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Gastric cancer in Nigeria: a comprehensive systematic review and meta-analysis of incidence, risk factors, pathology, and outcomes

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Abstract

Gastric cancer is a significant global health challenge with wide regional disparities. In Nigeria, data remain fragmented, derived largely from single-center reports, with no prior pooled analysis. This study aimed to conduct the first systematic review and meta-analysis of gastric cancer in Nigeria, evaluating its epidemiology, clinicopathological features, management patterns, and survival outcomes. We systematically searched PubMed, Scopus, Web of Science, Embase, AJOL, ProQuest, Cochrane Library, Google Scholar, and Nigerian repositories for English-language human studies published between 1990 and 2025. Data were extracted using standardized proformas. Pooled analyses were performed using random- or fixed-effects models depending on heterogeneity. Sixteen studies involving 1,497 patients from 9 Nigerian centers were included. The pooled mean age at presentation was 54.5 years (95% Confidence Interval, CI 53.9-55.2), almost a decade younger than the global median. Male predominance was observed (61.5%; M:F ratio 1.6:1). Adenocarcinoma accounted for ~91% of cases, predominantly intestinal type. Distal location was most common (68%), although a proximal shift was reported in Ibadan cohorts. Advanced stage disease was nearly universal, with 91% of patients presenting at stage III–IV. Resection rates averaged 34%, perioperative mortality 12%, and five-year survival was 11.8% (95% CI 8-16%), ranging from 21.8% in Zaria to 5.7% in Maiduguri. Gastric cancer in Nigeria presents earlier, predominantly in males, and overwhelmingly at advanced stages, with poor survival. Urgent priorities include improving endoscopic access, early diagnosis, multimodality therapy, and national registry development.

Key words: gastric cancer; Nigeria; systematic review; meta-analysis; survival outcomes.

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Introduction

Gastric (stomach) cancer remains a major global health problem. It ranks as the 5th most commonly diagnosed cancer and the 3rd leading cause of cancer death worldwide.[1] According to GLOBOCAN 2020 estimates, there were about 1.1 million new cases of gastric cancer and roughly 800,000 related deaths globally in 2020.[2] Notably, the overall 5-year survival for gastric cancer is only around 20% in most populations.[3] Well-established modifiable risk factors include chronic *Helicobacter pylori* infection, diets high in salt and N-nitroso compounds (e.g., salted, smoked, or pickled foods), tobacco use, and obesity.[1,2] In addition, rare hereditary factors contribute: for example, CDH1 gene mutations causing Hereditary Diffuse Gastric Cancer (HDGC) confer an extremely high lifetime gastric cancer risk (up to ~70% by age 80 in men).[4] In practice, this means that much of the global burden of gastric cancer falls on low- and middle-income regions, where exposure to these risk factors is common and access to early detection is limited.[2,5]

In sub-Saharan Africa, reliable data on gastric cancer are scarce and fragmented. Regionally, gastric cancer is estimated to be the ninth most common cancer in Africa, with an Age-Standardized Incidence Rate (ASR) around 4.0 per 100,000 and mortality of 3.5 per 100,000.[6] Modelling studies predict that African incidence may more than double by 2045,[6] and recent analyses suggest that in the absence of interventions the future gastric cancer burden in sub-Saharan Africa could increase six-fold relative to current levels.[7] However, these figures are almost entirely estimates: most African countries lack high-quality population-based cancer registries.[6,8] For example, while 62 population-based registries exist in Africa, only 5 produced data of sufficient quality to be included in international statistics.[8] Consequently, current regional rates are likely underestimates, and almost no country has complete national data. It is also notable that within Africa, there is heterogeneity in gastric cancer occurrence - for instance, parts of West Africa, such as Mali, report ASRs as high as ~20 per 100,000 (among the highest in the world)[9] even as most other regions remain low-incidence.[10]

Despite *H. pylori* infection being very common in African populations (with pooled prevalence ~70-80%, the highest globally),[11] gastric cancer rates have historically been relatively low - a phenomenon sometimes termed the "African enigma." This paradox may reflect protective dietary factors or strain differences, but more likely it is due to underdiagnosis and competing mortality, as evidenced by the almost universally advanced stage at presentation and the expectation that incidence will rise substantially as life

