(1), 55-60.
38. Adejumo, A., Akambi, O. O., Akims, S., Koroye, O., Nnadozie, U., Itoje, E., ... & Omoregie, P. (2022). Clinico-Pathological Presentation and Management Outcome of Thyroid Diseases at a Tertiary Medical Centre in North-central Nigeria. Benue Journal Of Medicine, 1(1), 1-6.
39. Durante C, Montesano T, Attard M, Torlontano M, Monzani F, Costante G, et al. Long-term surveillance of papillary thyroid cancer patients who do not undergo postoperative radioiodine remnant ablation: is there a role for serum thyroglobulin measurement? J Clin Endocrinol Metab. 2013;98(1):326–34.
40. Roman S, Lin R, Sosa JA. Prognosis of medullary thyroid carcinoma: demographic, clinical, and pathologic predictors of survival in 1252 cases. Cancer. 2006;107(9):2134–42.
41. Raue, F., & Frank-Raue, K. (2015). Epidemiology and clinical presentation of medullary thyroid carcinoma. Medullary Thyroid Carcinoma: Biology–Management–Treatment, 61-90.
42. Gbaa, Z. L., Ugwu, V. I., Annenga, R., Ojo, B. A., Umobong, E., Zaka, A. N., ... & Edo, A. V. (2024). Spectrum of Thyroid Diseases at Benue State University TeachingHospital Makurdi, Nigeria: A Histopathological Survey. Journal of BioMedical Research and Clinical Practice, 7(1-2).
43. Okafor, E. N., Ugonabo, M. C., Chukwukelu, E. E., Okonkwo, I. N., Ezigbo, E., & Odurukwe, O. (2019). Prevalence and pattern of thyroid disorders among patients attending University of Nigeria Teaching Hospital, Enugu, Southeastern Nigeria. Nigerian Medical Journal, 60(2), 62-67.
44. Morhason-Bello, I. O., Odedina, F., Rebbeck, T. R., Harford, J., Dangou, J. M., Denny, L., & Adewole, I. F. (2013). Challenges and opportunities in cancer control in Africa: a perspective from the African Organisation for Research and Training in Cancer. The lancet oncology, 14(4), e142-e151.
45. Moon WJ, Jung SL, Lee JH, Na DG, Baek JH, Lee YH, et al. Benign and malignant thyroid nodules: US differentiation—multicentre retrospective study. Radiology. 2008;247(3):762–70. doi:10.1148/radiol.2473070944. PMID: 18430824.
46. Aruah, S. C., Chidebe, R. C., Orjiakor, T. C., Uba, F., Shagaya, U. N., Ugwanyi, C., ... & Manjit, D. (2023). Status of government-funded radiotherapy services in Nigeria. JCO global oncology, 9, e2200406.
47. Cibas ES, Ali SZ. The Bethesda System for reporting thyroid cytopathology. Am J Clin Pathol. 2009;132(5):658–65. doi:10.1309/AJCPPHLWMI3JV4LA. PMID: 19846805.
48. Folaranmi, O. O., Olayiwola, O. I., Ibiyeye, K. M., Buhari, M. O., Ibrahim, O. K., Ighodalo, E. J., & Balogun, A. (2025). Cytopathology Practice in Nigeria. Diagnostic Cytopathology, 53(4), 186-190.
49. Ogbuanya AU, Anyanwu SN, Nwigwe GC, Iyare FE. Diagnostic accuracy of fine needle aspiration cytology for palpable breast lumps in a Nigerian teaching hospital. Niger J Clin Pract. 2021;24(1):69–74. doi: 10.4103/njcp.njcp\_540\_19. PMID: 33473028.
50. Wells SA Jr, Asa SL, Dralle H, Elisei R, Evans DB, Gagel RF, et al. Revised American Thyroid Association guidelines for the management of medullary thyroid carcinoma. J Clin Oncol. 2013;31(29):3779–87. doi:10.1200/JCO.2012.47.5557. PMID: 24002536.
51. Akinbohun, A., Olarinoye, O. T., Ogunkeyede, S. A., & Osukoya, A. T. Thyroid cancers and airway management in Nigeria. IOSR-JDMS), 19(8), 1-6.
52. Zafereo, M., Yu, J., Onakoya, P. A., Aswani, J., Baidoo, K., Bogale, M., ... & Fagan, J. J. (2020). African Head and Neck Society Clinical Practice guidelines for thyroid nodules and cancer in developing countries and limited resource settings. Head & Neck, 42(8), 1746-1756.
53. Baloch ZW, LiVolsi VA. Fine-needle aspiration of thyroid nodules: past, present, and future. Endocr Pract. 2004;10(3):234–41. doi:10.4158/EP.10.3.234. PMID: 15251688.
54. Onyiriuka, A. N., Abiodun, P. O., & Onyiriuka, L. C. (2012). Thyroid Disorders in Childhood and Adolescence: Analysis of clinical data and management challenges in patients seen in a Nigerian Teaching Hospital. Greener J Med Sci, 2(2), 45-50.
55. Yadav, K., Cree, I., Field, A., Vielh, P., & Mehrotra, R. (2022). Importance of cytopathologic diagnosis in early cancer diagnosis in resource-constrained countries. JCO Global Oncology, 8, e2100337.
56. Davies L, Welch HG. Increasing incidence of thyroid cancer in the United States, 1973–2002. JAMA. 2006;295(18):2164–7.
57. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71(3):209–49.
58. Tsegaye, B., & Ergete, W. (2003). Histopathologic pattern of thyroid disease. East African medical journal, 80(10), 525-528.
59. Ukekwe, F. I., Olusina, D. B., & Okere, P. C. (2017). Patterns of thyroid cancers in southeastern Nigeria: a 15 year histopathologic review (2000-2014). Journal of clinical and diagnostic research: JCDR, 11(8), EC16.
60. Azeez, T. A., Iyapo, O., Folorunso, S. A., & Onwudijor, C. J. (2024). The pattern of thyroid cancers in Nigeria: a systematic review and meta-analysis. Indian Journal of Surgical Oncology, 15(Suppl 3), 440-455.
61. Achonu, C. U., Olopade, O. B., Yusuf, B. O., Fadeyi, A. A., & Fasanmade, O. A. (2023). Case Report of Graves' Disease in a 45-Year-Old Woman Secondary to Herceptin Treatment for Breast Cancer. Monoclonal Antibodies in Immunodiagnosis and Immunotherapy, 42(6), 194-202.
62. **Adesunkanmi ARK, Agbakwuru EA. Malignant thyroid diseases in Ile-Ife, Nigeria. East Afr Med J. 2000;77(3):135–9.**Cibas ES, Ali SZ. The Bethesda system for reporting thyroid cytopathology. Am J Clin Pathol. 2009;132(5):658–65. doi:10.1309/AJCPQH3WWPPYAGZD. PMID:19846809.
63. Baloch ZW, LiVolsi VA. Fine-needle aspiration of thyroid nodules: past, present, and future. Endocr Pract. 2004;10(3):234–41. doi:10.4158/EP.10.3.234. APMID:15330321.
64. Onyiriuka, A. N., Abiodun, P. O., & Onyiriuka, L. C. (2012). Thyroid Disorders in Childhood and Adolescence: Analysis of clinical data and management challenges in patients seen in a Nigerian Teaching Hospital. Greener J Med Sci, 2(2), 45-50.
65. Abubkar, B. I., Saleh, L. A., Suleiman, D. E., Musa, S., Adegoke, B. O., Naziru, I., ... & Isichei, C. (2024). Biochemical pattern and prevalence of thyroid disorders among adults in a tertiary hospital in North-East Nigeria. Annals of African Medical Research, 7.
66. Folaranmi, O. O., Olayiwola, O. I., Ibiyeye, K. M., Buhari, M. O., Ibrahim, O. K., Ighodalo, E. J., & Balogun, A. (2025). Cytopathology Practice in Nigeria. Diagnostic Cytopathology, 53(4), 186-190.
67. Yadav, K., Cree, I., Field, A., Vielh, P., & Mehrotra, R. (2022). Importance of cytopathologic diagnosis in early cancer diagnosis in resource-constrained countries. JCO Global Oncology, 8, e2100337.
68. Lope, V., Pérez-Gómez, B., Aragonés, N., López-Abente, G., Gustavsson, P., Plato, N., ... & Pollán, M. (2009). Occupational exposure to chemicals and risk of thyroid cancer in Sweden. International archives of occupational and environmental health, 82(2), 267-274.
69. Sunday-Nweke, N., Nwoye, C., Icheku, S., Udu, U., Enemuo, V., Oboke, O., ... & Ekuma, M. (2025). Frequency of Thyroid Malignancy and Surgical Outcomes in a Private Low-resource Center: A Retrospective Study. Asian Journal of Medicine and Health, 23(5), 68-74.
70. Fagin, J. A. (2004). Challenging dogma in thyroid cancer molecular genetics—role of RET/PTC and BRAF in tumor initiation. The Journal of Clinical Endocrinology & Metabolism, 89(9), 4264-4266.
71. Nikiforov YE. Molecular diagnostics of thyroid tumours. Arch Pathol Lab Med. 2011;135(5):569–77. doi:10.5858/2010-0630-RAR.1. PMID:21526923.
72. Xing M. BRAF mutation in thyroid cancer. Endocr Relat Cancer. 2005;12(2):245–62. doi:10.1677/erc.1.0978. PMID:15947101.
73. Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforov YE, et al. 2015 American Thyroid Association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer. Thyroid. 2016;26(1):1–133. doi:10.1089/thy. 2015.0020. PMID:26462967; PMCID: PMC4739132.
74. Adeyemi, O. F., & Mghari, R. (2020). First brachytherapy treatment of prostate cancer in Nigeria using low dose rate radioactive iodine 125. African Journal of Urology, 26(1), 89.
75. Elhassan, M. M. A., Gismalla, M. D. A., Mohamed, S. A. H., & Faggad, A. (2023). Clinicopathological profile and management of thyroid carcinoma: a Sub-Saharan country experience. Thyroid Research, 16(1), 35.
76. Kebebew, E., Fualal, J., Moses, W., Nalugo, M., Ozgediz, D., & Gosnell, J. (2015). Characterizing thyroid disease and identifying barriers to care and treatment in Uganda. World Journal of Endocrine Surgery, 4(2), 47-53.
77. Kruger, E., Toraih, E. A., Hussein, M. H., Shehata, S. A., Waheed, A., Fawzy, M. S., & Kandil, E. (2022). Thyroid carcinoma: A review for 25 years of environmental risk factor studies. Cancers, 14(24), 6172.