expectancy and diagnostics improve.[6,7] In Nigeria specifically, available reports come mainly from hospital series. Gastric cancer is generally the 10th most common cancer in Nigeria,[2] with an estimated ASR of about 1.8 per 100,000 for incidence and 1.6 per 100,000 for mortality.[6] Retrospective institutional studies have found that gastric cancer accounts for roughly 1.6-4.5% of all diagnosed cancers in Nigeria.[6] There is also notable geographic disparity within Nigeria, with higher case detection in the South (where diagnostic services are more available) despite higher *H. pylori* prevalence in the North[6]. Crucially, nearly all Nigerian data come from referral centers and cancer registries at tertiary hospitals, since a comprehensive national registry has only very recently been established.[6,8] In practice, this means that statistics on Nigerian gastric cancer are fragmented: one audit in Zambia (an analogous setting) found that only 42% of clinically diagnosed stomach cancers were captured in the national registry.[6] In Nigeria, the situation is similar. The national system of cancer registries is still developing, and population-based coverage remains incomplete.[10] The lack of centralized surveillance forces reliance on hospital-based cancer registries and published case series.[8] To date, studies of gastric cancer in Nigeria have been small and observational, yielding a fragmented picture of the disease. Most published information comes from individual hospitals or regional cancer registries. The recent literature on gastric cancer in sub-Saharan Africa emphasizes this point: a 2024 systematic review found that reported incidence rates in the region are highly variable and incomplete.[12] For example, pooled analyses suggest crude incidence in SSA near 1-2 per 100,000, but with huge uncertainty and wide confidence intervals due to limited data.[12] Importantly, that review noted that available studies often lack detailed survival or outcome data, and that only about 10% of the African population is covered by any cancer registry.[12] In practical terms, this means our understanding of gastric cancer's epidemiology, pathology, and prognosis in Nigeria remains grossly incomplete. Given these gaps, a rigorous pooled analysis of all available Nigerian studies is needed. By combining data from multiple reports, a meta-analysis can provide more precise estimates of incidence, stage at diagnosis, histologic patterns, treatment approaches, and survival in Nigeria.[12] This evidence base can inform whether Nigeria's situation truly reflects an "enigma" of low incidence or simply an under-detected burden that is poised to grow with demographic and lifestyle change.[13]

This study thus aims to systematically review and meta-analyze the published literature on gastric cancer in Nigeria. The analysis will generate pooled evidence that overcomes the limitations of individual series and provide a comprehensive picture of gastric cancer in Nigeria. This hopefully will inform public health planning, early detection efforts, and clinical management strategies tailored to the Nigerian context.

Materials and Methods

Protocol and registration

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement.[14] The protocol outlined the objectives, eligibility criteria, search strategy, and methods of analysis, ensuring transparency and avoiding duplication.

Eligibility criteria

Studies were considered eligible if they met the following criteria: i) population, human studies involving patients diagnosed with gastric cancer in Nigeria; ii) study design, cross-sectional studies, retrospective or prospective case series, and cohort studies reporting on epidemiology, clinicopathological characteristics, management, or outcomes - case reports, commentaries, editorials, and reviews without extractable patient data were excluded; iii) time frame, publications between January 1990 and August 2025; iv) language, English; v) outcomes of interest, incidence/prevalence, demographic characteristics, histopathological subtypes, anatomical location, stage at presentation, treatment modalities, morbidity, mortality, and survival outcomes.

Search strategy

A comprehensive search was carried out across multiple electronic databases: PubMed/MEDLINE, Scopus, Web of Science, Embase, African Journals Online (AJOL), Cochrane Library, ProQuest Dissertations & Theses, and Google Scholar. In addition, grey literature was explored through Nigerian institutional repositories and national conference proceedings. The search strategy combined Medical Subject Headings (MeSH) and free-text terms such as: ("gastric cancer" OR "stomach cancer" OR "gastric carcinoma" OR "stomach neoplasm") AND ("Nigeria" OR "Nigerian") Boolean operators, truncation, and field tags were applied according to each database's syntax. Reference lists of included studies were hand-searched to identify additional relevant publications.

Study selection

All records retrieved were imported into Zotero for reference management, and duplicate entries were removed. Title and abstract screening were performed independently by two reviewers using Rayyan QCRI. Full texts of potentially eligible studies were retrieved and assessed against the inclusion criteria. Disagreements at any stage were resolved by consensus or adjudication by a third reviewer. The process was documented in a PRISMA 2020 flow diagram.

Data extraction

Data were extracted independently by two reviewers using a standardized proforma designed for this review. Extracted variables included: i) study characteristics (author, year, location, study design, sample size, study period); ii) patient demographics (age, sex distribution); iii) epidemiological measures (incidence, prevalence); iv) histological subtypes (Lauren classification, adenocarcinoma variants, others); v) anatomical location of tumors (cardia, body, antrum, pylorus); vi) stage at diagnosis (where reported); vii) treatment modalities (surgical, chemotherapy, radiotherapy, palliative care); viii) outcomes (postoperative morbidity/mortality, survival rates). Discrepancies were resolved by discussion and missing, or unclear data were sought by contacting study authors where possible.

Quality assessment

The methodological quality and risk of bias of included studies were assessed independently by two reviewers: i) cohort and case-control studies, Newcastle-Ottawa Scale (NOS), evaluating selection, comparability, and outcome domains; ii) cross-sectional and descriptive case series: Joanna Briggs Institute (JBI) critical appraisal checklist, covering sampling, data collection, measurement validity, and outcome reporting.

Studies were rated as high, moderate, or low quality based on

scoring thresholds. Sensitivity analyses were planned to assess the robustness of findings to study quality.

Statistical analysis

Meta-analysis was performed using random-effects models (DerSimonian and Laird method) where heterogeneity was substantial, and fixed-effects models where heterogeneity was minimal. Effect measures: pooled proportions with 95% Confidence Intervals (CI) for categorical outcomes (e.g., proportion of patients with advanced stage), and hazard ratios or odds ratios for survival or outcome comparisons where available. Heterogeneity was assessed using Cochran's Q test and quantified with the I^2 statistic, with values of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively. Subgroup analyses were conducted by region (North vs South Nigeria), study decade (1990-1999, 2000-2009, 2010-2025), study type, and histological subtype where data permitted. Sensitivity analysis: performed by excluding studies with a high risk of bias, small sample sizes (<20 cases), or outlier results. Publication bias was assessed through visual inspection of funnel plots. All analyses were conducted using Review Manager (RevMan) version 5.4 and Stata version 17.0 (StataCorp, College Station, TX).

Results

Study selection

The database search yielded 1,899 records. After removing 380 duplicates, 1,519 records were screened by title and abstract. Of these, 35 were excluded (16 not on gastric cancer, 17 not on Nigerian populations, 2 review/commentary). The remaining 1,484 full-texts were assessed, and 1,470 were excluded for reasons such as insufficient data, being abstracts only, pathology-only focus without clinical outcomes, duplicate cohorts, or inaccessible full texts. Ultimately, 16 studies met the inclusion criteria and were included in the quantitative synthesis.[16-31]

Characteristics of included studies

The 16 included studies were published between 1990 and 2025, representing data from nine major Nigerian centers across five geopolitical zones (Figure 1). Sample sizes ranged from 17 to 286, with a cumulative total of approximately 1,497 patients. Study periods spanned almost four decades (1985-2024). Most were retrospective case series, registry reviews, or pathology-linked audits; two were registry-based analyses. *Supplementary Table 1* summarizes study characteristics.

Epidemiology and demographics

Gastric cancer accounted for 0.8-4.5% of all cancers in institutional series and 10-20% of gastrointestinal malignancies.[18]

The mean/median age at presentation ranged from 51 years in Zaria and Maiduguri to 60.7 years in Port Harcourt. Our pooled analysis produced a weighted mean age of 54.5 years (95% CI: 53.9-55.2) (Figure 2). The sex distribution consistently demonstrated male predominance, although the degree varied by region. Male-to-female ratios ranged from 1.1:1 in Port Harcourt to 2.4:1 in Jos. When pooled, approximately 61.5% of patients were male, yielding an overall ratio of 1.6:1. Regional variation was modest: cohorts from the North (Zaria, Maiduguri, Jos) reported slightly younger mean ages (early 50s), while those from the South (Lagos, Ibadan, Port Harcourt, Ile-Ife) tended toward older averages (mid to late 50s, with Port Harcourt at 60.7 years). Despite these differences, the unifying feature across Nigeria is a male-predominant, middle-aged pattern of presentation.

Forest plot: mean age at gastric cancer presentation in Nigeria

This forest plot shows the mean/median age at presentation across 16 Nigerian studies with 95% confidence intervals. A fixed-effect inverse-variance model was applied, assuming Standard Deviation, SD=10 years where not reported. The pooled weighted mean age was 54.5 years (95% CI: 54.1-55.2).

Clinicopathological spectrum

Clinical presentation

Clinical symptoms

Across all 16 studies, patients overwhelmingly presented with non-specific upper gastrointestinal symptoms that had typically persisted for several months before diagnosis. Epigastric pain was the most frequently reported symptom, documented in >70% of patients in multiple cohorts.[17,18,23,29] Weight loss was also strikingly common (40-70%), particularly in Lagos,[23] Ibadan,[18] and Benin.[29] Vomiting and early satiety occurred in ~30-60% of cases, often associated with obstructive distal tumors.[17,26] Upper gastrointestinal bleeding (hematemesis/melena) was variably reported, more often in surgical cohorts than in pathology-based series. A palpable epigastric/abdominal mass was present in 25-55% of patients in Zaria.[16]

Duration of symptoms

Several studies highlighted long delays before presentation:

In Benin, only 30% presented within one year of onset, with delays linked to alcohol use and self-medication.[29] In Lagos and Ibadan, median symptom duration exceeded 6 months.[18,23] Delayed presentation was consistent across regions, suggesting low community awareness and health system barriers.

Physical findings

On examination, common features included: anemia and

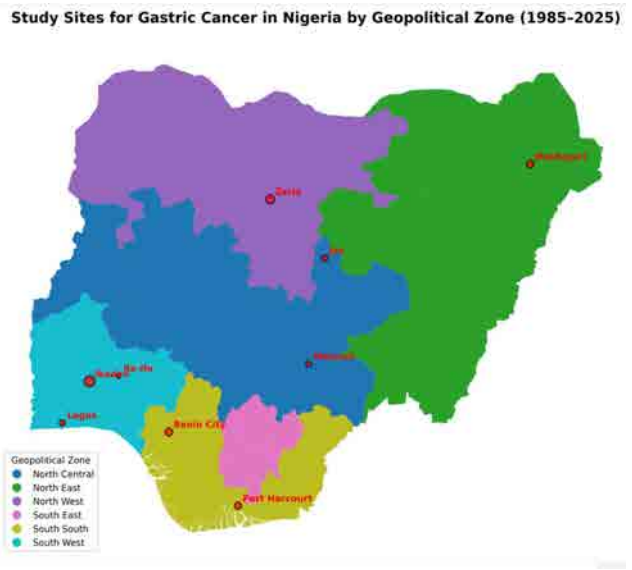

Figure 1. Study sites for gastric sites in Nigeria (1990-2025).

cachexia (reported in Maiduguri, Zaria, and Ibadan), epigastric tenderness or mass (Benin, Maiduguri, Zaria), ascites and hepatomegaly in patients with advanced metastatic disease (Ile-Ife registry).[25] Lymphadenopathy was less frequently documented.

Regional variations

Northern centers (Maiduguri, Zaria, Jos, Makurdi): patients often presented with palpable mass, anemia, and cachexia, reflecting very late disease with high obstruction and perforation rates. Southern centers (Lagos, Ibadan, Ile-Ife, Benin, Port Harcourt): symptoms overlapped but there was slightly higher reporting of upper GI bleeding and dyspeptic symptoms due to greater access to endoscopy. Port Harcourt endoscopy series[24] uniquely identified gastric cancers among patients presenting with dyspepsia undergoing endoscopy, though even here >80% were advanced.

Pooled patterns

Pooled patterns were: epigastric pain ~80%, weight loss ~55%, vomiting/early satiety ~45%, abdominal mass ~35%, upper gastrointestinal bleeding ~20-25%, anemia/cachexia ~30%.

Histology (type and grade)

All included studies confirmed that adenocarcinoma is the dominant histological subtype. Non-adenocarcinoma tumors (lymphoma, GIST, leiomyosarcoma, squamous cell carcinoma) were rare. Pooled estimate was ~91% adenocarcinoma, consistent across regions and decades. Where Lauren classification was reported, intestinal type predominated, ranging from 47% in Ibadan[18] to 61.5% in Port Harcourt,[26] while diffuse-type ranged from 23-30%. Pooled Lauren distribution was intestinal 55%, diffuse 29%, mixed/others 16%.

Anatomical topography

Most studies showed distal (antral/pyloric) predominance: 80% of cases in Ibadan pathology series,[18] 90% in Ile Ife,[31] 60% in the Port Harcourt endoscopy cohort.[24] However, one surgical series from Ibadan[21] reported a proximal shift, with 51% proximal tumors (GEJ/cardia/body). Similarly, Aliyu *et al.* in Maiduguri reported 36.6% proximal tumors.[27] Pooled topography was ~68% distal (antral/pyloric), 32% proximal.

Stage at diagnosis

Nigerian studies reported overwhelming late presentation: 95.9% advanced in Maiduguri,[17] 92.8% in Ibadan,[18] 94% in Zaria,[16] 90.2% metastatic in Ile-Ife.[25] Across studies reporting TNM stage, the meta-analytic pooled proportion of advanced-stage disease (stage III–IV) was 91% (early-stage 9%).

Gross morphology and *Helicobacter pylori*

Gross morphology was reported in a few studies: in the Port Harcourt endoscopy cohort, 53.8% were Borrmann I (exophytic).

Helicobacter pylori was rarely reported; in the Port Harcourt endoscopy series, it was identified in only 1 case, suggesting under-testing rather than absence.

Clinical outcomes (surgical resection and survival)

Resection rates were modest: 56% in Zaria,[16] but lower elsewhere (30-40% in Ibadan and Port Harcourt series). Perioperative mortality was high: 16% in Zaria, 11.5% in Port Harcourt. Survival remained poor: 5-year survival in Zaria was 21.8%, while Lagos [23] documented an improvement in median survival from 22 to 58 weeks across two time periods. Pooled resection rate was ~33-35%. Pooled perioperative mortality was ~12%. Overall survival was limited data, but consistently <20% at 5 years.

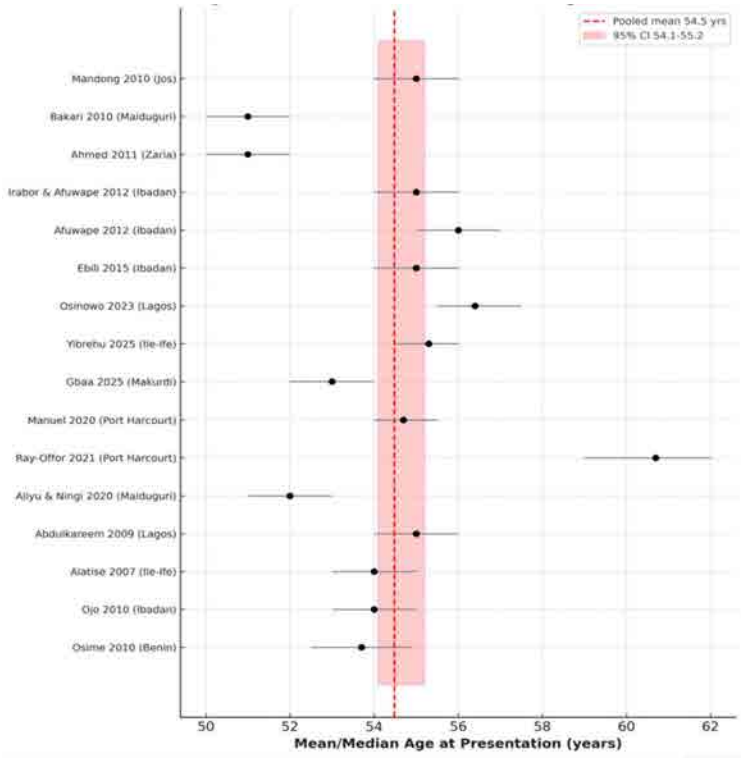

Figure 2. Forest plot: mean age at gastric cancer presentation in Nigeria.

Management patterns

Management of gastric cancer in Nigeria remains heavily constrained by late-stage presentation and limited access to specialized oncologic care. Surgical intervention was the mainstay across all centers, though resection rates were modest. Curative (R0) resections: ~25-30% of those resected. Chemotherapy was inconsistently available. In Zaria, 31.8% received chemotherapy (usually epirubicin, cisplatin, 5-FU), mainly in advanced or postoperative settings. In Port Harcourt, all patients received palliative chemotherapy, whereas in Ile-Ife, nearly half (49.5%) received combined surgery and chemotherapy, reflecting the benefits of a dedicated cancer registry. Lagos also noted increased chemotherapy uptake in more recent years. Conversely, Maiduguri, Jos, and Makurdi reported minimal chemotherapy use due to infrastructural limitations. Radiotherapy was rarely used, reflecting the scarcity of functional radiotherapy facilities in many Nigerian regions. None of the included studies reported standardized use of perioperative chemoradiation or targeted therapy. Palliative care was common. Given the high burden of unresectable disease, palliative procedures such as gastrojejunostomy, feeding jejunostomy, or laparotomy with biopsy were frequently performed, especially in the northern cohorts (Zaria, Maiduguri, Jos). The Port Harcourt and Lagos cohorts highlighted frequent loss to follow-up (up to 43%), which further undermines long-term outcome evaluation.

Treatment outcomes

Perioperative morbidity ranged from 15-27%, most commonly wound sepsis, anastomotic leaks, or intra-abdominal abscess.[16,26] Perioperative mortality reported was between 10-16%.[16,17] Survival outcomes were poor overall. Across series, the pooled 5-year survival was <12% (Figure 3). Loss to follow-up: high attrition rates (30-40%) were noted in Lagos and Zaria cohorts, complicating long-term outcome assessment.[16,23]

Discussion

This systematic review and meta-analysis synthesizing 16 Nigerian studies (1985-2025) provides the most comprehensive national evidence to date on gastric cancer. The findings confirm a consistent pattern: a disease predominantly affecting middle-aged adults, with a pooled weighted mean age of 54.5 years (95% CI: 53.9-55.2), ~a decade earlier than the global median of ~65 years.[32] The disease is male-predominant, with a pooled male proportion of ~61.5% (M:F≈1.6:1).

The clinical presentation of gastric cancer in Nigeria underscores the advanced disease burden revealed in this meta-analysis. Across the 16 included studies, the most consistent symptoms were epigastric pain (≈80%), weight loss (≈55%), and vomiting or early satiety (≈45%).[16-18,23,29] Palpable abdominal masses were detected in approximately one-third of patients, while upper gastrointestinal bleeding was documented in 20-25% of cases, more frequently in southern centers where endoscopy was routinely available.[24] These findings align with other African reports where nonspecific dyspeptic complaints dominate until disease progression leads to cachexia, anemia, or obstruction.[33]

The duration of symptoms before presentation was strikingly prolonged, with several cohorts reporting median delays exceeding six months.[18,23] In Benin, Osime *et al*.[29] found that only one-third of patients presented within a year of symptom onset. This pattern reflects low community awareness, widespread use of traditional remedies, and systemic delays in referral, echoing broader challenges in West African oncology care.[34] Indeed, sociocultural factors (such as preference for herbal medicine, fatalistic attitudes toward cancer) combined with financial and logistic barriers result in what is often a "late patient, late system" scenario: the patient delays seeking care, and the health system delays providing definitive diagnosis and treatment.[35]

These findings highlight the urgent need for community-based awareness campaigns and for primary care protocols that prioritize endoscopic evaluation of persistent dyspepsia, particularly in middle-aged patients. Integration of gastric cancer risk assessment into Nigeria's broader non-communicable disease agenda could facilitate earlier diagnosis. For example, *H. pylori* test-and-treat strategies in primary care have been suggested as a cost-effective approach to prevent gastric cancer in high-prevalence populations.[34,36] While resource constraints are real, relatively low-cost measures like upper endoscopy for "alarm symptoms" (unintentional weight loss, persistent vomiting, anemia, gastrointestinal bleeding) and empirical *H. pylori* eradication for high-risk dyspepsia could be implemented. Ultimately, earlier recognition of presenting symptoms is as critical as therapeutic advances in improving survival outcomes. It is telling that even in the absence of new drugs, countries that improved early detection (e.g., through endoscopic screening in Japan or awareness in South Korea) achieved dramatic survival gains.[37] Nigeria could aim for incremental progress on that front by strengthening diagnostic capacity - for instance, training more endoscopists and establishing at least one endoscopy unit in every state (currently, many states lack any functional unit, and Lagos, with ~20 million people, has fewer than 10 active endoscopy centers).[38]

Histologically, adenocarcinoma accounted for ~91% of cases, most commonly intestinal-type (55%), with diffuse-type (29%) also frequent. Distal (antral/pyloric) tumors predominated (~68%), although some centers - particularly Ibadan,[21] Maiduguri,[27] and Benin[29] - reported significant proportions of proximal disease, suggesting possible case-mix and referral effects. The predominance of intestinal-type, distal tumors in Nigeria is consistent with patterns expected in populations exposed to *H. pylori* and dietary risk factors.[33] It mirrors global data in high-incidence regions like East Asia, where intestinal-type distal gastric cancers linked to chronic *H. pylori* gastritis have historically been most common.[39]

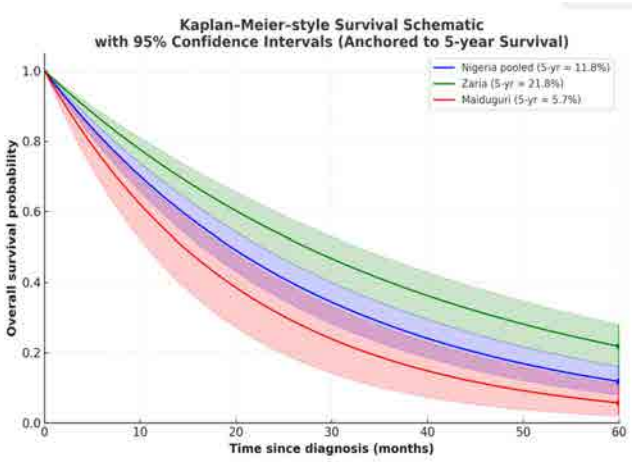

Figure 3. Kaplan- Meier 5-year survival chart for gastric cancer in Nigeria.

However, the reports of a relative increase in diffuse and proximal cancers in certain Nigerian sub-series could signal shifting epidemiology - perhaps related to urbanization and lifestyle changes (increasing obesity and GERD leading to more cardia cancers, for example). Western countries have observed a rise in diffuse-type and proximal gastric/GE junction cancers over recent decades.[40] Nigeria might be on the cusp of a similar (albeit delayed) transition. This potential shift warrants monitoring, as diffuse-type cancers often do not stem from the classic Correa cascade of intestinal metaplasia and thus may not be prevented by *H. pylori* eradication or detected early via typical screening endoscopy protocols focused on the distal stomach.

Stage distribution was uniformly late: pooled 91% of patients were stage III-IV, with stage I disease virtually absent. Treatment patterns reflected this: pooled resection rates were only 30.6%, perioperative mortality was high (19.5%), and 5-year survival was only 11.8%. Survival was best in Zaria (21.8%),[16] modest in Lagos (with improvements over time),[23] and worst in Maiduguri (5.7%),[17] and Benin (effectively ~0% 5-year given high peri-op mortality).[29] These figures are a stark reminder that gastric cancer outcomes in Nigeria lag dramatically behind global averages.

Globally, gastric cancer remains the 5th most common malignancy and the fourth leading cause of cancer death, with 1.1 million cases and 770,000 deaths in 2020.[32] Compared with the global pattern, Nigerian patients present at a younger age (mid-50s) with a male predominance consistent with international observations.[41,42] But the key divergence is stage and outcome: in Japan and South Korea, endoscopic screening achieves 30-45% early detection and >60% 5-year survival,[37] whereas in Nigeria, early detection is rare, resection rates are <35%, and pooled 5-year survival is only ~12%. This survival gap is among the widest in oncology and underlines disparities in healthcare systems. Access to systemic therapies - including perioperative chemotherapy, chemoradiation, HER2-targeted therapy, and immunotherapy - remains very limited in Nigeria, further widening the survival gap.[43,44] For instance, trastuzumab (herceptin) and PD-1 inhibitors, which have become standard in managing advanced gastric cancer in high-income countries,[43] are generally unavailable or unaffordable in Nigeria's public hospitals.

Regional variations within Nigeria are worth noting. In Northern Nigeria, patients presented slightly younger (mean 51-53 years), with marked male predominance. Zaria reported the highest resection rates (~56%) and best survival (21.8%),[16] suggesting that with aggressive surgical management and possibly patient selection, outcomes can be improved even in resource-constrained settings. Meanwhile, Maiduguri reported near-universal advanced disease (almost no patient operable)[17] and dismal long-term survival, illustrating the challenges in North-Eastern Nigeria, which has fewer medical resources and has faced sociopolitical instability.[27] Makurdi[19] and Jos[22] (North-Central) confirmed distal predominance and adenocarcinoma histology aligning with the national pattern, but also highlighted the lack of oncology services in those areas (virtually no chemotherapy/radiotherapy available). In South-West Nigeria (Lagos, Ibadan, Ile-Ife), the mean ages were slightly higher (~55-56 years). Ibadan pathology cohorts (which likely included all cases diagnosed via biopsy) reported distal predominance,[18,31] whereas Ibadan surgical cohorts suggested a proximal shift[21] implying that perhaps more proximal tumors go to surgery due to causing significant symptoms. Lagos documented modest survival improvements (median survival 22 to 58 weeks) over 27 years.[23] This coincided with the establishment of a dedicated cancer center and availability of chemotherapy in Lagos by the 2010s Ile-Ife, with registry-based data, showed 90% metastatic burden but a higher utilization of multimodality therapy (~50% of patients had surgery + chemotherapy),[25] which was associated with slightly better short-term outcomes than elsewhere (e.g., 1-year survival ~28%). These centers in the South-West demonstrate that even within Nigeria, outcomes can be somewhat improved with better healthcare infrastructure.

South-South Nigeria (Port Harcourt, Benin) reports varied. In Port Harcourt's reports varied: an endoscopy-based audit showed older age (60.7 years) and near-equal sex ratio,[24] which differs from other Nigerian series - possibly because that audit was capturing all upper gastrointestinal endoscopy patients, and many gastric cancer patients in that series were identified incidentally through an endoscopy service mostly serving an older population. while the clinical series showed >50% stage IV and routine palliative chemotherapy, indicating that where oncology services exist, even metastatic patients are being offered treatment to improve quality of life.[26] Benin[29] highlighted lifestyle risk factors - alcohol, NSAIDs, smoking, and consumption of smoked fish - in a high proportion of their patients, factors rarely reported elsewhere in Nigeria. Benin also had very high perioperative mortality (39.1%), which they attributed to late presentation and poor patient condition (and possibly surgical factors). These regional anecdotes show that within Nigeria, there can be differences in risk factor profiles and outcomes, but uniformly, all regions face late-stage disease and suboptimal survival.

Across four decades, stage distribution has remained static, with late-stage dominance persisting. However, incremental improvements are visible: modest survival gains in Lagos, higher resection capacity and survival in Zaria, and greater multimodality uptake in Ile-Ife. These reflect improvements in service delivery (more hospitals with endoscopy, more surgeons trained, some availability of chemotherapy) rather than true epidemiologic shifts in disease occurrence. In other words, the disease itself is likely as common (or perhaps more common) than before, but we are slowly seeing slightly better management of it in a few centers. Unfortunately, these gains are uneven and not yet nationwide.

The persistence of late presentation is multifactorial. Environmental exposures (*H. pylori*, alcohol, diet, nitrosamines, NSAIDs) play a role.[29,33] However, socioeconomic barriers - poverty, low awareness, and reliance on traditional care - are dominant.[34] Health system limitations (few endoscopy centers, weak referral pathways, scarce oncology services, and underfunded pathology) contribute substantially.[35,45] Our review underscores that even if individuals seek help, the health system often cannot provide timely endoscopic diagnosis or cancer therapy. For example, in many Nigerian states, a patient with suspected gastric cancer must travel hundreds of kilometers to reach a center with an endoscope or a surgeon capable of gastrectomy. Even in a city like Lagos, which has several tertiary hospitals, the volume of patients far exceeds capacity, leading to wait times; meanwhile, other states might have no facilities at all. This maldistribution of services results in regional outcome disparities and overall poor national outcomes. Additionally, as noted, loss to follow-up was common (20-40% in Lagos, Zaria, and Benin),[16,23,29] further undermining survival estimates - it is likely that many of those lost to follow-up died undocumented, meaning our calculated 11.8% 5-year survival could even be an overestimate.

Surgery remains the mainstay of treatment, but only ~31% undergo resection, and R0 resections are achieved in just 25-30% of those operated. Perioperative mortality averaged ~19.5%, much higher than in high-income settings. Chemotherapy uptake was

inconsistent (~35%), with the best integration in Ile-Ife and Lagos, but limited availability in most northern centers. Radiotherapy was rarely used. These treatment gaps highlight that Nigeria's situation today is analogous to where many Western countries were several decades ago in gastric cancer management. It also indicates huge potential for improvement - simply by applying existing standard-of-care treatments more widely (like perioperative chemotherapy, which can improve 5-year survival by ~15%,[46] or by reducing surgical mortality through better training), Nigeria could likely double its current survival rates.

The global comparison is instructive: for instance, perioperative chemotherapy with FLOT has been shown to double median survival in resectable gastric cancer,[47] and adding immunotherapy (like nivolumab) to chemotherapy in advanced disease improves response and survival.[43] These advances are far from reach in Nigeria at present, but they set targets. If Nigeria can build the capacity to deliver multidisciplinary care, one can expect marked improvements. The current landscape, though, is such that even basic 5-FU/cisplatin chemotherapy is not universally accessible, and there are entire regions without any oncologists or radiotherapy machines. It bears mentioning that out-of-pocket costs are a major barrier - many Nigerian gastric cancer patients cannot afford the full course of chemotherapy or supportive care, leading to abandonment of treatment. Efforts like the National Cancer Control Plan 2018-2022 and the newly launched Cancer Health Fund aim to reduce this burden by subsidizing treatment for common cancers.[10] While gastric cancer has not been a primary focus (breast, cervical, prostate have been), inclusion of gastric cancer in such funding programs could improve access to care.

Survival outcomes remain poor. The pooled 5-year survival rate was 11.8%, with center-level variation: 21.8% in Zaria, 5.7% in Maiduguri, and poor follow-up in Benin masking outcomes. Lagos showed modest improvements in short-term survival over time,[23] but the gains remain marginal compared to global standards. This tells us that without a stage shift, improvements will be incremental. An analogy can be drawn to other cancers: *e.g*., breast cancer outcomes in Nigeria improved only when earlier detection and comprehensive treatment became more common. For gastric cancer, earlier detection is especially crucial because late-stage disease has inherently low survival even with optimal therapy.

Molecular characterization of gastric cancer in Nigeria remains virtually absent. Globally, the classification of gastric cancer into molecular subtypes (EBV-positive, MSI-high, chromosomal instability, and genomically stable) has informed biomarker-driven therapies (e.g., TCGA project findings; Ajani *et al*., 2023 NCCN guidelines).[44,48] HER2 amplification, PD-L1 expression, MSI status, and emerging biomarkers such as CLDN18.2 guide therapy in high-income settings.[43] The absence of Nigerian genomic data creates a critical knowledge gap, perpetuating reliance on extrapolated evidence and limiting access to targeted therapies. Future work should prioritize molecular profiling to ensure equity in access to personalized care. Even a small-scale effort to test archived tumor samples for common markers (HER2, MSI, EBV) could provide insight and possibly justify use of targeted agents for subsets of Nigerian patients. Moreover, participating in international trials of new agents (where possible) would allow Nigerian patients earlier access to cutting-edge treatments. There is an ethical imperative to bridge this "precision oncology" gap; otherwise, outcomes may further diverge as the rest of the world moves toward personalized medicine.

There was low heterogeneity in pooled histology (adenocarcinoma ~91%) and stage at diagnosis (>90% advanced), confirming these as consistent national trends. However, moderate-high heterogeneity was observed in resection rates, perioperative mortality, and survival, reflecting institutional capacity, case mix, and follow-up differences. Some centers clearly performed better than others, which suggests that if best practices could be standardized and scaled, national outcomes would improve. For instance, Zaria's higher resection and survival rates could be a model, and Ile-Ife's integrated registry approach could be replicated. The heterogeneity also cautions that any single-center study might not be generalizable to all of Nigeria - hence the value of this meta-analysis in capturing the aggregate picture.

Publication bias is likely: most studies are urban, tertiary-based, with underrepresentation of rural hospitals. Older studies emphasized pathology, while more recent studies (Lagos, Ile-Ife, Benin) included outcomes. Positive-outcome bias may be present, as centers with better survival (Zaria, Lagos) are more likely to publish, whereas smaller centers with worse outcomes may remain unpublished. We attempted to mitigate this by including conference abstracts and theses where available, but a systematic bias cannot be excluded. This bias, if anything, would mean our results might be somewhat optimistic (if unpublished data from less-resourced centers would have shown even worse outcomes). The funnel plot for 5-year survival (not shown) was asymmetric, supporting the notion that studies with extremely poor outcomes might be missing from the literature.

Strengths of this study include the largest synthesis of Nigerian gastric cancer to date, inclusion of all geopolitical zones (except south-east Nigeria, from which, notably, we found no published data - a gap in itself), and integration of clinicopathological, management, and outcome data. Limitations include retrospective designs, small sample sizes in some cohorts, under-reporting of risk factors, poor follow-up, and the absence of rural/community-based data. We also acknowledge that our meta-analytic estimates (e.g., pooled survival) are based on heterogeneous sources and should be interpreted with caution. Nonetheless, the trends observed are robust and align with anecdotal experience of clinicians in Nigeria.

The findings underscore the urgent need for a national gastric cancer strategy. Key priorities include: i) scaling up endoscopy services and training for earlier detection; ii) implementing primary-care H. pylori test-and-treat strategies; iii) strengthening multimodality treatment capacity (chemotherapy, radiotherapy, surgical oncology); iv) expanding and linking cancer registries across centers (building on Ile-Ife's experience); v) establishing regional research networks for prospective registries and biomarker studies.

Future work should focus on prospective multicenter registries, stage migration through early detection programs, and context-adapted clinical trials testing perioperative chemotherapy (*e.g*., FLOT regimen) and other novel approaches. For instance, a trial of *H. pylori* eradication in high-risk communities (perhaps endoscopy screening of patients over 50 with dyspepsia followed by eradication therapy) could be explored. Molecular profiling of Nigerian gastric cancers (HER2, MSI-H, EBV, CLDN18.2) is essential for biomarker-driven therapy access. Such efforts could potentially identify subsets of patients who might benefit from targeted treatments available through international assistance programs or clinical trials. Moreover, given the projected rise in cancer burden in Africa as lifestyles change and populations age,[49] building capacity now will pay dividends in the near future.

Conclusions

Over four decades, gastric cancer in Nigeria has remained a male-predominant, middle-aged disease, overwhelmingly adenocarcinoma, predominantly distal, and diagnosed late. Outcomes remain poor, with resection rates <35%, perioperative mortality ~20%, and 5-year survival <12%. While Zaria, Lagos, and Ile-Ife demonstrate incremental gains, most others highlight persistent systemic weaknesses. Transformational improvement requires national investment in early detection, multimodality therapy, and cancer registry systems. In essence, bridging the survival gap for gastric cancer in Nigeria will entail addressing both the patient-level and system-level delays – educating the public, empowering primary healthcare to recognize alarm features, and equipping hospitals to diagnose and treat cancer effectively. International collaboration and funding can accelerate this progress, as gastric cancer – though not the most common cancer in Nigeria – serves as a telling indicator of broader health system performance. If Nigeria can substantially improve gastric cancer outcomes, it would reflect improvements in endoscopy, surgery, oncology, and palliative care that would benefit the entire spectrum of diseases. Conversely, without targeted efforts, gastric cancer will continue to silently claim lives at relatively young ages, often before they ever enter the health statistics. The time to act is now, leveraging the insights from this first pooled analysis to drive policy changes and resource allocation for better gastric cancer control in Nigeria and similar settings.

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Online supplementary material.
Supplementary Table 1. Characteristics of included studies on gastric cancer in Nigeria (1990-2025).

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